

INTEGRITY IN HALAL FOOD SUPPLY CHAIN TOWARDS THE SOCIETY 5.0

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ABSTRACT – Recent integrity issues related to halal product is alarming. While the literature has introduced Industry 4.0 technologies, the reality in the food industry especially halal related product shows disparity in the contribution of scholars to real-world issue. The disparity between both literature and industry is due to information integration. The issue related to information integration can be solved through Society 5.0 where human and technology are connected through information management, monitoring, and control. Nevertheless, studies related to Society 5.0 are limited and isolated to social and technology area since the concept is still new in the literature. However, the advantages of integrating Industry 4.0 and Society 5.0 are able in ensuring integrity in food supply chain especially related to halal. Thus, the objective of this paper is to propose a model based on Society 5.0 to provide solution to food integrity in the supply chain. This study has undertaken extensive literature review related to Society 5.0 and integrity practices. The outcome of the paper proposed a model that links Society 5.0 and Industry 4.0 technologies to help organisation manage halal food in the supply chain with integrity as its measurements. The model proposed in this study is useful for any organisation to adopt halal supply chain and understand how to implement Industry 4.0 as well as managing information through Society 5.0.

ARTICLE HISTORY

Received: 24-1-2021

Revised: 13-2-2021

Accepted: 15-3-2021

KEYWORDS

Society 5.0,
Industry 4.0,
Halal supply chain,
Integrity,
Food integrity

INTRODUCTION

The dire changes in society and industry nowadays are the results of the aggressive use of information and communication technology (ICT) in most parts of the world. Industry and society must further explore cutting-edge technology and adequate technical know-how (Fernando et al., 2021). New value creation is becoming a central pillar of any industry involved in digital transformation. The "Society 5.0" was introduced by the Japanese Cabinet back in 2015 as the core concept to be adopted by the local society to respond to the global trends in today's world. This way forward concept is known as one of the precise strategies intended to be used for Japan's growth. This concept has similarities with the Industrial Revolution phase of Industry 4.0 that started in Germany, followed by the United States with the Internet Industrial Era and China's efforts on "Made in China 2025 and Smart Cities".

According to Harayama (2017), Society 5.0 was built upon what has been highlighted in Society 4.0 that targeted more on building human-centered society's prosperity. It means that Society 5.0 is not solely the era of industrial modernization, but it also comes together with increased capabilities of technological digitization and societal infrastructures (Fukuda, 2020). However, Keidanren (2016) argued that Society 5.0 contained a more comprehensive mission and vision that looks purely beyond the technologically driven idea because society considers the human-centric society as a whole.

In Society 5.0, it is expected that advanced technologies are used to connect with the people by using all information available to create new business and social chains and to improve society values (Shiroishi et al., 2018). The overflow of information has led to difficulties in analyzing information because it is not appropriately supported by the new technological solutions (Palazzeschi et al., 2018). Thus, Society 5.0 aims to free humans from tiring routine work using modern technologies as a solution and to improve the available information (Higashihara, 2018). Improving available information to achieve Society 5.0 is linked with the supply chain concept, a response to the readiness of Industry 4.0 and demand uncertainty (Fernando et al., 2020).

According to Christopher (2012), supply chain management is the relationship between the upstream and downstream with the suppliers and customers to deliver the best value of money to the customers at the low cost possible and also to the supply chain as a whole. It can be known as a large connection and involved suppliers and customers. A supply chain can be described as a connection through the network that cooperatively working together to control and manage the materials flow from the suppliers to the end-users (Aitken, 1998). Communication and teamwork are two dynamic domains in supply chain competencies (Fernando & Wulansari, 2021). It is also understandable that the food supply chain is different from any other product supply chain because food involved fresh food that is usually prone and vulnerable to changes significantly in terms of quality and the contamination risk throughout the entire process of supply chain management (Yu & Nagurney, 2013). Therefore, exceptional care is needed for the food supply chain to be more resilient and robust in the future. Another issue that has always become a significant concern in Muslim society is the halal supply

chain. The best example is a robust food supply chain which aims to avoid poisonous and contaminated food, and a breach of food integrity is developing and adopting a halal supply chain (Tieman, 2011).

