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HALAL RISK PRIORITY IN FOOD SUPPLY CHAIN MANAJEMEN BASED ON A TECHNOLOGY PERSPECTIVE

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Halal is a main requirement for Muslims in food selection. On the other hand, the increasing Muslim population in the world also encourages an increase in the availability of halal food. In its development, driven by technological advances, there is a risk of changes in halal food. These changes can occur in the food supply chain that involves various aspects. This study aims to identify risks based on technological aspects (technoware, humanware, infoware, orgaware). Furthermore, this study also aims to prioritize halal risk using the AHP method. The results showed that the type of transportation, cooperation, shipping schedule and supplier legality are sub criteria that are priority in arranging corrective actions in preventing halal risk.

Keywords: Halal, Risk, Food supply chain

Halal menjadi syarat utama bagi umat Islam dalam pemilihan makanan. Di sisi lain, meningkatnya populasi Muslim di dunia juga mendorong peningkatan ketersediaan makanan halal. Dalam perkembangannya, didorong oleh kemajuan teknologi, ada risiko perubahan makanan halal. Perubahan tersebut dapat terjadi pada rantai pasok pangan yang melibatkan berbagai aspek. Penelitian ini bertujuan untuk mengidentifikasi risiko berdasarkan aspek teknologi (technoware, humanware, infoware, orgaware). Selanjutnya, penelitian ini juga bertujuan untuk memprioritaskan risiko halal dengan menggunakan metode AHP. Hasil penelitian menunjukkan bahwa jenis transportasi, kerjasama, jadwal pengiriman dan legalitas pemasok merupakan sub kriteria yang diprioritaskan dalam menyusun tindakan korektif dalam mencegah risiko halal.

Kata Kunci: Halal, Risk, Food supply chain

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INTRODUCTION

The development of the Muslim population in the world has increased very significantly. It is estimated that the average growth rate reaches 1.5% per year. This percentage is higher when compared to non-Muslim growth, only 0.7% per year (Pew Research Center's Forum on Religion & Public Life). The Muslim population will reach 26.4% of the total world population which is projected to be 8.3 billion in 2030. More than fifty countries are countries with a majority Muslim population. The largest Muslim population lives in Southeast Asia, while the countries in the Middle East and North Africa are only 20% of the total.

The increase in the muslim population is associated with an increase in the need for halal food. This is because halal is a mandatory requirement for Muslims in choosing food consumed. This condition is in accordance with the Qur'an of Surah Al-Maidah 88: "And eat food that is lawful again good than what Allah has blessed you, and fear Allah whom you believe in Him". More than that, at present, the availability of halal food is a necessity for non-Muslims. This phenomenon occurs because non-Muslims view halal as a healthy and safe food consumption trend compared to non-halal food products [1]. This is an opportunity for companies to market halal products to Muslim and non-Muslim consumers [2] [3].

For this reason, currently various Muslim or non-Muslim countries are developing halal guarantee systems. This system aims to provide assurance that food consumed by consumers has met the halal element. In Korea, it is demonstrated through the availability of halal certificates issued by the Korean Muslim Federation (Yonhap News Agency) for all food products. n various countries, institutional system management of halal management has been made.

Table 1. Halal institutions

But, in fact, this opportunity has not been accompanied by a commitment to keep food halal when accepted by end consumers. This can be seen from the occurrence of several changes in food status from halal to non-halal in the supply chain process. Sales of non-halal meat to Muslims by the Birmingham wholesale market, pork content in lamb burgers at Leicester school (halalhmc.org). These events indicate that there is a risk of changing food status from halal to non-halal in some processes, for example in the logistics process, transportation system and storage in warehouses [4]. This problem was triggered because food producers did not fully understand halal risks in the food supply chain. Most producers understand that halal is focused on raw materials that do not contain materials that are prohibited by Islam. Meanwhile, other halal aspects, such as: transportation, distribution, storage have not received attention.

Along with a touch of technology starting from the procurement of raw materials, production processes, and distribution results in increasingly difficult for consumers to ensure the halal of a product. This is triggered by the use of various kinds of additional materials in the production process, distribution system and increasingly complex marketing systems. Basically, the concept of halal in the supply chain is different from the conventional supply chain concept. Halal in the supply chain requires specific and specific policies especially to ensure halal integrity from sources to consumers about supply chain objectives, logistics control systems, supply chain business processes, supply chain resources, and supply chain performance matrices [5]. Halal integration in the supply chain begins with the use of raw materials that are in accordance with the concept of halal, halal processes, such as slaughter, storage and logistics systems that are not contaminated with non-halal products [6].

