JURNAL ILMIAH TEKNIK INDUSTRI
ISSN: 1412-6869 (Print), ISSN: 2460-4038 (Online)
Journal homepage: http://journals.ums.ac.id/index.php/jiti/index
doi:10.23917/jiti.v20i1.12973

Risk Assessment and Mitigation Strategy in The Halal Food Supply Chain in The Covid-19 Pandemic

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Abstract. *Halal is mandatory for Muslims in choosing food. During the Covid-19 pandemic, there were changes in the food supply chain system, and there was a risk of changing the status of halal to non-halal due to various sources. The research objectives are to identify halal risk activities in the supply chain, determine risk priorities and develop mitigation strategies. A case study was conducted at a fish cracker company in Sidoarjo, East Java. Data processing was performed using the FMEA method. The results showed 26 risky activities in the fish cracker supply chain, consisting of 9 risks from suppliers, 7 risks from processes, and 10 risks from distributors. The highest risk is in the process of sending crackers from the company to the distributor. A mitigation strategy is prepared by involving the government, suppliers, companies, and distributors. The formulation of a mitigation strategy is focused on the aspects of technology, human resources, and infrastructure.*

Keywords: *risk assessment, mitigation strategy, halal, supply chain, pandemic Covid-19*

I. INTRODUCTION

Halal is a mandatory requirement for Muslims in choosing the food they will consume. This mandatory is following the orders of Allah SWT on Al Baqarah: 168-171. Therefore, halal requirements need to be considered and fulfilled by all actors involved in providing food linked in the supply chain. The development of the halal food market has experienced significant growth, estimated at more than one trillion dollars due to an increase in demand from Muslim and non-Muslim communities (Lubis et al., 2016). This growth is driven by the understanding that halal food guarantees quality for non-Muslims because it considers cleanliness, health, and taste (Poniman et al., 2015; Ayyub, 2015).

But in reality, there are several phenomena of incompatibility in the provision of halal food. The counterfeiting of halal logos on food impacts reputation, integrity, and quality, causing consumers to find it difficult to distinguish the authenticity of goods (Bailey et al., 2015; Rahman et al., 2017). Another phenomenon is indicated by the presence of pork content in processed beef products circulated in several supermarkets in Ireland in January 2013 (Food Safety Authority of Ireland, 2016) and the discovery of pork DNA content in halal-labeled chocolate in Malaysia in 2014 (Significance Systems.com, 2016).

This phenomenon shows that there are risks that impact changing the status of food from halal to non-halal. Risks can occur in all activities in the food supply chain, especially during the Covid-19 Pandemic. There have been several changes in the food supply chain activity during this pandemic. Changes are indicated by the shorter flow of the food supply chain due to the use of an online system, the limited mobility of people and goods, and the higher demands of consumers for fast and durable food.

The food supply chain is the entire process, operation, and entity that helps convert raw materials into food ready for consumption by consumers, producers, processors, retailers and agents, the hospitality sector, consumers (consumers) (Dani, 2015). In this supply chain, agricultural and fishery products are used as raw materials to produce food products with higher added value. The supply chain for fresh food

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Submited: 20-12-2020 Revised: 20-05-2021
Accepted: 05-06-2021

types involves many agents to bring products from farmers to the final seller so that policies are needed to obtain an economical supply chain because the relationship between agents in the chain will affect prices (Aysoy et al., 2015).

In the halal context, the halal food supply chain has particular specifications compared to food in general. Halal food supply chain requires specific and specific policies to ensure halal integrity from source to consumer regarding supply chain objectives, logistics control systems, supply chain business processes, supply chain resources, and supply chain performance matrices (Tieman et al., 2012). The integration of halal in the supply chain begins with the use of raw materials in accordance with the concept of halal, halal processes, for example, methods of slaughter, storage, and logistics systems that are not contaminated with non-halal products (Soon et al., 2017). 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 promotion of the halal industry, halal certification authorities, providing incentives for halal businesses, and funding research on halal, (2) dedicated assets, which are related to the 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) collaborative relationships, vertically (suppliers) and horizontally (external parties, competitors or non-competitors), (5) halal certification, (6) halal traceability (Ab Thalib et al., 2015).

In the context of risk, various activities in the food supply chain provide opportunities for changes in halal status to non-halal. Halal is absolute, so if it is contaminated with non-halal materials or activities, the product must be rejected, cannot be reprocessed (Wahyuni et al., 2020). Therefore, to minimize the influence of the Covid-19 pandemic in the food supply chain, several strategic steps need to be taken (Badan Siber dan Sandi Negara, 2020): (a) conducted an assessment of the supply chain that experienced disruption due to the Covid-19 Pandemic, (b) communicating with suppliers who Covid-19 may constrain, (c) identifying other suppliers in anticipation of the primary supplier experiences disruption due to Covid-19, (d) provide information to users/consumers about the limitations that the company has due to Covid-19 and provide information about mitigation.