Halal logistics is part of halal supply chain management that involved the process of procurement management, movement from one place to another, storage and material handlings either on livestock or inventory for both non-food or food, documentation flows throughout the organization, and the Shariah general principles compliance (Tieman, 2013). Thus, based on these definitions, food integrity should be taken seriously for both non-food and food materials to prevent any adulteration and food contamination, and finally, ensure the accuracy of information and documentation in the supply chain network. Thus, it can be argued that the management of the halal supply chain will lead to the achievement of Society 5.0.

Nevertheless, the concept of Society 5.0 in the literature is still isolated and not well discussed with halal supply chain or integrity literature (Roblek et al., 2020). Furthermore, due to Society 5.0 being a new concept in the literature, scholars are vastly trying to contribute to several research areas while neglecting to strengthen the definition and measurement of Society 5.0 (Polat & Erkollar, 2020). Nevertheless, evidence in the literature has pointed toward multi-disciplinary studies being conducted, especially in social studies (Fukuda, 2020) but lacking in a particular research area such as supply chain and industry-related studies (Aquilani et al., 2020). The limited empirical evidence contributes to the scarce framework development linking Society 5.0 and supply chain management, especially concerning halal supply chain and integrity. The linkage is the missing piece in achieving multi-performances of supply chain performance and Society 5.0 assimilation.

Hence, this study proposed a model that leads to halal supply chain management and Society 5.0 establishments. This study is significant to the literature as it expands the knowledge of Society 5.0 and integrating the concept with halal supply chain management. Besides, this study proposed an Integrity Framework Model 5.0 to address food integrity, which is crucial to companies and countries. Practically, this study helps companies adopt the Society 5.0 concept to increase integrity in the supply chain whether they are involved in the halal supply chain or in other respects.

LITERATURE REVIEW

According to Hamid (2018), the concept of Society 5.0 was introduced in Japan to establish the super-smart with a high-technology society. The Society 5.0 involved different stages as defined in Table 1 and further simplified in Figure 1 on the evolution phases involved.

Table 1: Multi Stages of Society

Society 1.0	Group of people that are looking and gathering for their existence with nature. It is known as a hunting society.
Society 2.0	Group of people formed on the cultivation of agriculture, increasing their organization and building the nation and called the agricultural society.
Society 3.0	It has promoted advanced industrialization technology that prefers mass production. It is known as an industrial society.
Society 4.0	The group of information societies that realized value-added can be done through connecting intangible assets as information networking.
Society 5.0	The informative society built based on Society 4.0 that aimed for more human-centered societies and people can enjoy a high quality of life by creating new values and solutions to resolve problems that occurred in life.

Society 5.0 aims to gather all of the systems together with the people connected in cyberspace, and the information in physical space is collected and analyzed using artificial intelligence (AI). The analysis results are sent back to humans in various types of methods with the hope to help us in balancing the development of the economy, conserving the environments, and solving the social issues that arise. These thorough analyses used robots to support society in creating new values and be free from any cumbersome on people's daily work.

