

# HALAL FOOD SUPPLY CHAIN INTEGRITY: THE INFLUENCE OF HALAL TRACEABILITY SYSTEM ADOPTION AND ENVIRONMENTAL FACTORS IN MALAYSIA

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**Abstract:** *Cross-contamination issues in the halal food have make Muslim consumers aware and put more effort into ensuring the integrity of the halal status. Food integrity distresses closely more on the health, safety, religious and cultural matters rather than just focusing on the good quality of the food products. In order to achieve the untainted halal food supply chain integrity (HFSCIn), the halal food firms have to adopt the halal traceability system (HTS) as to meet the expectations of halal qualities and protected from any risk of cross-contamination. Accordingly, the aim of this study is to examine the relationship between the HTS and environmental factors on HFSCIn. Based on a survey with 127 Halal food producers specifically in food and beverages category, the study found that there is a significant relationship between halal traceability system adoption (HTSA) and halal industry environmental factors (HIEF) on halal food supply chain integrity (HFSCIn). The study also found that the highest adoptions of halal traceability system are among the producer and end user while the highest contributions in influencing the HIEF are the economic and socio-cultural factors. These findings have given some thoughts on the development of a theoretical framework specifically on the food supply chain integrity in the context of the halal industry.*

**Keywords:** *Halal Traceability System, Halal Industry Environmental Factors, Halal Food Supply Chain Integrity, Halal Product, Food Industry.*

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## Introduction

The various cases of contaminated halal food such as mixing of halal and non-halal food in storage, poultry and meat slaughtering do not comply with the Shariah requirement (Omar & Jaafar, 2011), fraudulent halal certification and physical contamination (Zulfakar, Anuar, & Talib, 2014), and on 23rd May 2014, Muslim consumers in Malaysia were shocked with the

report by the Ministry of Health (MOH) that Cadbury Dairy Milk Hazelnut and Cadbury Dairy Milk Roast Almond analysed by the MOH tested positive for traces of porcine DNA (New Strait Times, 2014) have forced the product to be immediately removed from the marketplace and withdraw the halal certification of the product. These scandals have shaken consumer's confidence in food they consumed and they have demanded stricter controls in food production (Ali, Zhan, & Alam, 2017).

Ensuring food integrity is difficult with today's global food supply chains, due to the length and complexity (Ali, Tan, & Ismail, 2017; Manning, 2016). The production of halal food needs a very cautious understanding throughout the supply chain. Nowadays, Muslim consumers are very curious and want assurance that the products they consume are authentically halal and should be *toyyib*, meaning wholesome, pure, healthy, nutritious and good. Therefore, the halal foods supply chain integrity becoming an increasing concern (Suhaiza et. al., 2010; Lam & Alhashmi, 2008; Zulfakar, Jie, & Chan, 2012; Zulfakar, Anuar, & Talib, 2014).

In order to achieve the untainted halal food supply chain integrity, each partners in the supply chain from supplier until the end user need to be monitored, so that users can satisfy with the authenticity of halal products (Bahrudin, Ilyas, & Desa, 2011). In addition, the adoption of halal traceability system should be addressed whilst the increasing demands for better halal food supply chain among customers. Furthermore, the traceability also can be used to trace the halal status of particular food products at every stage of the supply chain and can increase the halal transparency and strengthens the halal integrity (Zulfakar, Anuar, & Talib, 2014).

Although numerous study has been conducted in halal integrity and food supply chain integrity (Ali, Tan, & Ismail, 2017; Ali et.al., 2016; Zulfakar, Anuar, & Talib, 2014; Ali et. al., 2014; Zulfakar, Jie, & Chan, 2012; Abdul & Hazlinda, 2011; Suhaiza et. al., 2010), little have focusing on identification of factors enhancing halal food supply chain integrity within supply chain partners. In addition, according to Zulfakar, Anuar, and Talib, (2014), a comprehensive and reliable traceability system in the halal food supply chain can increase the halal transparency and strengthen the halal integrity. However, there is no empirical study focused specifically to shows the relationship between halal traceability system adoption and factors enhancing halal food supply chain integrity.

Thus, to help bridge this gap in literature, this study attempt to examine to what extent the halal traceability system adoption and environmental factors are relevant in enhancing the halal food supply chain integrity particularly within supply chain partners. Furthermore, this study also will observe which partners in the supply chain have the highest adoptions on halal traceability system and the highest contributions in influencing the halal industry environmental factors.

## **Literature Review**

### ***Halal Traceability System Adoption (HTSA)***

With regard to halal food industry, the application of traceability is at a new stage due to its infancy of large scale production of halal products (Shafii & Wan Siti Khadijah, 2012). From the requirements of halal food production, traceability is critical to manufacturers, producers and distributors as the aim is to provide products with safety and healthy assurance, good quality and most importantly the products must comply with Shariah. According to Suhaiza et al. (2010), traceability in the halal industry is defined as a communication tool to ensure that information related to halal food and products is available along the supply chain. In addition,

traceability can be used to trace the halal status of a particular food product at every stage of the supply chain (Zulfakar, Anuar, & Talib, 2014) and traceability must be set up with the purpose to increase transparency in the production chain.

