Impact of supply chain integration on halal food supply chain integrity and food quality performance

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Abstract

Purpose – The current complex halal food supply chain has caused food scandals, which have illustrated the weakness of multiple Food quality standards and certification, and audits in ensuring food safety. Drawn on the resource-based view theory (RBV), this study has aimed to explore the impacts of supply chain integration on halal food supply chain integrity and, consequently, food quality.

Design/methodology/approach - Empirical data were collected from 275 halal-certified food companies in Malaysia and analysed using structural equation modelling - SmartPLS3.0.

Findings – The results confirmed that supply chain integration including internal, supplier, and customer integrations, have significant effects on the dimensions of the halal food supply chain integrity which, in turn, lead to halal food safety and quality.

Practical implication – The importance of supply chain integration in halal food supply chain is highlighted in this study. The impact of supply chain integration is contexted in halal food supply chain integrity and food quality. Therefore provides a clear understanding to managers of supply chain applicability in the halal food industry.

Originality/value – Based on the RBV theory, this study contributes to the limited body of research of the relationships amongst supply chain integration from the context of the halal industry with a specific focus on food supply chain integrity and food quality.

Keywords: Supply Chain Integration, Food Integrity, Food Quality, Halal Food

1. Introduction

In ensuring food quality and safety, policymakers imposed myriad certifications, standards, and regulations on food manufacturers. From the context of food industry, literature has highlighted the importance of food standards and certifications (Ab Talib et al., 2015; Hosseini et al., 2019; Wilson, 2014). However, the recent plethora of food scandals across the globe, such as Malaysia’s fraudulent non-halal meat cartel (2020), Australian’s rockmelon listeriosis outbreak (2018), Europe’s Fipronil eggs contamination (2017), and the United Kingdom’s horsemeat scandal (2013), have heavily challenged the reliability and integrity of the food industry and suggest that the current standards and controlling mechanisms are insufficient to ensure food integrity. In response to food scandals and incidents, the customers’ concerns on
food quality and safety have increased tremendously (Aung and Chang, 2014; Iranmanesh et al., 2018). Additionally, Muslim customers as one of the big targeted markets of food companies, demands assurance on the food they consume is holds the integrity of Islamic principles manifestation (Hosseini et al., 2019; Wilson et al., 2013; Tieman, 2011; Zailani et al., 2017). As such, food companies need to establish a mechanism to ensure halal food integrity (Mohamed et al., 2020; Solatnian et al., 2016), which addresses the safety, quality, and Shariah compliance concerns of Muslim customers.

The over the competition in the food industry forces food companies to outsource their logistics activities and source more cost-effective raw materials, as well as, to export products to a vast geographical area to enhance revenue (Ali and Suleiman, 2018; Greenberg, 2017; Yunan et al., 2020). Although the involvement of more suppliers and logistics service providers can enhance the profit of food companies, food integrity becomes a challenging task due to the complexity and length of today’s’ global supply chains (SC) (Ali et al., 2017; Manning, 2016). The previous studies have shown that supply chain integration (SCI) is crucial to address uncertainties (Flynn et al., 2016; Kim and Chai, 2016). SCI enables firms to develop high levels of interaction and collaboration with suppliers and customers which have been regarded as key enablers of SC success (Lu et al., 2018; Tyagi et al., 2015; Wilden et al., 2013). Considering the impacts of current food SC complexity on halal food integrity and the role of SCI in addressing SC uncertainties, in this study, SCI was proposed as a potential enabler of food SC integrity and, consequently, halal food quality.

The findings of this study contribute to the literature in two ways. Firstly, the study has extended the literature on food integrity by providing empirical evidence on the impacts of SCI on food SC Integrity. Secondly, the findings have determined the role of halal raw material integrity, halal production integrity, and information integrity, on halal food quality. From the practical perspective, the findings have shed light on the impacts of SCI on halal SC integrity and halal food quality and safety and will help managers to mitigate food quality, safety, and contamination risks.

2. Literature review

2.1 Halal supply chain

Tieman (2011) and Wilson and Liu (2010) defined halal as permissible, lawful, or allowed. Following Islamic law, Muslims should consume halal products and avoid consuming haram ones. Scholars have shown that Muslim behaviours are significantly influenced by Islamic law
(Atal et al., 2020; Iranmanesh et al., 2018; Wilson and Liu, 2011). Accordingly, Muslims' utmost importance on food selection is product compliance with Islamic principles (Ali et al., 2017; Tan et al., 2017; Zailani et al., 2019). According to Wilson and Liu (2010) and Atal et al. (2020), as behaviours of Muslims are affected by Islamic law, marketers should understand Islamic Law. The halal status of the foods does not only depend on their ingredients and the contamination can be occurred at the entire supply chain process including farming, manufacturing, warehousing, transportation, and retailing, as the consequence of contact between halal and haram products (Iranmanesh et al., 2019). As such, halal SC has received attention as a way of reducing the risk of contamination. Segregation of haram and halal products should be practiced at post-production points namely transportation, warehouse, and store (Ab Talib et al., 2015; Tieman, 2011). Tieman et al. (2012) proposed terminal operation, storage, and transportation as critical points of halal SC.