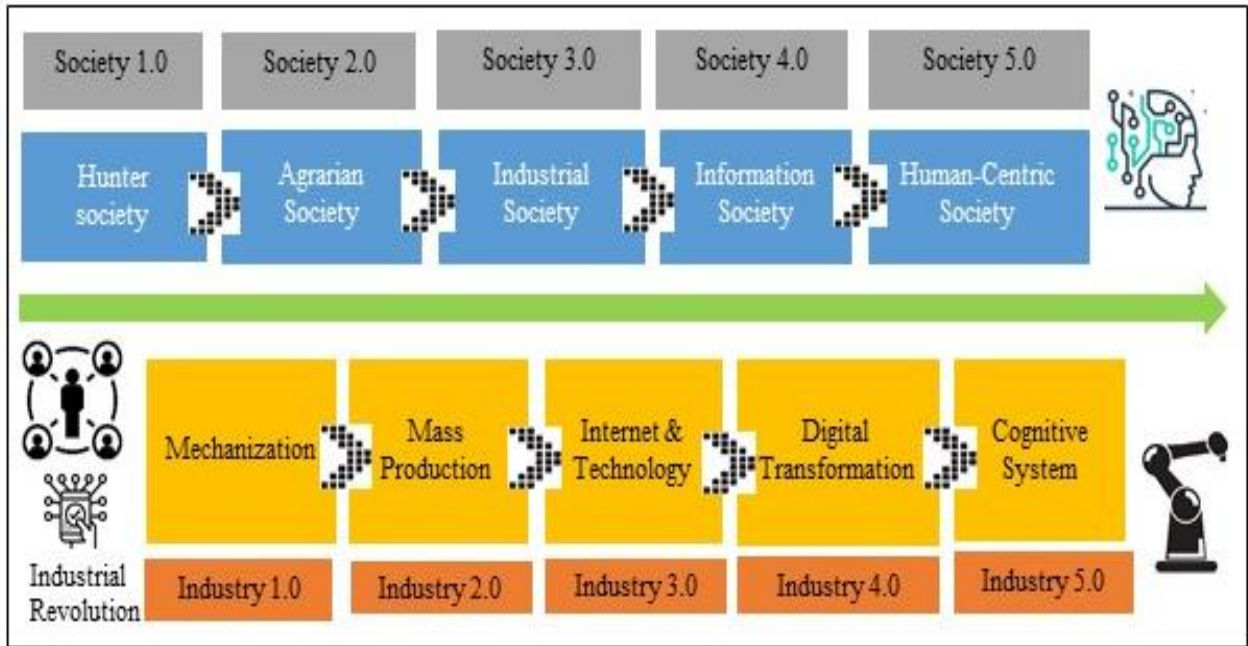


Figure 1: Society and Industry Revolution

Elements of Food Integrity

Deception or cheating in the food supply chain can happen in many ways, such as how the food was produced, who is the person involved or employed in the process, and what data is on the food items. The food fraud was identified based on its categorization, the supply chain fraud catalyst, the systems, and the machines used to trace the fraud itself. To mitigate these issues, the ongoing development of centralizing the data systems to ensure the prevention of food fraud is currently being tackled by inappropriate mechanisms and systems. Fraud is defined as the intentional misrepresentation by one individual or acting in a group to engage and encourage other people to take part with them in return for something with intrinsic value that could benefit oneself or a group of people involved. Manning (2016) has identified four food integrity elements (P3D), such as product integrity, process/distribution integrity, people integrity, and data integrity. These elements are further elaborated in Table 2.

Table 2: Elements of Food Integrity (P3D)

No	Elements of Food Integrity	Examples
1.	Product Integrity	<ul style="list-style-type: none"> Foul or adulteration, fake product, expiration date, product tampering, and simulation
2.	Process/ Distribution Integrity	<ul style="list-style-type: none"> Illicit import, diverting the products to another market, does not meet standards or damage, theft, and distribution.
3.	People Integrity	<ul style="list-style-type: none"> The people characters are professional criminals, opportunists, extremists, cyber criminalists, irrational people, and extortionists.
4.	Data Integrity	<ul style="list-style-type: none"> The health certificates were absent/missing or being a fraud Missing important data on documents The product has been mislabelled The import process has been done in an improper manner

According to Bouzemrak and Marvin (2016), six categories of fraud in food have been identified in Table 3.

Table 3: Categories of food fraud

CATEGORIES OF FOOD FRAUD	
•	Missing or absent health certificates
•	Illegal import
•	Tampering
•	Expired or missing any related documents or declaration of imported goods
•	The expiration dates
•	The food was mislabelled

A CASE OF FOOD SUPPLY CHAIN IN MALAYSIA

According to the Malaysian Investment Development Authority (2019), about 10% of manufacturing output is contributed by the food processing sector in Malaysia. This output contributed approximately about RM21.76 billion to Malaysia's income as it has been exported to more than 200 countries worldwide. In 2019, the imported value for processed food accounted for RM20.27 billion. One of the reasons that contributed to this large income is that Malaysia has used advanced processing technology. It has led to a widened usage of local raw materials, thus expanding the capacity to increase investment and the range of products offered in the food industry. Malaysia's major export destinations were Indonesia, Singapore, Thailand, China, and the USA. However, over the past few decades, Malaysia is still a net importer country that amounted to more than RM36 billion annual imports in 2012. The exported industries involved are further detailed in Table 4.