Based on the definitions given by various literatures, for the purpose of the current study, halal food traceability system is defined as the ability to trace and track the history of food and food ingredients through specified stages of supply chain; thus traceability can be applied through all stages of production, processing and distribution of halal food. The key to an effective traceability system is good communication and management between the connections along the supply chain (Mohamed, Rahim, Ma'ram, & Hamza, 2016) This is due to the reason that traceability system usually involves many participants in the supply chain (i.e., supplier, producer, logistics, and end users). Thus, it is obvious that halal food traceability is not a single firm's responsibility. It is a shared commitment between all the players along the supply chain which involves the integration of both the supply chain management and the inter-organizations information flow (Engelseth, 2009).

In addition, halal traceability system is essential to diminish the contamination and risks associated with halal requirements. The Food Traceability Standard ISO 22005 requires that each company should know who is its immediate supplier and to whom is the product being sent according to the principle of "one-up and one-down". Consequently, it is very crucial for each of the partners in the supply chain cooperates to ensure the authenticity of the halal food and no contamination issues occur along the production chain. In the current study, the adoption of halal traceability system will be viewed from the supply chain partners' perspectives (i.e., supplier, producer, logistics, and end user).

#### ***Halal Industry Environmental Factors (HIEF)***

The halal industry environmental factors in this study represent the macro-environmental factor in the sub-dimensions of political-legal, economic, socio-cultural, and technological environments as suggested by Mohamed et al. (2010), Talib and Hamid (2014), and Hassan (2013). These factors will give some idea of what constitutes Halal because Muslim populations originate from different continents, bringing their own differences in culture, taste, and school of taught. Therefore, it is imperative for halal food and beverages producer to understand each dimension of the macro-environmental factors associated with the industry as discussed below:

#### ***Political-Legal Factors***

The role of the government is apparent in the halal industry as the political interventions such as Halal standards, halal enforcement, and halal incentive, will accelerate the growth and development of halal industry in Malaysia. Apart from that, halal industry players in every part of the world have various government assistance programs in order to encourage their participant in the lucrative halal market. The political and government support can be seen from various efforts such as introducing halal certification and standards for halal products and services, tax incentives, financial supports, and guidelines (Ramli, 2006; Muhammad, Isa, & Kifli, 2009; Tan, Razali, & Husny, 2012; Talib & Hamid, 2014).

Halal standards are the regulation concerning halal requirements as to ensure the integrity of halal products is being met by the halal producers along the entire production chain. Many agencies, associations, councils, or federations have established various halal standards globally. Currently, more than hundreds of listed certification bodies implement various halal

standards worldwide. For Malaysia, the government agency under the Department of Islamic Development Malaysia (JAKIM) has the authority to produce the halal certificate. For example, in food industry, JAKIM has introduced the Malaysian Standard MS 1500:2009 implemented for Halal Food – Production, Preparation, Handling and Storage General Guidelines (Second Revision). According to Talib (2014), the government support also comes in the form of policies, procedures and guidelines. The government efforts have managed to position Malaysia's halal certification as the most reliable standard and Malaysia is known for its halal certification (Muhammad et al., 2009).

In addition, halal enforcement has been established to ensure that food producers involved in this industry strictly comply with the halal standard. In Malaysia, offenses related to halal certification and the logo are governed under the Trade Description Act 1972 – Trade Description (Use of the Expression Halal) Order 1975. Other laws are the Food Act 1983 under the Ministry of Health Malaysia (MOH) that covers cleanliness and safety of the contents, and Animal Importation Order 1962 under the Agriculture and Agro-based Industry Ministry Malaysia (MOA) that requires the animals to be slaughtered according to Islamic ways. While in 2011, the Halal Act was introduced to monitor the observance of halal requirements among industry players. As strict penalties could be imposed under this act, food producers may be affected, especially with respect to Halal logo selection and the selection of halal-certified shipping container for their distribution activities.

Finally, the halal incentive may also assist the growing of halal market by looking at the various initiatives such as trade and investment promotion, institutional mechanism for the development and promotion of halal certification, research and development (R&D) and capacity building (i.e., IMP3, 2006-2020). In Malaysia, as an effort to enhance the competitiveness of local halal products in the global market, a wide range of incentives has been introduced which includes (IMP3, 2006-2020):

- i. Special grant for the development and promotion of Halal products;
- ii. Investment Tax Allowance of 100 per cent for qualifying capital expenditures for five years for companies that produce Halal foods;
- iii. Double tax deductions on expenditures for obtaining Halal certification and accreditation of international quality system and standard certification; and
- iv. Grants for business planning and development, product and process improvement, productivity and quality improvements and certification, market development and brand promotion.

With regard to halal food production activities, the halal standards and incentives provided by the government enable the Halal food industry especially among small and medium enterprises (SMEs) to have an extra inducement in succession of their business.

### ***Economic Factors***

Economic indicators provide information regarding industry development and demand conditions of a particular product. According to Mohamed et al. (2010), a strong economic and industry growth is one of the aspects in economic factors. Thus, in the current study, the economics factors of Halal industry will further discuss on the Muslim population, halal market growth, standard of living, geographical factors and halal compliant infrastructures.

A comprehensive demographic study done by PEW Research Centre found that there are 2.1 billion Muslims of all ages living in over 200 countries worldwide in 2012. This number was

forecasted to grow at twice the rate by 2030 representing 27 per cent of global population (PEW Research Centre, 2013). Table 1 illustrates the estimated Muslim population and the percentage of world Muslim population in 2030.

