

Studies on Technology and Halal Food Security: A Review

Nur Syahidah Jalil, Azah Anir Norman* and Suraya Hamid

*Faculty of Computer Science and Information Technology, Universiti Malaya (UM),
50603 Kuala Lumpur, Malaysia*

ABSTRACT

Food security has an important place in global agenda. The innovation of technology in food security is helpful as the consumers are able to identify or track the inventories, to ensure the product is kept in optimal condition, for example by using RFID technology. The objective of this study is to identify trends related to user behaviour and acceptance of technology in food security. The focus is on the user, technology and food security and how it's related to and affect each other for user acceptance and behaviour. This study adopted Kitchenham's systematic literature review technique. Findings show user acceptance of technology in food security is influenced by the following variables - ease of use, convenience and effectiveness of the technology.

Keywords: Ease of use, food security, halal, technology, user acceptance

INTRODUCTION

Food security is now on the global agenda thanks to World Health Organization (WHO), an international body concerned with food security issues. Food security is important for Muslims as food must be of

halal origins. Technology plays a role here to ensure halal sourced food. The world's population will reach 8.1 billion in 2025 and 9.6 billion in 2050 (The world population situation in 2014). This will affect directly the demand for which may have an impact on food security from the Islamic perspective, the Malaysian government plays a crucial role in ensuring there is adequate halal food and appropriately plan and monitor food supplies, as mentioned by Ishak (2005).

Technology in food security is helpful for the user to identify or track the inventories, such as RFID (Radio Frequency Identification) and barcode technology. Junaini and Abdullah (2008) studied how

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E-mail addresses:

dinul_haq_syeda@yahoo.com (Nur Syahidah Jalil)

azahnorman@um.edu.my (Azah Anir Norman)

suraya_hamid@um.edu.my (Suraya Hamid)

* Corresponding author

camera phone barcode scanning and MMS are used for halal verification, while (Toha, Tajuldin & Rahim, 2012), examined the use of smart handheld budget tracker (RFID) for this purpose. The present study looks at user acceptance of technology to create an effective halal food security framework.

A systematic literature review was conducted based on Kitchenham. The focus was on specific halal stakeholders, namely halal agency, consumer, and entrepreneur. Consumers face problems in identifying halal products while entrepreneurs consider convenience in obtaining halal status for their product or premises. However, obtaining halal certification and recertification is not easy. New technologies can expedite and improve the halal certification process. However, they are not fully utilised or implemented because of lack of user acceptance.

Research Question

The following are the paper's research questions. RQ1: What are the current trends in halal food security? RQ2: What are the purposes of technology in halal food security? RQ3: What socio-technical factors motivate the user to use the technology in food security? RQ4: What are the possible challenges in implementing food security technology? And, RQ5: what types of technology are used in ensuring halal food security?

MATERIALS AND METHODS

This study reviewed 52 selected papers published between 1999 and 2015. Primary

and secondary data was examined based on Bano and Zowghi (2015).

Searching Process

Primary search process. This review is based on the RQ and using keyword for searching process. Boolean search (known as Boolean operator) is used in this review. This searching process use online database, Mendeley searching tools, Google, and journal archives among others.

Secondary search process. The researcher reviewed cited papers on this topic.

Selection Criteria

Keele (2007) mentioned the selection criteria to determine studies which can be included for review. The primary search process is based the title of the paper, abstract, finding and conclusion to filter which paper is relevant to the research area. Selected paper also must be related to the area of information technology / computer science / information systems.

Quality Assessment

Checklists are used in performing a quality assessment (QA) of papers to answer the research questions (Kitchenham et al., 2009). The checklists used for QA are: QA1: Are the aims clearly stated? QA2: Is the methodology is clearly described? QA3: Are the studies reviewed relevant to the topic? QA4: Are the findings of studies adequately described? This question will be evaluated based on scoring Y= 1, P= 0.5 and No = 0. The studies that score below 50% in the total

score of assessment, will be excluded due to inadequate information.

Data Extraction

According to Keele (2007), data extraction is to identify how the information was obtained. Data extraction refers to the research question as guidance and based on details of publications. Context description refers to methodologies, technology used and theory. Finally, the findings, where researchers look into factors that motivate or hinder user involvement, acceptance, and implementation of technology in food security.