The customers purchase products at stores and the halal food products are certified based on their status at the manufacturing stage of SC. Zailani et al. (2018) explained that the contact of halal products with non-halal products or contaminated equipment causes contamination. For example, using the equipment used for transporting or storing non-halal products can cause contamination after production (where the product is certified). Halal practices should be considered in the entire SC from the time that halal products are produced and certified. Fathi et al. (2016, p.465) defined halal SC as “a combination of business activities from the point of origin to the point of consumption performed in accordance with the Islamic law, known as Syariah”. Khan et al. (2019) and Selim et al. (2019) categorized the halal supply chain activities to halal sourcing, halal manufacturing, halal transportation, and halal warehousing. Halal supply chain management (SCM) guarantees the halal integrity of the product at the consumption point and offers Muslim consumers the confidence that they consume halal food (Tieman, 2011). Mohamed et al. (2020) found a positive association between halal SCM and halal integrity.

2.1 Halal food supply chain integrity

Food integrity refers to “ensuring that food which is offered for sale or is sold is not only safe and of nature, substance, and quality expected by the purchaser but also captures other aspects of food production, such as the way it has been sourced, procured, and distributed, and being honest about those elements to consumers” (Elliott, 2014, p.84). Manning (2016) introduced four factors that need to be considered in safeguarding integrity that involve product, process,
people, and data integrity. As, in response to competitive pressure, the food SC complexity and length has increased and food companies use global sources and export their products to various regions of the world, food integrity should be considered in the terms of the food SC. Azmi et al. (2019) highlighted halal integrity as one of the objectives of halal SCM. (Ali, Tan, et al., 2017b) proposed raw material, production, service, and information integrity as four dimensions of food SC integrity. Raw material integrity focuses on ensuring that raw materials are safe, pure, and traceable to the origin. Production integrity focuses on ensuring internal and manufacturing integrity, including the integrity of the facilities, management systems, and processes. Service integrity focuses on safeguarding the integrity of the food served is meeting the customers' demand. Finally, information integrity is related to transparency and accuracy of communication between customers and manufacturers. Commonly, manufacturers provide concise information on food descriptions to customers. In this study, three dimensions of food SC integrity, namely, raw material, production, and information integrity were considered and service integrity was excluded as this dimension is more related to restaurants and not food manufacturers.

In the context of halal food, Muslim customers, in addition to food safety, want to ensure that the food products meet Islamic requirements (Yusof et al., 2020; Wilson et al., 2013). Halal food integrity is jeopardised if the followings four situations occur in SC: “a) the presence of a prohibited animal (i.e., pig, boars, swine, carnivorous animals and birds, and animals that have died from natural causes); (b) contamination with blood or najis (filth) (i.e., carrion and dead animals); (c) the presence of intoxicants (alcohol); and (d) the use of the wrong method of slaughter or the wrong blessing” (Tan et al., 2017). Food safety is a part of halal food integrity as according to Islamic law, the food should be pure, good for human consumption, and lawful (Soon et al., 2017). In this study, halal food SC integrity was operationalised by integrating the halal concept with three dimensions of food integrity (raw material, production, and information integrity). Around 400 halal-certifying bodies exist worldwide but there is a lack of globally accepted criteria (Zailani et al., 2017) and, consequently, this has undermined efforts for halal food integrity (Halim and Salleh, 2012). Considering the weakness of halal certifications to ensure halal food integrity, this study proposed SCI as a measure to achieve halal food integrity.
2.2 Supply chain integration

Supply chain integration (SCI) has received increasing attention from scholars and practitioners (Lii and Kuo, 2016; Mora-Monge et al., 2019; and Wiengarten et al., 2016). SCI is defined as “the extent to which SC members work cooperatively together to achieve mutually beneficial outcomes” (Kannan and Tan, 2010, p. 207). The previous studies have shown the importance of SCI in achieving competitive advantages, such as reducing operational costs (Kim and Schoenherr, 2018) and improving product innovation (Wong et al., 2013), and enhancing SC performance (Lu et al., 2018; Yu et al., 2018).