**Table 1: Muslim Population by Region**

<b>Region</b>	<b>Estimated 2030 Muslim Population (000)</b>	<b>World Muslim Population (%)</b>
Asia-Pacific	1,295,625	59.2
Middle East-North Africa	439,453	20.1
Sub-Saharan Africa	385,939	17.6
Europe	58,209	2.7
Americas	10,927	0.5
<b>World Total</b>	<b>2,190,154</b>	<b>100</b>

Source: PEW Research Center (2013)

By looking at the magnitude and rate of Muslim population worldwide, the potential demand for halal food becomes more visible. According to Sumali (2006), the halal market opportunities are enormous with Muslims accounted for about one quarter of the world's population. As shown in Table 2, the world halal food market size in the year 2010 was USD 652.7 billion and this amount is estimated to grow at a tremendous rate. As reported by United Nation and IMF (2013), the GDP per capita for Muslims worldwide has grown at a Cumulative Annual Growth Rate (CAGR) of 6.8 per cent (Global CAGR = 5.0%) from 1990 to 2010.

In addition, standard of living will effect on how people spend their money across the globe. A higher living standard and lifestyle has increased the demand for better quality and convenience food. With regard to Halal food, consumers are eager to pay for premium products provided that they get the great quality and authenticity of Halal food. As mentioned by KasehDia's research in major European countries, it is found that consumers are willing to pay for premium products with better quality and safety as well as halal assurance.

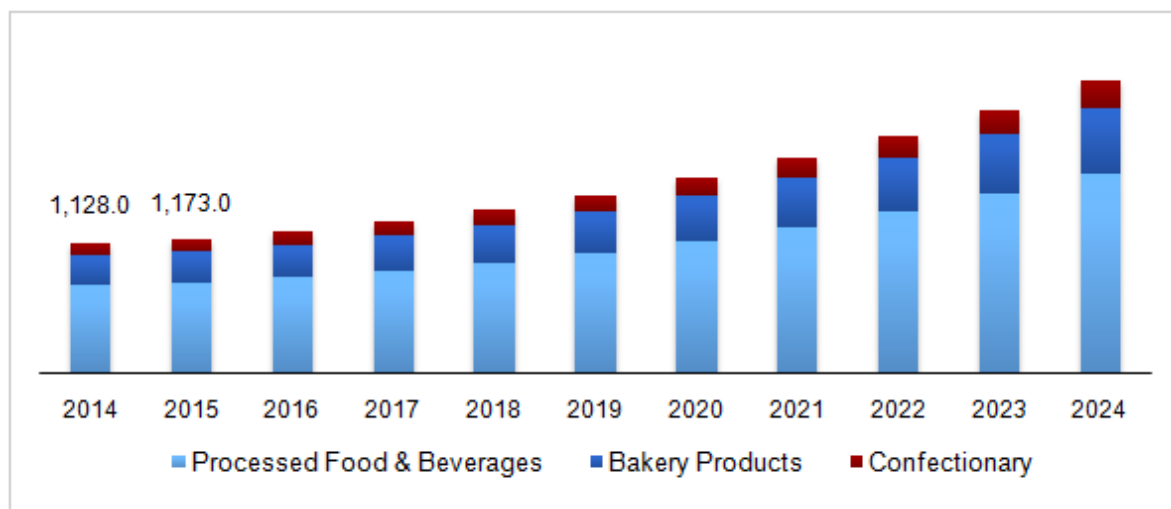
**Table 2: Halal Food Market Size 2010**

<b>Region</b>	<b>Halal food market size 2010 (billion)</b>	<b>World Halal food market size (%)</b>
Africa	USD 153.4	23.5
Europe	USD 67.0	10.3
Asia	USD 416.1	63.8
America	USD 16.2	2.48
<b>World Total</b>	<b>USD 652.7</b>	<b>100</b>

Source: Market Indicators Report April 2011 & HDC Analysis.

Moreover, halal market exists in all geographic locations around the world. As shown in Table 2, majority of Muslims are located in Asia (59.2%), followed by Africa (37.7%), Europe (2.7%), and America (0.5%). Each market region has specific indicators about the demand condition and potential for a Halal marketplace. Despite demographic differences, similar tastes and preferences within specific market regions can be found in majority of the population races and cultures.

As shown in Figure 2, the global halal market is expected to reach USD 2.55 trillion by 2024. The growing demand for the consumption by other communities is a leading factor which is anticipated to fuel market growth over the forecast period.



**Figure 1: Global Halal Food Market for 2014-2024 (USD Billion)**

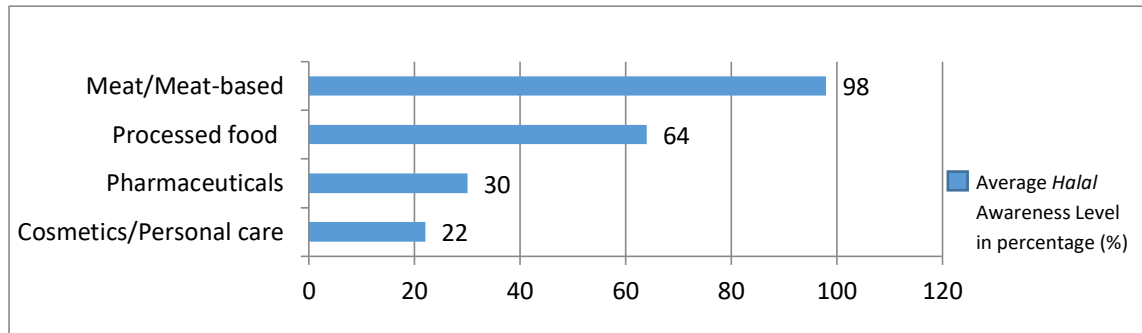
Source: Market Research Report (2017)

### *Socio-Cultural Factors*

Socio-cultural factors have a great influence on the demand of a firm’s products and services (Mohamed, Ann, & Yee, 2010). Therefore, the socio-cultural factors of the halal industry environments discussed in the current study include halal value, awareness, acceptance, perception and attitudes among Muslim consumers.