With the availability of healthy and nourishing food, the quality of life can be improved (Zailani et al., 2010). Food is the catalyst that leads to human well-being, physical fitness, and a healthy mind. Muslims need to eat food that is permissible in Islam and halal according to Islamic guidelines. Halal is not only about how the slaughter process of the animal took place or the use of alcoholism in any food resources, but it also involves the whole standards and processes adhere to it. Halal means justifiable, lawful, and permissible to consume under what has been stipulated under Islamic Law. Halal is all about the safety to consume, cleanliness, reliability and food quality assurance (Phuah et al., 2013).

The supply chain is networking among the organization that works together, domestically or globally to ensure that the flow of material and information are improvised between suppliers and customers at the minimum cost but with the highest speed possible. It is to ensure that customer satisfaction is achieved. The supply chain can be described as the timeline of materials moving from one supplier to the end customer which includes the processes such as purchasing, manufacturing, warehousing, transportation, customer service, and supply planning. These processes will involve people, activities, flow of information, and product movement from supplier to the intended customer.

On the other hand, the halal supply chain involved has almost the same definitions but strengthen with compliance to Shariah elements. Each stage of the halal supply chain will abide by the Shariah Law. For example, the process of producing meat involves the slaughtering of a cow and this process must be conducted by a Muslim that begins the process with the word Bismillah and using a correct equipment such as a knife (Qardhawi, 2001). In a simple understanding, the entire halal supply chain involves the processes and activities that are halal compliant and abide by Shariah laws.

Table 4: Types of Industry

NO	TYPES OF INDUSTRY	EXPLANATION
1	Livestock and dairy poultry	<ul style="list-style-type: none"> 60% of the meat processing industry came from livestock and dairy poultry. Malaysia is still a net importer of meat products, although we are a net exporter of poultry meat. The processed livestock products are using poultry meat as their raw materials.
2	Fisheries	<ul style="list-style-type: none"> This sector has contributed about 2.2 million tonnes of fish in the year 2019. Of that amount, the aquaculture sector alone contributed more than 400,000 tonnes a year.
3	Cereal Products/Flour-based Products	<ul style="list-style-type: none"> The total net export for cereal preparation/products are accounted for more than RM3.5 billion in 2019. The exported products include biscuits, loaves of bread, premixes, instant noodles, frozen cakes, vegetarian food, and pastries. This industry is well established and depends on the raw materials imported from other countries.

NO	TYPES OF INDUSTRY	EXPLANATION
4	Chocolate and Sugar Confectionaries	<ul style="list-style-type: none"> • In 2019, Malaysia's export value for cocoa preparations amounted to RM5.5 billion, and the recorded amount of cocoa grinding capacity was 249,661 tonnes. • This cocoa grinding provides raw materials downstream for further processing to end products. • Malaysia is the 7th largest cocoa grinding country globally and is a net exporter of cocoa products to almost 90 countries across the world.
5	Pepper and Pepper Products	<ul style="list-style-type: none"> • Among the exported products include chocolates. • For pepper and pepper products, the total net export for Malaysia in 2019 has amounted to RM246.6 million. • There are value-added pepper and pepper products including spice mixes and blends, seasonings, and flavourings among Malaysia's exported products.
6	Fruits and Vegetables	<ul style="list-style-type: none"> • There are many types of fresh vegetables and fruits that are produced to meet the demand of domestic and export markets. • In 2019, the value of Malaysia's net import of processed fruits and vegetables amounted to RM2.0 billion. • The potential of the fruit and vegetables processing industry has been recognized and can be one of the import substitution and opportunities to investors.
7	Palm Oil-based Products	<ul style="list-style-type: none"> • As the world's largest exporter and 2nd world largest palm oil producer, Malaysia has accounted for producing more than 84% of the world palm oil output.