SCI can be collapsed into three components; internal integration (II) and external integration. II denotes to the degree a company are able to structure its procedures, behaviours, and practices into manageable, synchronised, and collaborative processes to achieve the company’s goals and fulfill customer requirements (Huo et al., 2015; Zhao et al., 2011). External integration is further classified into two main dimensions; customer integration (CI) and supplier integration (SI). CI refers to “the extent to which customers and manufacturers coordinate decisions related to inventory level, production planning, demand forecasting, order tracking, and product delivery” (He et al., 2014, p. 261). SI refers to “the extent to which suppliers and manufacturers coordinate decisions related to inventory management, collaborative planning, forecasting, replenishment, and the flows of physical resources” (He et al., 2014). From the perspective of halal food industry, the lack of internal and external integration may prevent a firm from achieving its halal food integrity goal due to the existence of incompatible goals and objectives amongst the SC partners (Ali et al., 2019).

3. Resource-based view theory

The resource-based view (RBV) theory is grounded on resources and capabilities as two drivers of competitive advantage and performance. A resource is considered as the core in the RBV theory due to its main role in providing inputs to the firm’s processes and activities (Barney, 1991), whereas capabilities arise as a result of the firm’s ability in creating value of the process through utilising and combining the resources (Amit and Schoemaker, 1993). The RBV theory suggests that a firm contains resources and some of these resources are called strategic resources that are rare, valuable, and imperfectly imitable, and substitutable (Barney, 1991). Strategic resources may cause heterogeneity amongst firms and result in sustainable competitive advantages. According to SC scholars, internal and external integration with
suppliers and customers can be considered as internal strategic resources that can result in a competitive capability and, consequently, improve firm performance (Barney, 2012; Leuschner et al., 2013). Due to Muslim customers’ calls for food safety and Shariah compliance, and high competition in the industry, halal SC integrity is considered as a valuable competitive capability that may enhance the food quality. As such, according to the RBV theory, internal, customer, and supplier relationships are strategic resources of halal food manufacturers that affect halal food SC integrity as a valuable and rare capability that affects food quality performance.

4. Conceptualisation and hypotheses development

Drawn on the RBV theory and literature, this study has explored SCI in the context of internal integration (II), supplier integration (SI), and customer integration (CI), that have effects on the halal SC integrity dimensions, including halal raw material (RMI), halal production (PI), and information integrity (INFI) which, in turn, will lead to halal food quality performance (QP) as depicted in Figure 1. The hypotheses were developed and explained in the following sub-section.

[Insert Figure 1 about here]

4.1 Internal integration and external integration

Amongst the three types of SCI, II is viewed as a top priority in establishing an effective SCM before extending synchronisation between the supplier and the customer. The capability of a company to integrate with its suppliers and customers depends on the level of its II (Zhao et al., 2011). From the organisational capability perspective, the company that has a high level of integration is capable of interpreting and evaluating new knowledge from customers and suppliers and, consequently, learning from external partners and coordinating with them (Lane et al., 2006). From the information sharing perspective, the firm that already has access to internal systems for sharing information amongst their internal functional units is capable of and has a foundation to link with customers and partners (Zhao et al., 2011). From the strategic cooperation perspective, the interaction amongst employees of different functional departments facilitates the integration with customers and suppliers (Swink et al., 2007). From the working together perspective, internal teamwork may enable a firm to communicate with
its partners and address the SC issues more effectively. Literature have shown that II has a positive relationship with external integration; SI and CI (Horn et al., 2014; Huo, 2012; Rodrigues et al., 2004; Stank et al., 2001; Zhao et al., 2011). Accordingly, the positive effect of II on external integration amongst halal food firms was proposed in this study as follows:

H1. II has a positive effect on (a) SI and (b) CI.

4.2 Internal integration and halal food SC integrity

II smoothen the progress of sharing firms’ aims and enables the utilisation of each functional area’s capabilities (Schoenherr and Swink, 2012; Williams et al., 2013). Additionally, the adoption of other quality management concepts, such as total quality management and lean, is facilitated with II (Zhao et al., 2011). Through II, a firm may ensure that all departments and employees understand the strategic goal of the firm (i.e., food integrity) and have compatible goals and objectives for food integrity (Johnson, 1999). II enhances the visibility of the firm, accuracy of the information flow (Zhang et al., 2018), and the firm’s capability to prevent potential conflicts (Moyano-Fuentes et al., 2016) which, in turn, will enhance the understanding of the firm’s objectives, especially regarding the food integrity. Joint decision-making and planning also enable employees of a company to identify the issues and challenges (Williams et al., 2013) that may enhance the extent of food integrity. Halal integrity is an example of companies’ strategic goals that require inter-departmental collaboration, thus, developing and enhancing II is vital. Donk et al. (2008) have strongly argued that food integrity is closely associated with SCI via three main dimensions, namely, raw materials, production, and information. In light of this, this study hypothesised that:

H2. II has a positive effect on (a) RMI, (b) PI, and (c) INFI.