The different interpretations on the meaning of halal can significantly impact consumers’ reaction towards halal products. According to Salehudin and Luthfi (2010), halal literacy differs among Muslims due to various interpretations of Islamic laws. His study found that consumers with low halal literacy score had less intention to switch from product without halal label than consumer with a moderate to high literacy. Even within an individual country or society, different ethnic or cultural group might understand, perceive, and respond to these concepts differently, depending on regional situations, ethnic backgrounds and socio-economic situation (Hassan, 2013).

Furthermore, the increased level of awareness on the halal concept has also spread among non-Muslim consumers due to the growing concerns of natural, safe, and healthy products. Besides, Muslim consumers nowadays are more knowledgeable on their food consumption (Bonne & Verbeke, 2008) and have greater awareness on meat/meat-based products due to high level of exposure to Shariah principles with respect to slaughtering of animals, production, and processing. As shown in Figure 2, the result of Amri Sofi’s (2010) study showed that Muslims generally have the highest awareness level on halal meat/ meat-based products (98%), followed by processed food (64%), pharmaceuticals (30%), and cosmetics/personal care (22%).



**Figure 2: Average Halal Awareness Level among Product Ranges**

Source: Amri Sofi (2010)

The acceptance of halal products and services among Muslims and non-Muslims is increasing because of the perception that halal is a symbol of a healthier lifestyle and hygienic preparation (Ambali & Bakar, 2013; Aziz & Chok, 2013). Additionally, according to Sumali (2006), product with halal logo was perceived and recognized as a symbol of cleanliness, safety, and highly quality. Therefore, halal products and services has become highly accepted among consumers especially those who have shown a great concern for high quality standards. Moreover, other socio-cultural factors that affected the understanding and acceptance of halal were age, educational levels, level of religiosity, and geographical area (Rezai et al., 2009).

According to Abdul et al. (2009), trust and confidence have become crucial aspects of purchasing halal products and services. Besides, the impact of attitudes in determining the behavioral intention of purchasing halal products has been documented in past empirical studies (Abd Aziz et al., 2010; Hashim & Othman, 2011; Lada et al., 2009; Salehudin & Luthfi, 2010). Therefore, the variations in attitudes towards halal might create business opportunities and influence the decision on adoption of traceability system in halal food industry.

### ***Technological Factors***

The technological factors of halal industry have become apparent in assisting the industry to produce better quality products and also to ensure the integrity aspect of the halal products. The halal-related technological developments comprise the issues of halal production technology, halal packaging technology, halal information technology and halal logistics technology.

Production-related technologies such as machines and production systems have been applied to improve production methods and outputs. The development of halal production technology especially in slaughtering, processing, packaging, and labelling may increase the quality and integrity of halal products and enables mass production. In terms of packaging-related technologies, there are several alternatives that have been developed in ensuring the environmental consideration such as waterproofing, insect proofing, durables, recycled, reusable, and convenient packaging. The development of halal packaging technology has also become apparent in meeting the need of halal industry which concerns Shariah compliant materials.

Moreover, information-related technologies in halal industry such as electronic halal trading portals are getting increasing attention in assisting the industry to promote and disseminate the products, as well as consumers in reaching the products they want. In addition, the development of halal information technology (IT) has also facilitated the increasing of online

halal software that will assist consumers in checking the halal status and logo of the products before they proceed in buying it. For instance, consumer uses smart phones and multimedia message services (MMS) application to cross-check with halal authority about the legitimacy of a halal logo on a given product (Junaini & Abdullah, 2008; Mohd Albakir & Mohd-Mokhtar, 2011). With regards to traceability and integrity, the development of halal IT might influence the decision in adopting a more systematic traceability system especially in assisting the business of halal food products.

The use of information technology in logistic helps to improve productivity of logistics service providers, enhance the effectiveness and efficiency level, and even assist to position a country to become a logistics hub (Hazen & Byrd, 2012; Piplani, Pokharel, & Tan, 2004). Thus, the logistics-related technology in halal industry is vital as it is gaining interest and becomes lucrative business (Suhaiza et al., 2010; Tieman, 2010). There are various IT applications used in halal logistics, for instance Transportation Management System (TMS), Warehouse Management System (WMS), Electronic Data Interchange (EDI) and Global Positioning System (GPS) and Radio Frequency Identification Device (RFID) (Bahrudin, Illyas, & Desa, 2011; Tan, Razali, & Husny, 2012). According to Bahrudin et al. (2011) and Tan et al. (2012), the tracking and tracing activities in halal logistics is part of IT and it enhances the service integrity. Therefore, the applications of IT in halal logistics benefit the service providers as there are greater transparency and better control (Tieman, 2010), and for the consumers, it gives them more assurance.