Malaysian Investment Development Authority (2019)

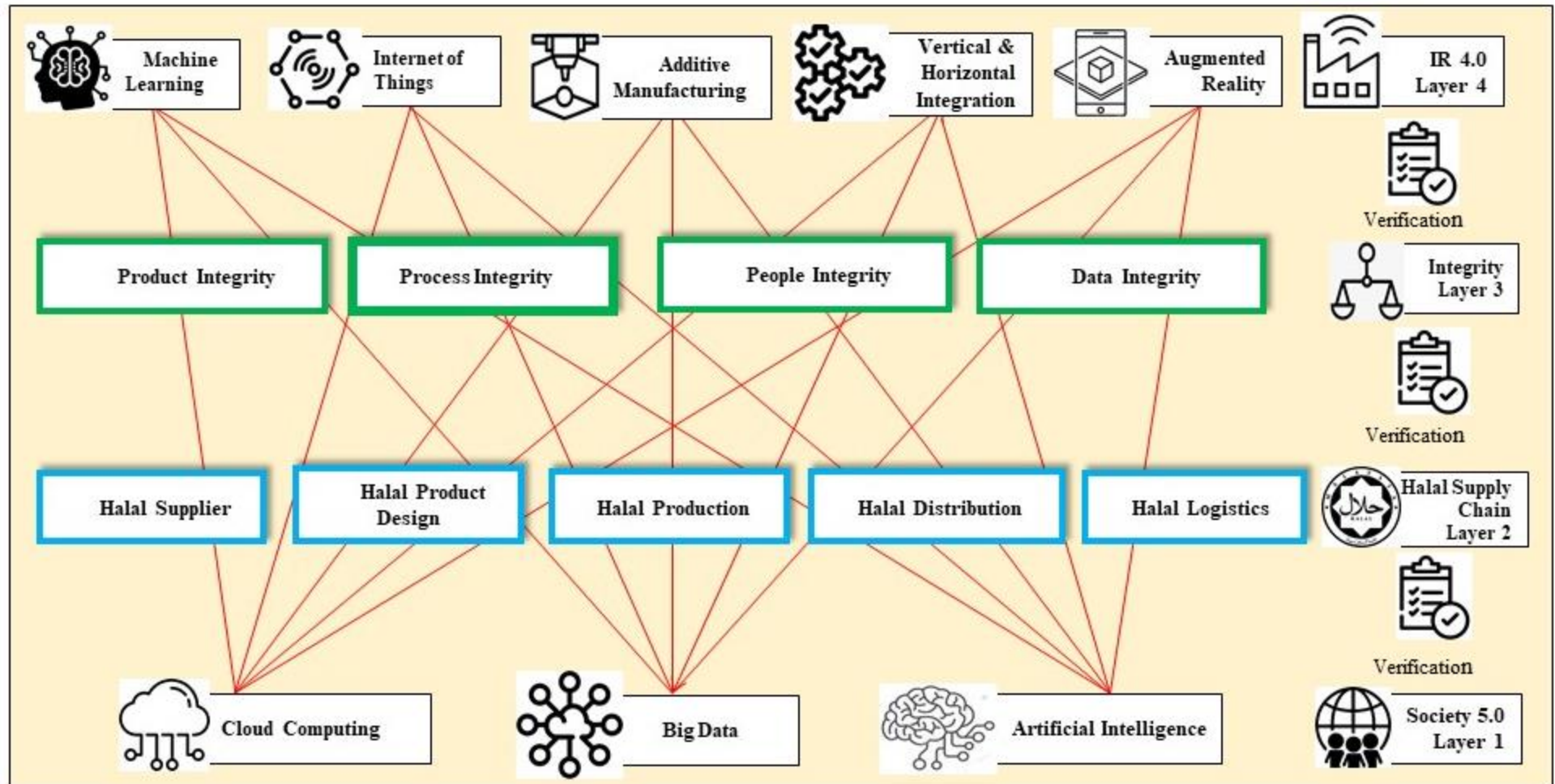


Figure 2: Society 5.0 Halal Supply Chain model

PROPOSED MODEL

Figure 2 shows the proposed model based on the integration of Society 5.0 concept with halal supply chain management. The first layer in the model is for Society 5.0, which serves as the foundation to improve the halal supply chain (Layer 2). The measurements or indicators critical to the organization are underlined in Layer 3 and the integration with Industry 4.0 technology (Layer 4) shows that Society 5.0 and Industry 4.0 are well-integrated and work well together to help the organization achieve its objectives. The model shows that Society 5.0 is human-technology-centric through information management that can help organizations to adopt halal supply chain management. Organizations can manage the integrity of the product, processes, people, and data along with the supply chain process. Thus, this will enable the organization to achieve its objectives in ensuring the product is halal (permissible) and tayyib (clean) right down to the end consumers.