Data Analysis

In order to answer the research questions of this paper, 52 papers published between 1999 and 2015 were reviewed after filtering and selection. The RQ2 and RQ5 are answered by reviewing 15 papers and while 16 papers were reviewed to answer RQ3 and RQ4, while, in order to answer RQ1, 21 papers were reviewed. To answer RQ1, the abstract, finding and conclusion of the paper review helped to identify current halal food security trends. Papers related to technologies and halal food securities were prioritised in this literature review. To answer RQ2 and RQ5, selected papers were reviewed by checking the abstract, methodology and finding of the research to identify usage and the purpose of technology in food security. In order to answer RQ3 and RQ4, the conclusion of the selected papers was reviewed together with the abstract, methodology and findings. The researcher

focused on user acceptance and possible hindrances or challenges in food security implementation and usage.

Conducting a Review

Using a Boolean search string, a number of papers were selected based on keywords and later filtered based on selection criteria as outlined in section 3.2. It entailed inclusion and exclusion criteria. A total of 48 papers were selected for the primary search process as discussed in section 3.3. Table 1 shows 52 papers were selected based on selection criteria. A secondary search process was performed and a further seven papers selected. Therefore, a total of 52 papers were reviewed and each selected paper was assigned with study ID (detail of Study ID can be referred to Appendix A). Figure 1 shows the flow of paper selection and review process in this study.

RQ1: After a careful selection process, only 21 papers were selected to be reviewed in this study. To answer RQ1, Backhouse and Mohamad (2014) was referred to in terms of study area. The searching process on halal food security trend is based on the key areas of halal industry in Malaysia. However, in this study, the researcher used key area in the searching process for global level. To answer RQ2 and RQ5, a total of 23503 results were displayed during the key word search. Once selection criteria were done, 15 papers were selected. For RQ3 and RQ4, 17025 papers popped up in keyword search but after a careful selection criteria and quality assessment, only 18 papers were selected.

Consumer, halal agency and entrepreneur are examined. The consumer is the party that consumes the product that has been certified by the halal agency. He or she depends on the halal agency to obtain the halal product and with the technology, it will contribute to the confidence level relating to the halal product. The technology can navigate the inventory from end to end and shows which product is certified by the halal agency. The halal agency is the body that certifies the product as halal. Consumers need systems that are easy, convenient and fast in getting halal product information. For the entrepreneur, they must adhere to all the process and procedures that have been set by the halal agency. In Malaysia, JAKIM

is the Department of Islamic Development Malaysia and act as authority for halal products and procedure. The entrepreneur produces a halal product, which must then go through the halal certification process in order to be certified by the halal agency.

RESULTS

This section discusses how the papers were selected for reviews and their results in relation to the research questions.

Table 1 shows quality evaluation. Table 2 shows food product, additive and ingredient, and lifestyle sectors as the most studied while the services sector is the least. Table 3 shows technology used in halal food security.