#### ***Halal Food Supply Chain Integrity (HFSCIn)***

Halal integrity has become a foundation in ensuring the successful of halal industry regardless of what type of the halal products. As the halal integrity of the product is a result of the various activities in the supply chain, a supply chain approach is important to guarantee the halal integrity at the point of consumption (Tieman, 2011). However, maintaining the halal integrity is the major challenge for all the parties involved in the halal supply chain (Zulfakar, Anuar, & Talib, 2014). This is because, the possibilities of cross contamination or tendency of halal products to be handled together with non- halal product is quite high throughout the supply chain. Therefore, to protect the halal integrity, complete understanding of the whole halal food supply chain is required (Khan, 2009; Lodhi, 2009; Tieman, 2011). In addition, according to Ali, Zhan, and Alam (2017), all stages of the halal food supply chain are required to follow the regulation according to the Quran to ensure its integrity. Thus, current study will elaborate the integrity issues for each of the supply chain partners (i.e., supplier, manufacturer, control system, and customer).

The supply of raw materials is the major concern over the halal integrity. Globalized food supply chain benefits such as higher availability make halal food not excused from sourcing imported raw materials (Ali et al., 2014). Thus, the appropriate sourcing, safety and quality genuinely is important as very few countries are implementing halal food certification and standards through government's involvement (i.e., Brunei) while, the other countries are still dependent on the private associations. Despite foreign certificates' recognition by JAKIM being in place, the halal raw materials integrity doubtful cannot be eliminated. The swarming issues around the raw materials and certification suggest the concern of halal integrity in raw materials is important (Ab Talib & Johan, 2012). In addition, the ethics aspects of supplier in term of pricing, efficiency and delivery time were also expected to affect the integrity of supplier particularly in halal industry.



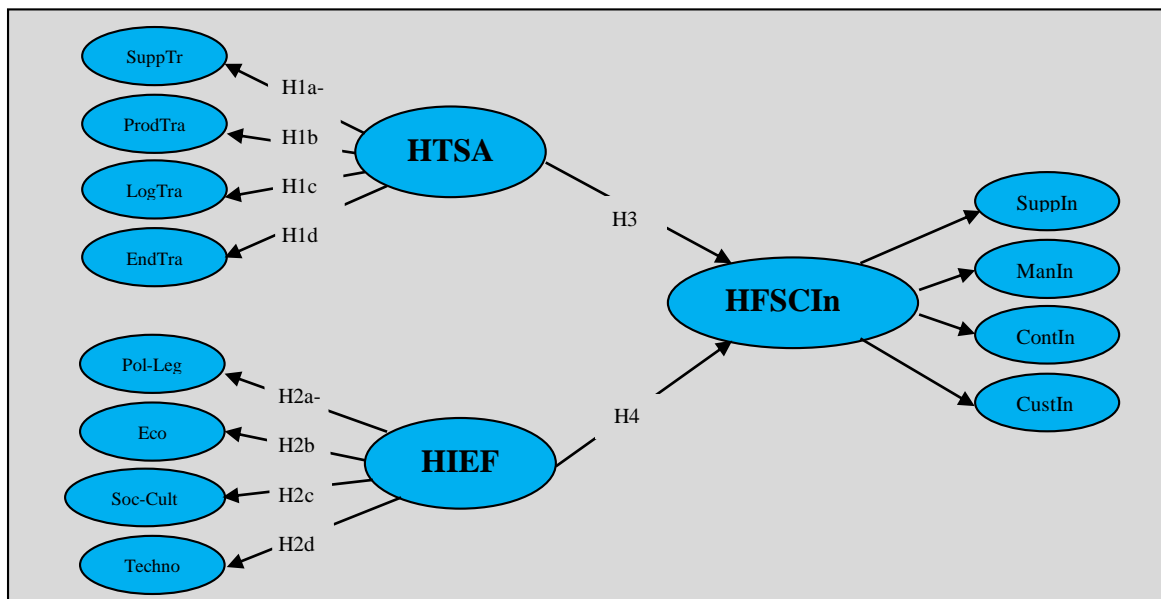
The production of halal food is administrated by standards and legislation (i.e., MS1500:2009, HACCP, GMP, GHP, etc.). According to Ali et al. (2014), production or manufacturing is the most emphasized stage in halal food supply chain to determining the quality and integrity of the food. This is because, the production processes involve numerous stages from choosing the ingredient or raw materials, assembly process, packaging, labelling, and storage of finished products. Thus, if there are slight changes in the ingredients, the integrity of the food which was certified as halal will be doubtful. In addition, halal food production also exposed to the risk of contamination from equipment which will eventually affects halal supply chain integrity. Ali et al. (2014) suggested, the use of appropriate equipment is not only limited to the factory and kitchen sections, but should be applied to all level of supply chain. Furthermore, customers are demanding for logistics services that can guarantee the halal status remains intact even during distribution activities with the concern on the integrity of halal products and services (Talib & Hamid, 2014). Thus, the container or transport needs to be ritually cleaned and consignment properly segregated in order to ensure the requirements are observed and the logistics are dedicated to the halal product shipment (Jaafar, Endut, Faisol, & Omar, 2011). On the other hand, the halal food producers or manufacturers need to pertained transparency in the whole process of production and have to make sure that all employees encompass an adequate awareness to ensure the integrity of halal product remains until the point of consumption.