In its implementation, the success of companies in implementing halal in the supply chain is driven by (1) government support factors in the form of halal industry promotion, halal certification authority, incentives for halal business, and funding for halal research, (2) dedicated assets, which are related to separation of halal and non-halal products during the distribution process, warehousing and other equipment, (3) information technology that can improve performance and efficiency and expand supply chain networks, (4) collaboration relationships, vertically (suppliers) and horizontally (external parties, competitors or non-competitors), (5) halal certification, (6) halal treacibility [7].

In the development of halal in the supply chain [8], it begins with consumer confidence in halal products. That is, consumers buy halal products based only on a sense of trust that the products sold / offered by sellers are halal products. Furthermore, it will develop in the halal direction based on certification of the products being marketed. The complete development (evolution) of halal is as follows:

Table 2. Halal evolution in supply chains

With the development of the concept of halal in the supply chain, the problem of the risk of changing the status of halal to non-halal also began to develop. The more activities in the supply chain process, the higher the chance of halal risk. The following table provides an overview of the various types of halal risk along the supply chain that have been carried out by previous researchers:

Table 3. Halal risk in supply chain**.**

Various types of halal risks that threaten the food supply chain, require every business actor to get preventive measures. Utilization of technology is one solution that can be used. Without technology, there will be difficulties in determining halal status because of the limited ability to identify it [13]. Technology will enable the emergence of the latest innovations related to halal authentication so as to ensure food products are in harmony with the halal principle [14]. Utilization of

technology will help determine the halal of the product effectively and efficiently, especially in the process, especially in the process of authentication and verification, for example in the detection of mixing pig products and their derivatives [15].

This study aims to identify halal risk based on technological aspects and determine risk priorities. The results of the study are expected to be used by business managers as information about insight into halal in the supply chain, then able to arrange strategic steps to avoid or reduce these risks.

METHOD

This study uses AHP (Analytical Hierarchy Process) to determine risk priorities. AHP is AHP is a decision making tool by considering various criteria based on the level of importance [16]. In previous research, AHP has been used to prioritize risks in various contexts. Dong et al [17] have developed the AHP concept to arrange risk priorities based on ordering in the supply chain at telecommunications equipment and service companies. [18] use AHP to compare various kinds of risks in the supply chain in various products with criteria of quality, price, continuity of supply, supplier service, and buyer supplier pathership. [19] use AHP to determine corrective measures to strengthen the risk management system at ports in China, which include: service risk, operational risk, port linkage process risk, and external environmental risk.

This method is used to find the most important criteria for each component of the technology, with the following steps:

- Begin by formulating C = {Cj / j = 1,2, ... n} criteria. Where the scale of comparison (pairwaise comparison) for n criteria arranged in a matrix A (nxn) with aij (i, j = 1,2, ... n) is the weight of each.
- Next, each matrix is normalized to find the relative weight, which is called eigenvactor (w) and is related to eigenvalue (λmak) through the following equation:

$$A_w = \lambda_{max} . W \quad (1)$$

- For answers that are more consistent, the value of mak tends to approach n. Saaty (1980) has developed a consistency index to measure consistency judgment when making comparisons by formulating a consistency index (CI) as:

$$CI = \frac{\lambda_{mak} - n}{(n-1)} \quad (2)$$

- The CI = 0 index reflects "pairwise comparision" of perfect consistent judgment. Then a CR (Consistency Ratio Index) index is developed which is defined as the comparison of CI for a particular judgment with the CI of "random judgment". Saaty has suggested that CRs should be below 10% (0.1) to show that the "value judgment" given is acceptable, and if necessary requires a revision or review.