People around the world are looking for quality assurance and safety consumption in the food that they consume. It is due to their changing of eating habits, values, and beliefs. For Muslims, the halal concept is not only limited to ensure the food is halal, but the entire process involved needed to be taken into consideration seriously. The processes involve food packaging, storage of the food, and its delivery which needs proper handling and management so that the halal is assured in accordance with Islamic Law (Sharia compliance).

In the year 2014, Malaysia which is a Muslim-majority country, was shocked by the disclosure news on the Cadbury chocolate milk which was found not halal because it was confirmed that it contained porcine (pig DNA) after the random testing was done by the Ministry of Health on the product itself (Astro-Awani, 2014).

The revelation of the tainted substance offended the Malaysian Muslims. It was noticed that Cadbury's halal certification was not enough to guarantee the trustworthiness of its label. There are questions about how to maintain high standards of quality management across the food supply chain. One issue has led to the discovery of many supply chain issues that shook the Malaysian Muslim consumers. For example, the initial call for frozen meat suspected that the meat was falsified to have halal status by combining non-halal meat with halal-certified meats (New Straits Times, 2020a). Additionally, the number of confirmed food-poisoning cases in institutions rose by 3.2% in relation to the previous year due to the food concerning problems coming from the local market, such as beef, vegetables, fish, and fruits. These examples show the importance of managing the food supply chain as a product can lead to an investigation of materials and production processes, which can impact the companies' performance. The complexity of managing the food supply chain is not the only critical issue here. Unethical companies are finding ways to bypass the stringent health, food safety, and halal regulations. The examples of increasing food poisoning cases have led food and beverage companies to be fined and investigated (The Star, 2020).

It happened due to the food that does not comply with the Food Act 1983 and Food Regulations 1985 (New Straits Times, 2020b), which has been set by the government. Malaysia is globally recognized as a Muslim-majority country, and halal food is the lifeline for all Muslim consumers. These occurrences have proven that the customers are more aware and concerned about the food intake they are having every day in terms of quality and safety, and always looking for transparency and assurance in regards to their food integrity (Manning & Smith, 2015). There are also incidents related to food integrity that occurred in a European country such as the Horsemeat scandals (BBC News, 2013).

Secondly, the government is now strictly governing the food sector with regulations and laws to be followed by all companies. Due to this matter, many companies are aggressively adopting numerous strategies on food safety and quality assurance standards to meet government requirements. There are also other standards that need to be adhered to by the company, such as the International Organization for Standardization (ISO) and Hazard Analysis and Critical Control Point (HACCP). These standards are required for the company to enhance its control in the food supply chain and to be easily traceable. The continuous food incidents and scandals that could deteriorate the health of the consumers has led the government to be strict in implementing the laws and regulations in the country (Maruchek et al., 2011)

Thirdly, as the supply chains are getting more complicated and complex, more players can affect the food integrity because it involved numerous inputs and processes, and have an influence on the outputs (The Guardian, 2014). It is believed that the scandal of horsemeat was initially coming from a slaughterhouse in Romania before the Dutch trader bought it and then move to France for meat processing before manufactured it as an end product and sold to the entire European country (BBC News, 2013). These recent decades have made the entire world experience globalization in almost everything. These long and complex food supply chains could expose the vulnerability and complications that compromise food integrity (Manning, 2016).

The food integrity scandal that occurred recently has shaken the public confidence in the food they consumed every day. Many public communities are concerned about the quality of the products and the safety of the food they consumed (Lupien, 2007). However, the recent scandal of non-halal meat has made the consumers question the food integrity whether the information provided is as precise as what they stated because this will affect their health, safety, religious and cultural requirements. The cases that happened urged the government to quickly tackle the issues and remove the products from the marketplace without hesitation as fast as possible.

It is not easy to ensure if food integrity is applied in today's global food supply chain. It is due to the complexity and the length of the process (Ali et al., 2017). In Malaysia, the mitigation risk process on food quality and the vulnerability of contamination in the food supply chain has been made through the food quality standards introduced by the government such as the ISO, GMP, and HACCP (Van Herck & Swinnen, 2015). This process also comes together with regulations to be followed by all parties involved. The other mechanisms that are widely used to control and ensure integrity are made through proper certification (Farouk et al., 2014).