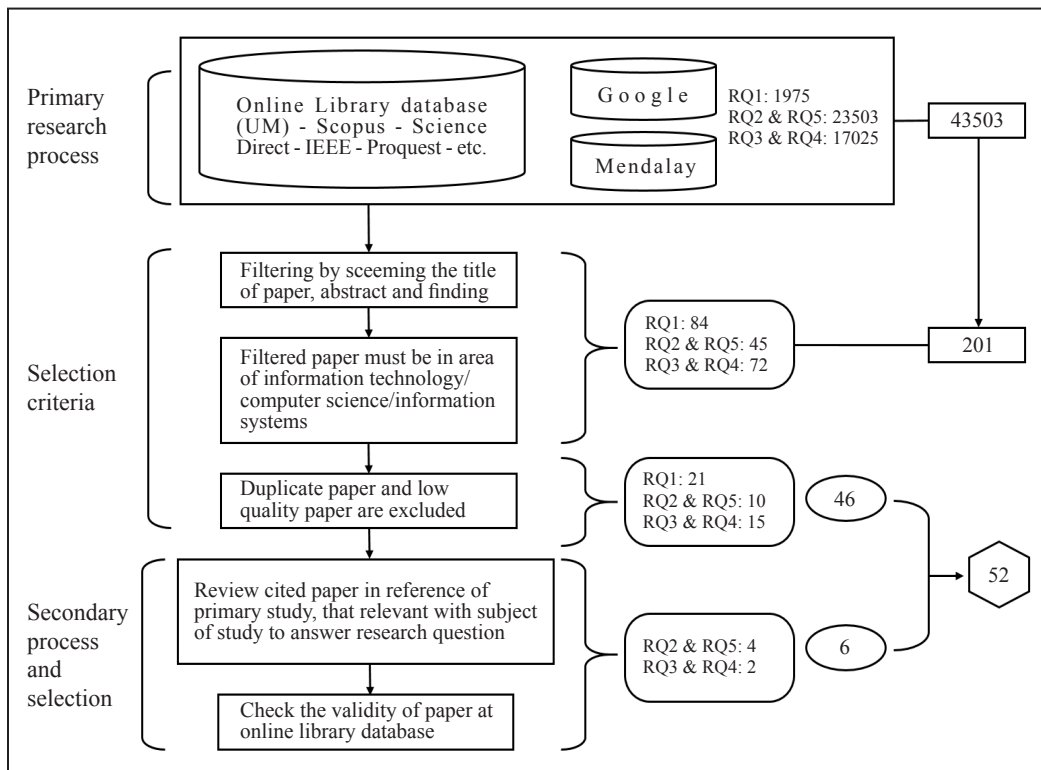


Figure 1. Flow of paper searching process

Table 1
Quality evaluation

Study ID	QA1	QA2	QA3	QA4	Total score	Study ID	QA1	QA2	QA3	QA4	Total score
S1	Y	Y	Y	Y	4	S27	Y	Y	Y	Y	4
S2	Y	P	P	N	2	S28	N	Y	Y	Y	3
S3	Y	Y	Y	Y	4	S29	N	Y	Y	P	2.5
S4	Y	Y	Y	P	3.5	S30	P	Y	Y	P	3
S5	Y	Y	Y	Y	4	S31	P	P	Y	P	2.5
S6	Y	Y	P	N	2.5	S32	N	P	Y	P	2
S7	Y	Y	P	Y	3.5	S33	P	Y	Y	Y	3.5
S8	Y	Y	P	P	3	S34	Y	Y	Y	Y	4
S9	Y	Y	Y	Y	4	S35	Y	Y	Y	Y	4
S10	Y	Y	P	Y	3.5	S36	Y	Y	Y	P	3.5
S11	Y	Y	Y	N	3	S37	Y	Y	Y	Y	4
S12	N	Y	Y	P	2.5	S38	Y	Y	Y	Y	4
S13	N	Y	Y	P	2.5	S39	Y	Y	Y	Y	4
S14	N	P	Y	P	2	S40	Y	Y	Y	Y	4
S15	Y	Y	Y	Y	4	S41	P	Y	Y	Y	3.5
S16	N	P	Y	P	2	S42	Y	Y	P	Y	3.5
S17	Y	Y	Y	Y	4	S43	Y	Y	P	Y	3.5
S18	Y	Y	Y	Y	4	S44	Y	Y	Y	Y	4
S19	N	P	Y	P	2	S45	Y	Y	Y	Y	4
S20	Y	Y	Y	N	3	S46	Y	Y	P	Y	3.5
S21	Y	Y	Y	Y	4	S47	Y	Y	P	Y	3.5
S22	Y	Y	Y	Y	4	S48	Y	Y	P	Y	3.5
S23	Y	Y	Y	P	3.5	S49	Y	Y	Y	Y	4
S24	N	P	Y	P	2	S50	N	Y	P	P	2
S25	Y	P	P	P	2.5	S51	Y	Y	Y	Y	4
S26	Y	Y	Y	Y	4	S52	Y	Y	Y	Y	4

Table 2
Trending of Halal food security

Paper study ID	Year	Author	Food product	Halal Sector			Additive and ingredient
				Pharmaceutical	Life-style	Services	
S1	2013	Wright & Annes (2013)					/
S2	2014	Aziz & Sulaiman (2014)			/		
S3	2014	Zulfakar, Anuar, & Ab Talib (2014)	/				

Table 2 (continue)

Paper study ID	Year	Author	Halal Sector				Additive and ingredient
			Food product	Pharmaceutical	Life-style	Services	
S4	2015	Kumari, Narsaiah, Grewal, & Anurag, (2015)					/
S5	2014	Alphonse, Alfnes, & Sharma (2014)			/		
S6	2012	Nakyinsige, Che Man, Sazili, Zulkifli, & Fatimah (2012)					/
S7	2008 KADIR	Bonne, & Verbeke (2008)					/
S8	2010	Zailani, Arrifin, Abd Wahid, Othman, & Fernando (2010)	/				
S9	2011	Nasir, Norman, Fauzi, & Azmi (2011)	/				
S10	2013	Ulca, Balta, Çağın, & Senyuva (2013)	/				
S11	2012	Nakyinsige, Man, & Sazili (2012)	/				
S12	1999	Little, Gillespie, De Louvois, & Mitchell (1999)	/		/		
S13	2013	Ikram, Rina, Khanapi, Ghani, Samad, & Basari (2013)		/			
S14	2014	Shah, & Yusof (2014)		/			/
S15	2015	Ghani, Ikram, & Basari (2015)		/			
S16	2012	Hunter (2012)		/			
S17	2015	Novianti (2015)			/		
S18	2015	Kadir, Shamsuddin, Rahim, & Rosa (2015)			/		
S19	2013	Farooqui, & Nurullah (2013)				/	
S20	2015	Arif, & Sidek (2015)				/	
S21	2011	Maharom, Hussin, Idrus, Safar, & Zulkifli (2011)					/
total =			6	4	5	2	6