Control system integrity in halal industry can be observed through halal certification and logo, halal standard, and traceability and tracking activities. According Zulfakar et al. (2014), halal certification is one of the factors in enhancing halal food supply chain integrity. In essence, halal certified products encourage sense of confidence and trust among customer that the food products they purchased are *Shariah*-compliant. In addition, Riaz and Chaudry (2004) added, halal certification such as halal logo or certified of compliance, issued by reputable and accredited agency shows that the product has sufficiently met the Islamic dietary. Thus, the authorized halal logo or certificates issued by trustworthy organization may improve integrity and prevent from any fraud, fake and misleading logo or certificates. Furthermore, halal standard is another concern in ensuring the integrity of control system. halal standard and guidelines are diverging due to various halal authorities and agencies in different countries. According to Evans (2011), due to multiple authorities and different Islamic practices, it is difficult for the halal industry players to have a global standard that can be practiced worldwide. In addition, this has resulted in multiple *Halal* standards that would cause questionable halal certification (Zulfakar, Anuar, & Talib, 2014) and consequently affects the integrity. Accordingly, having the halal certificate and applying halal standard will facilitate the company to practice a complete traceability system. According to Suhaiza et al. (2010), the halal traceability systems should be set up with the purpose to increase the halal transparency in the production chain. More transparency will increase customer trust on the products and increased information on the total supply chain processes. Zulfakar et al. (2014) added, a comprehensive and reliable traceability system in the halal food supply chain can increase the halal transparency and strengthen the halal integrity.

The increasing awareness, knowledge and perception of Muslims all over the world on their obligation to consume food based on Islamic dietary requirements creates greater effort among food producers to create reliable halal foods. According to Randolph (2003), awareness means the knowledge or understanding of particular subject or situation. With regards to halal context, awareness means having special interest in or experience of something and/or being well informed of what is happening at the present time on halal foods and products. In addition,

increasing customers' confidence in food and reducing customer complaints will increase food quality and safety (Arana, Soret, & Lasa, 2002; Liao, Chang, & Chang, 2011; Mousavi, Sarhadi, Lenk, & Fawcett, 2002), consequently will increase the integrity. Furthermore, customer sensitivity and cooperation in giving information regarding halal foods status is also expected to increase the integrity of the halal foods.

In addition, the use of traceability systems in food industry has been recognized as a tool to assist in the assurance of food safety and quality as well as to achieve consumer confidence. Suhaiza *et al.* (2010) proposed halal traceability systems that can be used to strengthen the halal food supply chain. Meanwhile, Siti, Mohd and Mohamad (2011), and Zulfakar, Anuar and Talib (2014) suggested that halal traceability systems will assist to sustain the integrity of halal product. In addition, traceability system increases the quality of food and food production system as it increases the awareness of workers through the focus on data capturing and documentation process (Donnelly & Olsen, 2012), and consequently, this will increase the integrity. Therefore, this study expected the halal traceability system adoption (HTSA) has a positive effect towards HFSCIn.



**Figure 3: Research Framework**

Furthermore, environmental factors have been identified as having a detrimental effect on supply chain (Lee, 2004; Xiao, Qi, & Yu, 2007). For example, the political legal factors such as halal standards are the regulations concerning halal requirements to ensure the integrity of halal products is being met by the halal producers along the entire production chain. For this reason, it is expected that halal Industry Environmental Factors (HIEF) will also affect the halal food supply chain integrity (HFSCIn). Figure 3 shown the research framework of current study.

### Materials and Methods

The unit of analysis of the study is the organizational level consists of halal food producers that have been certified by JAKIM. The self-administrated questionnaires were distributed during Malaysia International Halal Showcase (MIHAS) 2014 at KLCC, Kuala Lumpur on 9th -12th April 2014 and Halal Fiesta Malaysia (HALFEST) 2014 at MIECC, Mines Seri

Kembangan, Selangor on 3rd -7th September 2014. The exhibitors came from all around the globe and also came from every state in Malaysia. Since this study only focuses on companies which are operating in Malaysia, all international participants are excluded from the survey. The products range presented during this exhibition includes foods, pharmaceuticals, cosmetics, and services. However, due to the focus of this study is food manufacturers, thus, the questionnaires were only distributed among halal food manufacturers during the exhibition. Most of the respondents are the general manager or owner of the company, halal executives, quality assurance managers, operation managers and sales manager.