RESULTS AND DISCUSSION

The case study of this research was conducted on the supply of prawn crackers produced by a company in East Java, Indonesia. The company was founded in 1979 and currently has more than 500 workers. This company is classified as a medium-sized company that is developing. His commitment to implementing halal standards is very strong, as evidenced by the cooperation with the Indonesian Ulema Council (MUI) in implementing the halal concept. The supply chain system in this company is illustrated in the following figure:

Fig 1 Supply chain process

Data collection is performed on experts who have been experimenting in this field. Retrieval of data with questionnaires that use a comparison scale [20] as follows:

Table 5. Scale for pairwaise comparison

The AHP structure model used in this study is as follows:

Fig 2 AHP stucture

The results of the questionnaire obtained are arranged in a comparison matrix. This matrix shows the value of the comparison of the importance level of sub criteria in each technology criteria. The matrix arranged based on the results of the questionnaire is shown in the following table:

Table 6. Comparison matrix between sub criteria

Then weighting is calculated for each sub-criterion for technological criteria. The calculation results are shown in the following figure:

Table 7. Sub-criteria weighting matrix on technoware criteria

Furthermore, calculations are performed to determine the consistency index value (CI) of the technoware as the formula in the previous explanation. The calculation results show the CI value for technoware is 0, then the comparison value is considered consistent. With the same calculation, the priority weighting values for humanware, infoware and orgaware at halal risk are as follows:

Tabel 8. Halal risk weighting

The results of the study as shown in table 6 show that for technoware, the highest weight of halal risk is in the T1 criterion. The highest weight for humanware is in H2

criteria and the highest weight for infoware is in criterion I1. As for the software, the highest weight is in the O1 criteria. The highest weight value in each criterion shows the priority of the risk of halal contamination. For this reason, the highest weight for each technology criterion is the priority of improvement in the preparation of preventive measures.

DISCUSSION

In the techoware criteria, the type of vehicle used by suppliers to deliver raw materials is the highest risk of halal contamination. This happens when raw materials are sent using the same type of vehicle as non-halal products. This condition results in the mixing of halal and non-halal products. Before being used for acceleration, vehicles must be cleaned of unclean, separate transportation systems for halal and non-halal animals (based on animal type or slaughtering process) [4].

In humanware, supplier collaboration capability is a top priority that needs to be considered in halal risk subscriptions. This is related to the ability of suppliers to understand halal requirements for raw materials that will be sent to the company. Entrants must be able to understand the halal requirements in accordance with the halal guarantee system used in order to keep the raw materials halal at the producer. The ability of suppliers to implement halal requirements will determine the occurrence of such contamination. For example, suppliers who do not understand the process of slaughtering animals in a halal manner will result in a change in the status of halal to become halal.

Schedule delivery of supplier raw materials is a top priority in the risk of halal contamination. This condition can occur if the supplier does not have a planned schedule in the shipping process. Without a planned schedule, delivery is not structured. As a result of this, the choice of vehicle type, transport process etc. will be carried out without regard to halal requirements. This condition triggers a mixture of halal and non-halal products.

Supplier legality is the main priority of halal risk on the software criteria. Supplier legality is an institutional halal recognition held by the supplier. Usually halal legality is issued by government institutions that regulate the halal system, for example MUI in Indonesia, Jakim in Malaysia. With the halal certificate at the supplier, the company (consumer) automatically has obtained a guarantee that the product sent is halal. To get the halal certificate, the supplier will be inspected by an institution that handles halal certification. At present, some food companies use halal certificates to select suppliers.

CONCLUSION

Halal is an important aspect for Muslims in choosing food. This is related to the Muslim obligation to eat halal food. On the other hand, currently halal food is also a demand for non-Muslims, because halal food is considered to provide a guarantee of food safety for consumption. Therefore, the development of the halal food industry has experienced rapid progress in recent periods.

To guarantee halal food, technology can be utilized. The development of technology is able to make the early detection of the halal of a product. Technology makes it easy for humans to identify food content for non-halal materials, speeding up the production process (eg halal slaughtering, halal delivery). Technology will speed up the process and keep the product halal in the hands of consumers.

This study uses four technological criteria, namely technoware, humanware, infoware and orgaware. The type of transportation, cooperation, shipping schedule and supplier legality are sub criteria that are priority in arranging corrective actions in preventing halal risk. The technical implications of this research are that it can be used by business players in the food industry to develop improvement strategies to maintain halal products.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Countries	Institution	Standar/ guideline
Indonesia	LPPOM MUI	Halal assurance system
Malaysia	JAKIM	MS1500:2004
Singapura	Majlis Ugama Islam atau Islamic Religious Council Of Singapore	Halal Quality Management System (HalMQ)
Thailand	CICOT	THS24000:2552
Jepang	Japan Halal Assosiation (JHA)	International Halal Alliance
United Arab Emirates	GCC	GSO0933:1998; GSO1931/2009; UAE993:1998
Negara Eropa	CEN	Guidelin on halal definition
Austria	ASI	ONR 14200:2009