4.3 Supplier integration and food supply chain integrity

Lee et al. (2007) have suggested that management should focus more on SI and II before integrating downstream with customers. Recently, many product recalls were rooted in the upstream of the SCs (Tse and Tan, 2011). SI can be a beneficial tool to mitigate the risk causing the product recalls by enabling better SC transparency and visibility (Ali et al., 2017; Tse and Tan, 2011). According to Devaraj et al. (2007), SI contributes significantly to operational
performance such as product quality. SI enables suppliers to understand the goals and objectives (i.e., halal food integrity) of the focal firms (Flynn et al., 2010). Through SI, the suppliers can become aware of the buyers’ operational activities and meet their needs (Ralston et al., 2015). Suppliers involvement in companies’ activities such as product development and improvement projects, enabling mutual understanding of the customers’ needs (i.e., halal food integrity) and how to fulfill their needs (Schoenherr and Swink, 2012).

A firm can develop strategic SI by structuring its strategic goals and plans and involving the suppliers in developing and adjusting competitive strategies (Swink et al., 2007; Wong et al., 2011). Developing competitive strategies jointly with suppliers allows a firm to meet its objectives and customer needs by leveraging the suppliers’ capabilities (Schoenherr and Swink, 2012). Literature highlights the significant role played by SI in increasing food integrity (Storoy et al., 2013). This research has attempted to analyse the relationship between SI and performance which was evidenced by Frohlich and Westbrook (2001), Rosenzweig et al. (2003), and Wong et al. (2011) in the context of food integrity and quality. There have been remote cases in which studies did not support the SI effect on quality performance (e.g., Koufteros et al., 2005; Swink et al., 2007). However, in food SCs, quality and integrity parameters are complex to ascertain and the product is not able to be modulated (Grunert, 2005; Tunçer, 2001), therefore getting the production right from the very beginning is crucial where SI plays a bigger role. For that reason, this study hypothesised that:

H3. SI has a positive effect on (a) RMI and b) PI.

4.4 Customer integration and food supply chain integrity

CI involves understanding customers’ needs and wants and tailoring internal activities to meet these requirements (He et al., 2014; Jayaram et al., 2011). Previous operation management literature concerning SCs has shown that relatively less research has concentrated on CI alone, compared to the other two SCI typologies. The importance of CI cannot be disregarded since many researchers have claimed that it is directly related to quality performance, such as product quality and cost of quality (Ali et al., 2017; Tan et al., 2017; Wong et al., 2011). Furthermore, consumers have a strong influence on product development and product offerings, especially from the context of health, diet, religious beliefs, and other sensitive issues (Iranmanesh et al., 2019; Premanandh, 2013). A strategic CI is needed for the food manufacturers as insurance in regaining consumer trust in the aftermath of any scandal or amid speculations that may have
arisen, leading towards significant losses (Marucheck et al., 2011). This argument leads to the
development of the following hypotheses:

**H4.** CI has a positive effect on (a) PI and (b) INFI.

4.5 *Halal food SC integrity and quality performance*

The growing market and limited supply within the halal food industry has led the halal
manufacturers to seek solutions in fulfilling demands (Tan et al., 2017). The promising and
untapped market has led to the extension and global complexity of the halal food SC. The more
complex SC can be the cause and avenue of frauds, mishandlings, and contamination with non-
halal products that can happen at any stage in the SC. The halal-related scandals exemplify that
halal labelling cannot be relied solely upon as a guarantee to the food integrity and quality (Ali
et al., 2017; Fathi et al., 2016). As such, RMI is needed to ensure the halal integrity and safety
of the raw materials and ensure products on the market are reliable of its status quo that meet
the regulations and customers’ needs. Furthermore, PI enables firms to eliminate the risks of
contamination during the production stage (Ali et al., 2017). INFI is needed to enhance
visibility by exchanging the origins, history, and traceability of food products (Trienekens et
al., 2012). Accordingly, this study proposed RMI, PI, INFI as drivers of quality performance,
and the following hypotheses were developed:

**H5.** RMI has a positive effect on QP.

**H6.** PI has a positive effect on QP.

**H7.** INFI has a positive effect on QP.

5. Research methodology

5.1 *Measurement of the constructs*

To measure the constructs of the study, a structured questionnaire was used. The items of the
constructs were adapted from previous studies (as shown in Table 3) in ensuring content
validity. A seven-point Likert scale anchored by “not at all” to “very great extent” was used
in this study.

5.2 *Sample and data collection*

The population of this study consisted of all halal food companies in Malaysia that were
certified by Jabatan Kemajuan Islam Malaysia (JAKIM), the Malaysian halal certification
body. JAKIM and their food standard are recognized all over the world (Latif et al., 2014;
Zailani et al., 2017). This study limits and framed the sample to the companies certified by JAKIM to ensure the respondents have adequate knowledge to answer the questions about halal integrity. From the JAKIM halal directory, approximately 4,200 halal-certified firms listed in the JAKIM halal directory. This study targeted SC managers, production managers, and quality managers as they were directly involved in SCI and food integrity, which made them knowledgeable and experienced to answer the questionnaire items.