Table 3
Technology in Halal food

Paper study ID	RFID	NFC	E-Nose	Bar-code	QR-code	MMS	GSM	GPS	Inter-net
S22	X								
S23	X								
S24	X								
S25	X								
S26	X								
S8		X							
S27				X		X	X		
S28					X				
S29			X						
S30						X			
S31	X			X	X		X		X
S32	X								
S33	X								
S34	X								
S35	X							X	

DISCUSSION

This section discusses findings based on review of selected papers on technologies related to halal food security to answer the research questions. The focus was to examine user acceptance of the technologies used in food security.

RQ1: What are the current trends in halal food security? Table 2 show trends in halal food security based on 21 papers published between 1999 and 2015. The focus was on five halal sectors: food products, pharmaceutical, lifestyle, services, and additive and ingredient. The first three sectors were the most commonly studied as they affected customers most during the period of study while the services sector was the least popular where only two papers focused on this. Under the food product theme, Nakyinsige, Man and Sazili (2012)

(S11), and Nasir, Norman, Fauzi and Azmi (2011) (S9), focused on halal authentication of the food product, while in lifestyle sector, the focus was on food premises (Novianti, 2015) (S17), and Alphonse, Alfnes and Sharma (2014) (S5). Both focus on halal authentication but using different technologies.

RQ2: What are the purposes of technology in halal food security? Technologies offer many advantages in ensuring hall food security. In Table 3, it can be seen the technologies used in halal food security have different capability and usage. It was found there is a need for better tracking and tracing of halal food. Technology is important to improve monitoring of product quality and save energy in the production process. Technologies used in to track and monitor halal food provide a real-time and

accurate information and for safety purpose, efficiency and cost saving. Based on table 3, the most common technology used is RFID, known as tracking or identification technology, as mentioned by (Juels, 2006). Therefore, it is clear RFID is preferred over other technologies for its utility in tracking halal food.

RQ3: What socio-technical factor motivated the user to use technology in halal food security? A technology is considered successful if it is widely accepted by all the users and its growth is influenced by user involvement. The socio-technical factors that motivated the use technology in food security was examined. Here, socio-technical is the combination and interaction of social and technological factors. Based on the selected papers examined (paper study ID 35 to 53), it was found several factors can boost widespread use of technology in food security, such as ease of use, convenience, efficient, and useful, perceived at the personal and societal level. Public awareness, social influence, and knowledge also play a role in user acceptance of technology.

RQ4: What are the possible challenges in food security technology implementation and usage? To answer this, 18 papers were reviewed (S35 to S52). It was found people are willing to implement the technologies offered in halal food security. However, this is usually associated with large costs for the individual and the organisation, which many may not be able to afford (Tan, Razali, & Husny, 2012) (S35). Therefore, funding is an important consideration in implementing or

adoption of technology. This is aggravated by lack of knowledge and its feasibility, both economically and technically. Insufficient IT support, risk, and uncertainty is the main hindrance of technology implementation and usage by management, provider or consumer.

RQ5: What type of technology is used in food security? The most popular is RFID technology for its use in tracking halal products. Based on 15 selected papers, the most common technologies in halal food security are: Near Field Communication (NFC), watermarking – QR code, E-Nose, Barcode, RFID, Multimedia Message services (MMS), camera, Global Systems for Mobile Communication (GSM), Global Positioning System (GPS) and Internet technology. In terms of consumer concerns related to halal products, RFID is the most advanced technology that has been used to track and trace halal products, especially for halal authentication purposes.

CONCLUSION AND RECOMMENDATION FOR FUTURE STUDY

This paper has identified trends in user acceptance of technologies related to halal food security. It was found food product, additive and ingredients, and lifestyle are the most frequently discussed in the literature on halal sector. The RFID is the most popular technology well known for tracking purpose. Knowledge, awareness and technical aspects are the important factors when implementing technologies in halal food security. Therefore, this

study had contributed to understanding the current trend in research and the research gap in halal food security. There is only a small number of studies that looked at the application of RFID technology in halal sector. Therefore, it is hoped future studies can address this.

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APPENDIX A

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S4	Kumari, L., Narsaiah, K., Grewal, M. K., & Anurag, R. K. (2015). Application of RFID in agri-food sector. <i>Trends in Food Science & Technology</i> , 43(2), 144-161.
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