Phase Name	Muslim Company	Halal Product	Halal Supply Chain
Characteristic of halal supply chain	Based on trust	Based on local halal standard source is halal certified	Based on complex set of local, regional and international Halal standards International Halal manufacturing and distribution zones
Issues in Halal supply chains	Lack of Halal certification authority Halal integrity concerns on imports	Efficiency of Halal certification Transparency of Halal standard Lack of Halal certified ingredients	Halal standards are not harmonised Lack of certified logistics service providers
Example countries	Many countries in the Middle East, Africa, Asia and Eastern Europe	GCC countries, Indonesia, Singapore, Thailand, the USA, Canada, France, The Netherlands, Australia, New Zealand, Bosnia, the UK	Malaysia and Brunei are in the early stage of phase 3

Author, year	Risk Aspect	Risk Category
Yaacob el al, 2018 [9]	Transportation	Delay risk, opeartional risk, natural hazard, technology adoption risk, halal integrity risk.
Olya et al, 2018 [10]	Product and service	Health risk, physicological risk, enviromental risk, social risk, quality risk, financial risk, time risk
Fujiwara et al, 2018 [11]	Supplier management	Risk consequence, supply risk source, risk driver, risk mitigating strategy,
Handayani et al, 2019 [12]	Halal treaceability system	The addition of prohibited additives, the contamination of the waste of lizards, miceand cockroaches, and the unsuitability of food additives

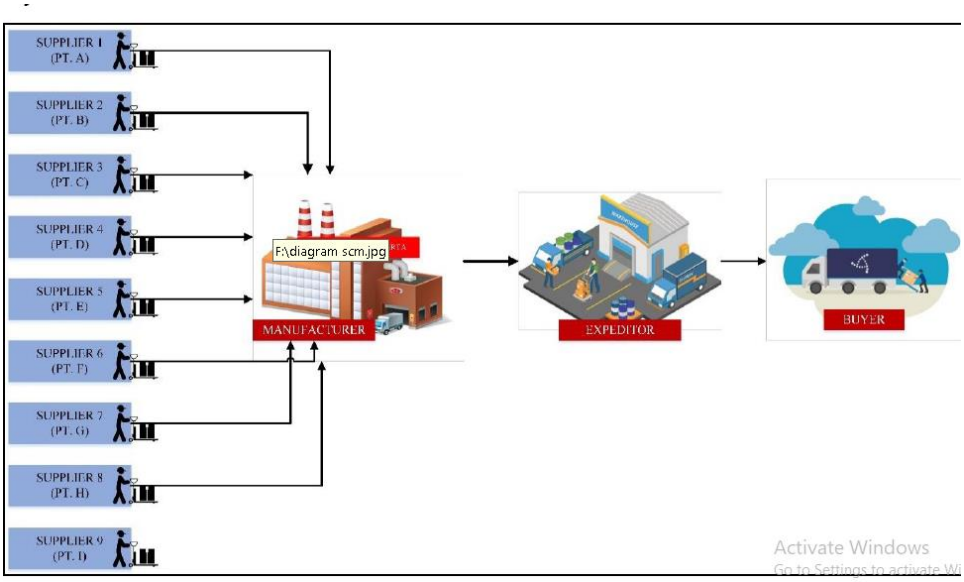
Criteria	Supply Chain	Sub kriteria	Code
Technoware	Supplier	type of transportation	T1
		Equipment for the process of moving raw materials	T2
	Production	machine type	T3
		Maintenance proces	T4
		Inspection process	T5
		Quality process	T6
	Distibutor	Distribution warehouse	T7
		Types of vehicles for distribution	T8
Humanware	Supplier	Dicipline	H1
		Coorperation	H2
	Production	Tim work	H3
		Target orientation	H4
		Leadhership	H5
	Distributor	Distribution plan	H6
		Commitment	H7
Infoware	Supplier	Delivery schedule	I1
	Production	Information system	I2
		Networking	I3
		Decision supplort system	I4
		Communication	I5
		Update information acces	I6
	Distributor	Information system for distribution	I7
Orgaware	Supplier	Supplier legality	O1
	Production	Legality company	O2
		Strategic plan	O3
		Productivity	O4
		company's competitive	O5
	Distributor	Distributor legality	O6