The targeted companies were called to obtain the appropriate respondents' information such as names and email addresses. The link of the questionnaire was emailed to 750 randomly selected halal-certified companies, which were followed up by phone calls at one-month intervals. An online survey method is designed for this research to reach a broader and more diversified population at a relatively low cost. In total, this research managed to collect 275 useful responses (36.7 percent response rate). According to Podsakoff et al. (2003), a low response rate may cause non-response bias. It means those who participate in data collection are different from those who do not respond to the questionnaire. To investigate the non-response bias, we compare early and late respondents by running the Mann-Whitney U test on several variables. Table 1 and the p-values (greater than 0.05) indicate the early responses and responses of this research are not statistically different. Therefore, the collected data were not affected by the time of responses, and non-response bias did not cause bias.

[Insert Table 1 about here]

The short questionnaire enables this research to scrutinize the completeness of the feedback form. The majority of the responses were obtained in person, thus reducing the possibility of missing data. For data collected through the online survey, an effort was taken in getting back the responses on the missing data were made through telephone calls. In all, there were 7 cases of missing data (more than 15% of the questionnaire) which led the author to exclude them from further analysis. Nevertheless, the author was unable to track and get the feedback for the 7 cases stipulated above. Otherwise, all the feedbacks were confirmed for completeness. Following Podsakoff et al. (2003) recommendation, this study tested the common method variance (CMV) using Harmann’s one-factor test. The CMV result indicates the value of 36.045 percent, therefore suggesting CMV was not a major concern and not affecting this research validity (Esmailifar et al., 2020; Subramaniam et al., 2019).
The profile of firms is provided in Table 2. According to the descriptive analysis, small-medium enterprises (SMEs) (of less than 200 full-time employees) dominated the study’s respondents (87.3%). Regarding the sales revenue, around 63.6% of the companies’ sales revenues were less than USD 1 million and only 12% were above USD 5 million.

[Insert Table 2 about here]

5.3 Data analysis

To test the hypotheses, the study conducted the partial least squares (PLS) technique using SmartPLS 3.0 software (Ringle et al., 2015). According to Hair et al. (2019) recommendation, the PLS technique was used in this study due to the exploratory nature of the study and also the ability of PLS to test both reflective and formative constructs. Accordingly, the two-step approach: (1) measurement model and, (2) hypotheses testing using a non-parametric bootstrapping technique, was used to test the proposed model of the study (Nikbin et al., 2015; Iranmanesh et al., 2017).

6. Results

6.1 Measurement model evaluation

For the reflective constructs, the convergent validity was assessed by three criteria, namely, each item loading should have been above 0.7 and each construct composite reliability (CR) and average variance extracted (AVE) values should have been greater than 0.7 and 0.5, respectively (Hair et al., 2019). According to the results, all items and constructs met the thresholds and the convergent validity was established. For the formative constructs (Table 3), following Hair et al. (2019) criteria guideline, convergent validity, indicator collinearity, and statistical significance of the indicator weight were investigated. Based on the results, the correlation of the formative constructs and single-item constructs were above 0.7, the variance inflation (VIF) values were less than 3, and all indicators were statistically significant and relevant (Hair et al., 2019).

[Insert Table 3 about here]
Heterotrait-monotrait (HTMT) analysis was used to evaluate the discriminant validity (Henseler et al., 2015; Foroughi et al., 2019; Kim et al., 219). The HTMT values (less than 0.85) are depicted in Table 4 indicating the discriminant validity of all the constructs (Kline, 2015). Also, this research is not suffering from the multicollinearity, where the VIF value of all constructs was below 3 established in Table 5.

[Insert Table 4 about here]
[Insert Table 5 about here]

6.2 Assessment of the structural model

The predictive accuracy of the model was evaluated based on the explained variance portion (Ali et al., 2019; Zailani et al., 2015), and the $R^2$ values were illustrated in Table 3. To test the hypotheses, non-parametric bootstrapping was applied (Wetzels et al., 2009) with 2,000 replications (Min et al., 2013; Zainuddin et al., 2017; Batouei et al., 2019). All the paths were found significant and all the hypothesis is supported (Figure 2 and Table 6).

[Insert Figure 2 about here]
[Insert Table 6 about here]

7. Discussion

The length and complexity of the SC in the current halal food industry have caused food scandals and contamination with non-halal products. The food scandals exposed the vulnerability of the laws, policies, and standards on food safety in ensuring the safety and integrity of halal food. Consequently, the situation has attracted practitioners and scholars to venture into alternatives and supplementary techniques that may mitigate the risks of such scandals to reoccur. In this study, SCI, including II, SI, and CI, were introduced as a strategic source of a halal food company that may have an influence on the halal RMI, PI, and INFI which, in turn, could lead to halal food QP.