Ali et al. (2014) further postulated that the purposes of implementation of standards and regulation in ensuring food integrity are not being compromised as follows:

- i. To improve the standards of supplier and their consistency in minimizing product failure
- ii. To avoid and eliminate the frequency of supplier audits, especially during the selection process
- iii. To provide support to consumers and suppliers
- iv. To give accurate information on the food production process mostly when the investigation was carried out on the occurrence of specific food incidents

However, Gotzamani (2005) argued that, although standards and regulations are imposed on all parties involved, that alone cannot guarantee the success of functionality within the network of supply chain or organization, especially when the standards and regulations are only stressed on the production methods instead of regulating the products requirement itself (Polo-Redondo & Cambra-Fierro, 2008). Furthermore, using a standard for the whole process of the supply chain is questionable because only specific standards outlined for a certain part of the supply chain are acceptable and ideal (Trienekens & Zuurbier, 2008).

Advanced Technology in Food Supply Chains

World Economic Forum (2019) has stressed that food plays a crucial role in ensuring the well-being of people in human societies. However, the change is needed to meet the mission to achieve high efficiency, sustainability, nutritious and healthy food. They argued that modern information technology (IT) is critical in food supply chain traceability. The usage of the latest application on advanced information technology is seen to have a significant impact on the food industry and can provide a vast opportunity to everyone. The internet of things (IoT) is deployed in the food supply chain to provide a broader spectrum of transformation and to avoid disruptive technologies from occurring.

Conceptually, Society 5.0 has created new value in the food supply chain with the use of advanced analytical technology tools. These tools are used to analyze and study all the related data and information concerning the food supply trends and market conditions (Hitachi, 2020). Besides, the data that has been gathered can support the food supply chain to become more globalized. With the availability of data, food producers can: (i) adapt to new market conditions, (ii) identify a new market, and (iii) entertain the customers' demand for healthy food and environmentally sustainable products. The easy access to relevant data will identify and cater to the issues on food wastage and produce a more efficient food supply chain among the producers. The integrated system and data information will allow food producers to optimize their food quality, food safety, and food security.

CONCLUSION

Integrity in the supply chain is related to the quality, values, relationship, trusted collaboration, and honesty in managing supply chains. In the supply chain of food, food integrity can be defined as ensuring the food for sale can be safely used not only in the substance of the food itself but also in the expected quality to be offered to the customers. The other aspects of food production related to food integrity are how the procurement is done, what is the distribution process involved and how it is being sourced by the organization involved (Elliott, 2014).

The emerging technologies should not be regarded as an objective only, but also as a powerful mechanism that can provide solutions for Society 5.0 to be materialized to full potential. An effective traceability system of the food industry should be developed in order to cater to the needs of the food supply chain. The advanced system can be used to track and detect the vital information involved in the supply chain processes, and thus, it may reduce the number of non-compliance cases and product failure or withdrawal found by the authorities.

This study has proposed a model based on Society 5.0 and its integration with Industry 4.0 technologies. The model is established to ensure that the organisation can manage its halal supply chain by monitoring, managing, and controlling performance measures such as product, people, process, and data integrity. The model can be used in future studies to explore other multi-disciplinary research related to environmental research (Naina et al., 2019), low carbon supply chain (Mohter & Fernando, 2020), and even human ethical research (Wan-Fauzi, 2020).

Furthermore, future studies can integrate another layer into the framework that is relevant to the industry to enhance the outcome. Similarly, this study has provided an insight for future scholars to integrate organizational theory to improve the model further. In order to do so, scholars can undertake social network analysis and provide empirical evidence.

The properly controlled system may mitigate the negative impact on the growth of the food industry in Malaysia. The proper traceability system developed using advanced technology can also reduce the cost of removing the product out of the market due to its non-compliance with specifications or laws stipulated by the regulator bodies. The level of customer confidence can be boosted because the proper system can prevent product recalls, and non-integrity food supply can be minimized. The halal industry growth will be increased due to the development of the halal food tracking system in Malaysia.

ACKNOWLEDGEMENT

The authors convey their appreciation to the Division of Research & Innovation, Universiti Malaysia Pahang, for funding this study (RDU202703 & UIC201518).

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CONFLICT OF INTEREST

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