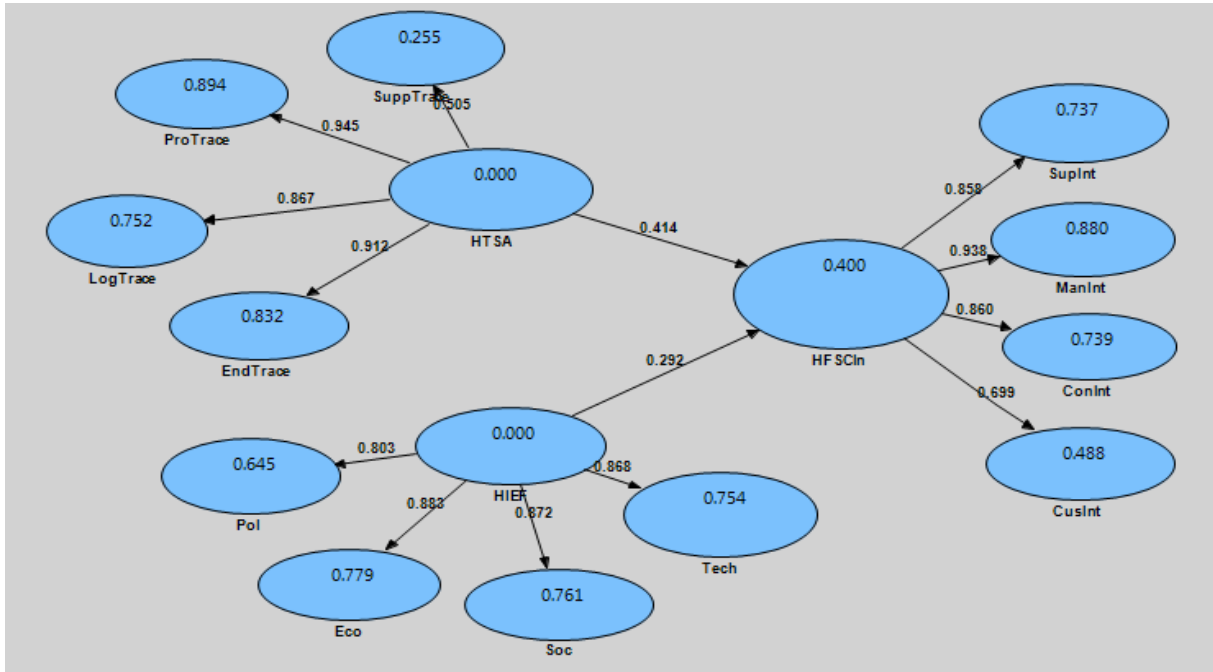
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#### ***Data Collection***

Two hundred (200) self-administered questionnaires were distributed to the exhibitors via face-to-face during MIHAS and HALFEST exhibition from 9th-12th April 2014 and 3rd -7th September 2014. A total of 175 of them were collected, but only 127 of them can be used for data analysis purpose. The other 48 returned questionnaires are unusable because of poor quality of data and they are not in food and beverages category. Only the person with good knowledge of the company and have halal certified product is qualified to complete the survey.

#### ***Structural Model Assessment***

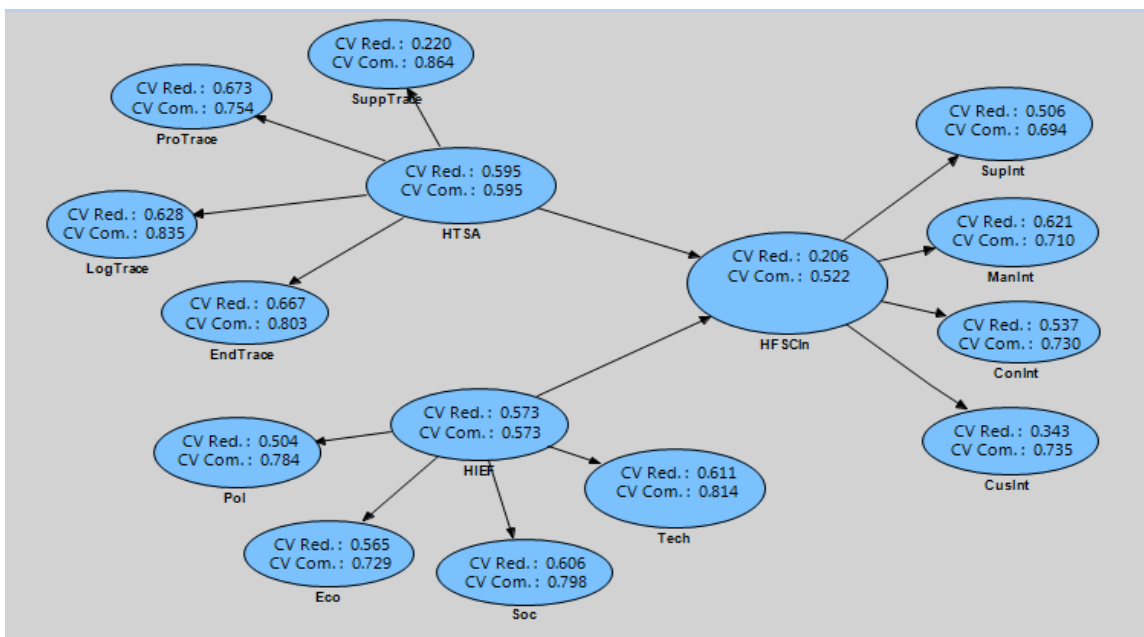
The first important criterion for assessing structural model is to measure the model's predictive accuracy by evaluating the coefficient of determination ( $R^2$ ). The  $R^2$  value indicates the amount of variance in dependent variables that is explained by the independent variables. According to Chin (1999),  $R^2$  values for endogenous latent variables are assessed with 0.67, 0.33, or 0.19, respectively describing substantial, moderate, or weak level of predictive accuracy. As illustrated in Figure 4, the  $R^2$  value for *Halal* Food Supply Chain Integrity (HFSCIn) was 0.400 suggesting that 40% of the variance can be explained by *Halal* Traceability System Adoption (HTSA) and *Halal* Industry Environmental Factors (HIEF).