The impacts of internal integrity on SI and CI were supported. These results corroborate with the findings of Huo (2012) and Zhao et al. (2011). These results imply that, the more extensive of II in halal food companies, the more extensive of SI and CI can be achieved. As
such, the companies need to pursue II before planning to enhance SI or CI. Furthermore, the results indicate that II has positive direct effects on RMI, PI, and INFI. II is a critical driver of SI and CI that can further enhance halal SC integrity. In other words, halal food companies need to progress from effective II to more extensive SI to achieve halal RMI and PI, whilst progressing to more extensive CI to achieve halal PI and INFI. The significant effect of SI on RMI and PI was consistent with the findings of Frohlich and Westbrook (2001), Rosenzweig et al. (2003), and Wong et al. (2011) who showed the important role of SI to quality performance, which this study evidenced in the context of food integrity and quality.

All three dimensions of SCI had positive effects on PI. These findings were in line with the finding of Donk et al. (2008) who indicated that food integrity is associated with three dimensions of SCI. The magnitude of both the supplier and customer relationships’ effects on production integrity were mostly the same which indicates that halal food companies should equally invest in and notice SI and CI in order to achieve their halal production integrity goals. Although, internal integrity has less effect on production integrity in comparison to the external integration factors, its high effect on both the supplier integrity and CI indicates its critical role in achieving halal production integrity.

The impacts of both II and CI on INFI were significant. These results were consistent with the finding of Donk et al. (2008). As such, in addition to II, the food companies need CI, such as process coordination with customers, communication and information sharing, strategic alliance with customers, and customer relationships, because they directly influence information sharing. In comparison to II, external integration (SI and CI) have higher direct effects on all three dimensions of halal food SC integrity. This can be explained by the stages of SCI as suggested by Stevens (Stevens, 1989). According to this theory, II is a low level of SCI, whereas SI and CI are high levels of integration, in which external partners of the SC are also integrated and, consequently, these two types of integration have more direct effects on firms’ capabilities, in this case, the halal SC integrity.

According to the findings, all three dimensions of halal SC integrity had positive effects on halal food quality performance. The findings were consistent with the results of Ali et al. (2017) who found halal raw material integrity, halal production integrity, and information integrity as being enablers of eliminating the risk of contamination amongst the SC processes. As such, the halal food companies should develop and enhance food traceability, management, and process systems, and communicate properly with customers to achieve higher levels of
halal food safety and quality. Finally, it is important to highlight, SCI may facilitate halal SC integrity and, accordingly, lead to food safety.

8. Theoretical and practical contributions

The findings of this study have both theoretical and practical contributions. From the theoretical perspective, the findings of this study extend the literature on halal food safety by exploring the impacts of SC integrity on quality performance. Specifically, halal raw material integrity, halal production, and information integration have positive significant effects on food quality. Amongst these three dimensions of food SC integrity, halal production plays the most important role. Furthermore, this study extends the literature through investigating the SCI impact on halal food SC integrity. This study found that indicate that halal RMI is not only driven by SI, but is highly dependent on the II itself. Similarly, INFI depending upon both II and CI. In a nutshell, all three SC integrations, namely, II, SI, and CI, play important roles in shaping halal SC integrity.

From a practical perspective, the findings of this study will be useful for managers of halal food companies to mitigate the risks of scandals and contamination amongst SCs. The significant effects of all three dimensions of halal food SC integrity on food quality indicate that food companies should safeguard the integrity in the raw materials, production, and information sharing. It means that the companies should ensure that their raw materials are safe and pure and that the facilities and production process will not cause any contamination, and finally, they must communicate properly with customers and provide a concise food description to customers. To successfully achieve halal food SC integrity, SCI is needed. It is important to highlight, that II is a driver of customer integrity and SI. It means that food companies should establish a sound II prior moving on to external integration. For example, if a weak II resides within a company, such as less teamwork and communication amongst the functional departments or poor internal data integration, it will be a daunting case for the company to work with suppliers and customers. Eventually, achieve halal food SC integrity and food quality will be challenging. As such, II is the initial stage of external integration and food integrity that needs special attention from the managers of food companies. Furthermore, the significant effect of information integrity on quality performance suggests non-certified companies that getting halal certification and sharing it with customers, as a practice of information integrity, can lead to higher food quality performance.
9. Limitations and future studies

Whilst the objectives of the study were successfully addressed in this study and the findings contribute towards the understanding of the relationships amongst SCI, halal food SC integrity, and halal food quality performance, some limitations should be addressed in future studies. Firstly, the study focused on SCI as a strategic resource of food companies, future studies are needed to investigate the impacts of supplier development practices, including supplier monitoring, supplier development, incentives, and supplier collaboration on enhancing the extent of food safety. Furthermore, the data were collected from halal-certified food manufacturers in Malaysia. A future study could test and validated the model used in this study amongst other food manufacturers in different food settings, such as kosher, vegan, and vegetarian, as well as in different countries. Finally, although the findings highlight the critical role of II in achieving external integration and, consequently, food integrity, the factors that may lead to the success of II were not investigated in this study. A future study should unravel the factors that halal food companies should consider to successfully integrate their functional departments throughout the firm.