Intensity of important	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one activity over another
5	Strong importance	Experience and judgment strongly favor over another
7	Very strong	An activity is favored very strongly over another; its dominance demonstrated in practice
9	Extreme importance	Theevidencefavoringoneactivityoveranotherisofthehighestpossibleorderofaffirmation
2,4,6,8	For compromise between the above values	Sometimes one needs to interpolate a compromise judgment numerically because there is no good word to describe it

Sub criteria	T1	T2	T3	T4	T5	T6	T7	T8
T1	1.00	2.87	2.60	3.40	5.60	5.40	5.40	1.77
T2	0.35	1.00	1.27	1.64	4.00	4.00	4.24	0.84
T3	0.38	0.79	1.00	2.40	3.40	2.80	5.40	0.89
T4	0.29	0.61	0.42	1.00	2.00	2.80	4.00	1.72
T5	0.18	0.25	0.29	0.50	1.00	1.29	2.07	0.55
T6	0.19	0.31	0.36	0.36	0.78	1.00	2.47	0.93
T7	0.19	0.24	0.19	0.25	0.48	0.40	1.00	0.94
T9	0.56	0.19	1.12	0.58	1.82	1.08	1.06	1.00
Total	3.14	7.26	7.25	10.13	19.09	17.97	25.64	8.64

Sub criteria	T1	T2	T3	T4	T5	T6	T7	T8	Total	Wieght	Eigen value
T1	0.32	0.40	0.36	0.34	0.29	0.30	0.21	0.20	2.42	0.30	8
T2	0.11	0.14	0.18	0.16	0.21	0.18	0.17	0.10	1.24	0.15	8
T3	0.12	0.11	0.14	0.24	0.18	0.16	0.21	0.10	1.25	0.16	8
T4	0.09	0.08	0.06	0.10	0.10	0.16	0.16	0.20	0.95	0.12	8
T5	0.06	0.03	0.04	0.05	0.05	0.07	0.08	0.06	0.45	0.06	8
T6	0.06	0.04	0.05	0.04	0.04	0.06	0.10	0.11	0.49	0.06	8
T7	0.06	0.03	0.03	0.02	0.03	0.02	0.04	0.11	0.34	0.04	8
T9	0.18	0.16	0.16	0.06	0.10	0.06	0.04	0.12	0.87	0.11	8
Total	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	8.00	1.00	64

Criteria	Code	Weigth	Risk Priority	Criteria	Code	Weigth	Risk Priority
Technoware	T1	0.30	1	Infoware	I1	0.30	1
	T2	0.15	3		I2	0.12	3
	T3	0.16	2		I3	0.17	2
	T4	0.12	4		I4	0.11	4
	T5	0.06	6		I5	0.11	5
	T6	0.06	7		I6	0.10	6
	T7	0.04	8		I7	0.09	7
	T8	0.11	5				
Humanware	H1	0.19	2	Orgaware	O1	0.31	1
	H2	0.25	1		O2	0.19	3
	H3	0.14	3		O3	0.20	2
	H4	0.12	4		O4	0.10	5
	H5	0.10	6		O5	0.11	4
	H6	0.11	5		O6	0.09	6
	H7	0.09	7				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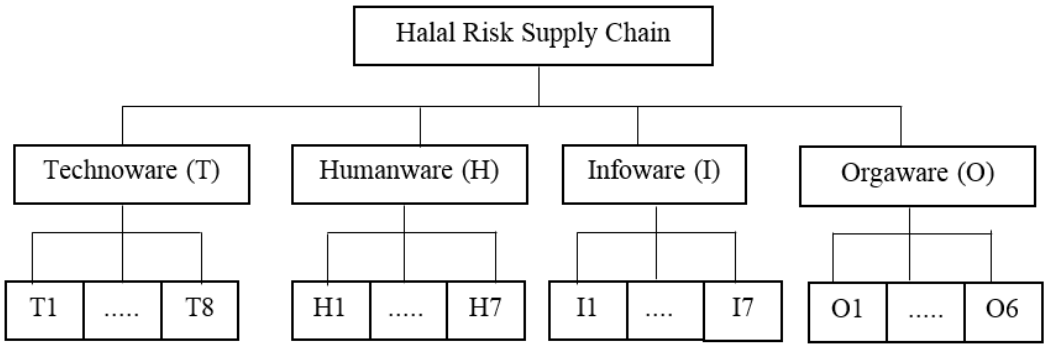
Halal Risk Supply Chain
Technoware (T)
Humanware (H)
Infoware (I)
Orgaware (O)
T1 ..... T8
H1 ..... H7
I1 .... I7
O1 ..... O6