**Figure 4: Result of Structural Model**

Source: Survey data

In the current study, the predictive sample reuse technique was applied (Chin, 2010; Fornell & Cha, 1994) besides looking at the magnitude of the R-square ( $R^2$ ) as a criterion for predictive relevance. Figure 5 revealed the current study  $Q^2$  value of 0.206 by using an omission distance of seven in the blindfolding procedures. The  $Q^2$  larger than zero indicates that the path model has predictive relevance for this particular construct. In this model, HTSA and HIEF predicted HFSCIn.



**Figure 5:  $Q^2$  Predictive Relevance**

Source: Survey data

### Data Analysis and Findings

The path coefficient between constructs was assessed to validate the proposed hypotheses and the structural model. According to Hair et al. (2011), the path coefficient values need to be at least 0.1 to account for a certain impact within the model. The results of hypotheses testing for current study (refer Table 3) showed that all proposed hypotheses are supported. From this analysis, supported hypotheses are significant at the level of 0.01, have positive sign directions and consist of a path coefficient value ( $\beta$ ) ranging from 0.292 to 0.945.

**Table 3: Path Coefficient and Hypothesis Testing**

Hypothesis	Relationship	Beta	Standard Error	T-Value	Decision
H1a	HTSA -> SuppTrace	0.505	0.097	5.226**	Supported
H1b	HTSA -> ProTrace	0.945	0.012	79.610**	Supported
H1c	HTSA -> LogTrace	0.867	0.026	33.326**	Supported
H1d	HTSA -> EndTrace	0.912	0.017	52.459**	Supported
H2a	HIEF -> Pol	0.803	0.052	15.367**	Supported
H2b	HIEF -> Eco	0.883	0.027	32.530**	Supported
H2c	HIEF -> Soc	0.872	0.028	31.274**	Supported
H2d	HIEF -> Tech	0.868	0.024	36.650**	Supported
H3	HTSA -> HFSCIn	0.414	0.090	4.604**	Supported
H4	HIEF -> HFSCIn	0.292	0.100	2.917**	Supported

\*Note:  $t$  value  $> 1.645^*$  ( $p < 0.05$ )  $t$  value  $> 2.33^{**}$  ( $p < 0.01$ )

Based on the result above, the highest adoption of halal traceability system is among the producer ( $\beta = 0.945$ ,  $t = 79.610$ ,  $p < 0.01$ ), followed by end user ( $\beta = 0.912$ ,  $t = 52.459$ ,  $p < 0.01$ ), logistics ( $\beta = 0.867$ ,  $t = 33.326$ ,  $p < 0.01$ ), and supplier ( $\beta = 0.505$ ,  $t = 5.226$ ,  $p < 0.01$ ). In addition, the highest contributions in halal environmental factors are economic ( $\beta = 0.883$ ,  $t = 32.530$ ,  $p < 0.01$ ), followed by socio-cultural ( $\beta = 0.872$ ,  $t = 31.724$ ,  $p < 0.01$ ), technological ( $\beta = 0.868$ ,  $t = 36.650$ ,  $p < 0.01$ ) and political ( $\beta = 0.803$ ,  $t = 15.367$ ,  $p < 0.01$ ). Meanwhile, HTSA and HIEF was also found to have significant influenced on HFSCIn ( $\beta = 0.414$ ,  $t = 4.604$ ,  $p < 0.01$ ); and ( $\beta = 0.292$ ,  $t = 2.917$ ,  $p < 0.01$ ).

Several reasons explain the significant results of HTSA on HFSCIn. This finding is consistent with previous study done by Zulfakar et al. (2014), Bahrudin et al. (2011), and Suhaiza et al. (2010) where they found with the implementation of comprehensive and reliable traceability system will strengthen the halal food supply chain and increase the halal integrity. In addition, a study by Hassan (2013) also found that the development of halal logistics such as halal control system, halal traceability, halal tracking system, halal transportation and warehousing system has been critical in ensuring the integrity of halal products. These results have providing opportunities to understand further on the importance of HTSA and HIEF in enhancing HFSCIn.

### Discussion and Conclusion

In the halal industry context, the halal integrity of the product is a result of the various activities in the supply chain. Given that food integrity cannot be achieved by depending solely on the current mechanism, complete understanding of the whole halal food supply chain is required to protect the halal integrity (Khan, 2009; Lodhi, 2009; Tieman, 2011).

Through the observation on the relevant sources across the food supply chain context, the research provides sufficient evidence that halal food supply chain integrity will also be influenced by traceability system adoption and environmental factors. Based on the findings, the traceability system adoption and environmental factors were found to have significant influence on halal food supply chain integrity.

This study only focused on halal food industry particularly the food and beverages category. Thus, future study can explore further on every category in food industry such as raw materials and ingredients; poultry, meat and dairy; fast food and premises and make comparison between pharmaceutical, cosmetics, and healthcare in halal industry. In addition, the sample size (N = 127) can be considered small and therefore, it is recommended that in future the subject matter be explored with a much larger sample to allow generalization of the result. Furthermore, a large sample would assist future researchers to make use of other stronger data analysis.

The study demonstrates that halal food supply chain integrity practice must be seen prominently in order to deliver the best authentic halal product to respected customers. Ensuring halal integrity is a daunting task for several halal food companies especially for the SMEs. Thus, by understanding the importance of HTSA and HIEF in enhancing HFSCIn, the finding may provide a guideline and better perceptives for developing effective strategies and modifications to improve the halal integrity practice and the company's supply chain performance.

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