References


Figure 1. Conceptual Framework
Figure 2. Hypotheses Results Summary Extracted from SmartPLS3.0
### Table 1. Assessing Non-Response Bias

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<th>Comp. Status</th>
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<td>Mann-Whitney U</td>
<td>1150.000</td>
<td>1095.000</td>
</tr>
<tr>
<td>Z</td>
<td>-1.676</td>
<td>-1.122</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.094</td>
<td>.262</td>
</tr>
</tbody>
</table>

### Table 2. Profile of Firms

<table>
<thead>
<tr>
<th>Classification</th>
<th>No. of respondents</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SME</td>
<td>240</td>
<td>87.3</td>
</tr>
<tr>
<td>Large Enterprise</td>
<td>35</td>
<td>12.7</td>
</tr>
<tr>
<td>Total</td>
<td>275</td>
<td>100</td>
</tr>
<tr>
<td>Sales Revenue (in USD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 1m</td>
<td>175</td>
<td>63.6</td>
</tr>
<tr>
<td>1m to 3m</td>
<td>44</td>
<td>16</td>
</tr>
<tr>
<td>3m to 5m</td>
<td>23</td>
<td>8.4</td>
</tr>
<tr>
<td>&gt; 5m</td>
<td>33</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>275</td>
<td>100</td>
</tr>
<tr>
<td>Number of Products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to 4</td>
<td>83</td>
<td>30.2</td>
</tr>
<tr>
<td>5 to 9</td>
<td>105</td>
<td>38</td>
</tr>
<tr>
<td>10 to 15</td>
<td>32</td>
<td>12</td>
</tr>
<tr>
<td>&gt; 15</td>
<td>55</td>
<td>19.8</td>
</tr>
<tr>
<td>Total</td>
<td>275</td>
<td>100</td>
</tr>
</tbody>
</table>

### Table 3. The Results of Measurement Model Evaluation

<table>
<thead>
<tr>
<th>Items</th>
<th>Scale Type</th>
<th>Loadings/Weights</th>
<th>CR</th>
<th>AVE</th>
<th>R²</th>
<th>GMC</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Customer Integration</strong> (Flynn et al., 2010; Swink et al., 2007; Wong et al., 2011)</td>
<td>Reflective</td>
<td>0.909</td>
<td>0.625</td>
<td>0.289</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintain close contacts with our customers</td>
<td></td>
<td>0.722</td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Results of customer satisfaction surveys are shared with all employees</td>
<td></td>
<td>0.862</td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Actively create opportunities for employee–customer interaction</td>
<td></td>
<td>0.821</td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Have a formal “customer satisfaction” programme</td>
<td></td>
<td>0.830</td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Have high level of information sharing (market information)</td>
<td></td>
<td>0.764</td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Share our information (information technologies) with our customers</td>
<td></td>
<td>0.849</td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td><strong>Internal Integration</strong> (Flynn et al., 2010; Narasimhan and Kim, 2002; Wong et al., 2011; Zhao et al., 2011)</td>
<td>Reflective</td>
<td>0.923</td>
<td>0.668</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have high data integrations across functional areas</td>
<td></td>
<td>0.846</td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Have an integrated system across functional areas</td>
<td></td>
<td>0.848</td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Within our plant, we emphasize on information flows among departments (i.e. purchasing, production, sales, quality and distribution department)</td>
<td></td>
<td>0.810</td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Within our plant, we emphasize on physical flows among</td>
<td></td>
<td>0.832</td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>
We involve cross-functional teams in process improvement and NPD We have periodic interdepartmental meetings across functional area

**Table 4. Heterotrait–Monotrait Ratio (HTMT) Test**

<table>
<thead>
<tr>
<th></th>
<th>CI</th>
<th>II</th>
<th>SI</th>
<th>QP</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI</td>
<td>0.595</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>0.781</td>
<td>0.663</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td>0.617</td>
<td>0.337</td>
<td>0.457</td>
<td></td>
</tr>
<tr>
<td>QP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: CI: Customer Integration; II: Internal Integration; SI: Supplier integration; QP: Quality performance

**Table 5. Construct VIF value**

<table>
<thead>
<tr>
<th>Construct</th>
<th>Reflective</th>
<th>Formative</th>
<th>NA</th>
<th>NA</th>
<th>0.334</th>
<th>0.782</th>
<th>NA</th>
<th>NA</th>
<th>0.394</th>
<th>0.793</th>
<th>NA</th>
<th>NA</th>
<th>0.266</th>
<th>0.847</th>
<th>NA</th>
<th>NA</th>
<th>0.867</th>
<th>0.621</th>
<th>0.563</th>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Materials Integrity</td>
<td>Formative</td>
<td>NA</td>
<td>NA</td>
<td>0.334</td>
<td>0.782</td>
<td></td>
<td>NA</td>
<td>NA</td>
<td>0.394</td>
<td>0.793</td>
<td>NA</td>
<td>NA</td>
<td>0.266</td>
<td>0.847</td>
<td>NA</td>
<td>NA</td>
<td>0.867</td>
<td>0.621</td>
<td>0.563</td>
<td>NA</td>
</tr>
<tr>
<td>Production Integrity</td>
<td>Formative</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
<td>1.844</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
<td>NA</td>
<td>NA</td>
<td>1.594</td>
<td></td>
<td>NA</td>
<td>NA</td>
<td>1.857</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information Integrity</td>
<td>Formative</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality Performance</td>
<td>Reflective</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We involve cross-functional teams in process improvement and NPD We have periodic interdepartmental meetings across functional area

Supplier Integration (Flynn et al., 2010; Narasimhan and Kim, 2002; Wong et al., 2011)

We share with our suppliers our quality information
Our suppliers share with us their quality information
Our suppliers share with us their production quality improvement process
We have a high degree of strategic partnership with our suppliers
We have a high degree of joint planning to obtain the quality standard with suppliers
We involve our suppliers in product development process

Notes: CI: Customer Integration; II: Internal Integration; SI: Supplier integration; QP: Quality performance
<table>
<thead>
<tr>
<th>Hypotheses and Relationships</th>
<th>Original Sample</th>
<th>Sample Mean</th>
<th>Standard Deviation</th>
<th>T Statistics</th>
<th>P Values</th>
<th>Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1a II → SI</td>
<td>0.612</td>
<td>0.614</td>
<td>0.046</td>
<td>13.360</td>
<td>0.000</td>
<td>Supported</td>
</tr>
<tr>
<td>H1b II → CI</td>
<td>0.540</td>
<td>0.542</td>
<td>0.047</td>
<td>11.391</td>
<td>0.000</td>
<td>Supported</td>
</tr>
<tr>
<td>H2a II → RMI</td>
<td>0.247</td>
<td>0.247</td>
<td>0.069</td>
<td>3.589</td>
<td>0.000</td>
<td>Supported</td>
</tr>
<tr>
<td>H2b II → PI</td>
<td>0.196</td>
<td>0.191</td>
<td>0.077</td>
<td>2.561</td>
<td>0.010</td>
<td>Supported</td>
</tr>
<tr>
<td>H2c II → INFI</td>
<td>0.229</td>
<td>0.232</td>
<td>0.076</td>
<td>3.002</td>
<td>0.003</td>
<td>Supported</td>
</tr>
<tr>
<td>H3a SI → RMI</td>
<td>0.397</td>
<td>0.400</td>
<td>0.070</td>
<td>5.680</td>
<td>0.000</td>
<td>Supported</td>
</tr>
<tr>
<td>H3b SI → PI</td>
<td>0.192</td>
<td>0.191</td>
<td>0.090</td>
<td>2.123</td>
<td>0.034</td>
<td>Supported</td>
</tr>
<tr>
<td>H4a CI → PI</td>
<td>0.338</td>
<td>0.349</td>
<td>0.091</td>
<td>3.721</td>
<td>0.000</td>
<td>Supported</td>
</tr>
<tr>
<td>H4b CI → INFI</td>
<td>0.360</td>
<td>0.362</td>
<td>0.076</td>
<td>4.739</td>
<td>0.000</td>
<td>Supported</td>
</tr>
<tr>
<td>H5 RMI → QP</td>
<td>0.435</td>
<td>0.433</td>
<td>0.059</td>
<td>7.361</td>
<td>0.000</td>
<td>Supported</td>
</tr>
<tr>
<td>H6 PI → QP</td>
<td>0.212</td>
<td>0.218</td>
<td>0.075</td>
<td>2.840</td>
<td>0.005</td>
<td>Supported</td>
</tr>
<tr>
<td>H7 INFI → QP</td>
<td>0.233</td>
<td>0.232</td>
<td>0.066</td>
<td>3.510</td>
<td>0.000</td>
<td>Supported</td>
</tr>
</tbody>
</table>

Notes: CI: Customer Integration; II: Internal Integration; SI: Supplier integration; QP: Quality performance
Reviewer(s)’ Comments to Author (JIMA-08-2020-0250.R1)

Reviewer(s)’ Comments to Author:
We believe almost all of the changes have been made successfully. The only task not undertaken is consideration/critique of the highly cited papers attached previously. Once this has been done, then the manuscript should be ready for publication.

Thank you. The manuscript was strengthened using the attached articles.