Based on this description, each company needs to identify risks in every activity in the product supply chain. The risk identification carried out by the company aims to be able to integrate between suppliers (Wiengarten et al. 2016) effectively and to minimize the resulting negative impact through the regulation (management) of suppliers who can provide halal raw materials, have halal certification, and have halal procedures (Ahmad et al. 2017). Moreover, the identification results can be used to measure the level of risk so that risk mitigation priorities can be formulated.

One tool to measure the risk that can be used is FMEA (Failure Mode Effect Analysis). Although, besides FMEA, there are several other methods for measuring risk, for example, Fine Kinnery (Wang et al., 2018), Monte Carlo (Li et al., 2016; Lautenberger, 2017), and Bayesian Network (Sykora et al., 2018; Kwag et al., 2018)). However, in this study, FMEA was chosen because it is a systematic analysis tool to reduce defects at all production levels. The advantages of FMEA in conducting risk analysis compared to other methods are its ability to detect failure and risk values quantitatively. It is a multidisciplinary and structured risk approach to measure the effect of a failure (Liu et al., 2015). For this reason, this research was carried out to identify risky halal activities, knowing risk priorities, and developing halal risk mitigation strategies in the food supply chain.

II. RESEARCH METHOD

This research was conducted at a DB company located in Prambon, Sidoarjo, East Java. This company was founded in 2018 with more than 150 employees, and its main product is fish crackers. The company's production capacity reaches 21 tons per week.

Data were collected using questionnaires,

interviews, and observations on the object of research. Questionnaires and interviews were conducted with employees who are responsible for halal management in the company. The data collection process was carried out in October 2020. The questionnaire given to the halal manager was filled based on the scale.

Data processing in this study was carried out using the FMEA method. FMEA is used to measure the value of halal risk in the fish cracker supply chain to arrange risk priorities. In general, this research was carried out with the flow, as shown in Figure 1.

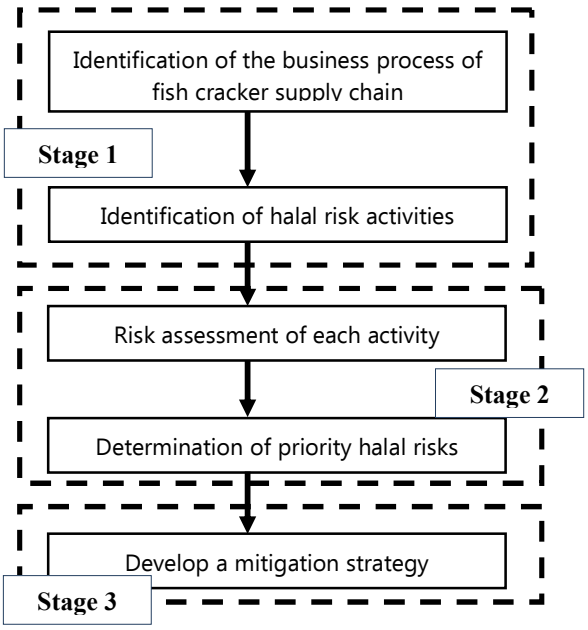

Figure 1. Flow and stages of research

This research was conducted in 3 stages. Stage 1 is the identification of business processes and activities at risk of changing the halal status to non-halal in fish crackers is carried out. Identification is carried out based on parties involved (actors), activities, and the impact of risks.

Stage 2 is the stage of measuring risk with FMEA. At this stage, the FMEA steps used were adopted from the formula developed by Fattahi et al. (2018):

RPN = Occurrence(O) x Severity(S) x Detection(D).

Occurrence **(O)** indicates the probability of failure, severity **(S)** indicates the severity as a result of failure, and detection **(D)** is the predicted probability of failure detection before failure occurs. The O, D, and S ratings can use a scale of 1 for the best case and 10 for the worst case. RPN (Risk Priority Number) value is a number that shows the value of risk. The higher the RPN, the higher the risk faced by an activity. Furthermore, risk priorities will be arranged based on the RPN value.

Stage 3 is the stage for developing a mitigation strategy. SWOT at this stage was carried out regarding the formulation developed by Rocha et al., 2019, which consists of designing a questionnaire/list of questions that will be used to multiply stakeholder perceptions about risk mitigation strategies, determination, and interviews with stakeholders, and data analysis.

III. Result and Discussion

Stage 1

The research process begins by identifying the business processes and risks in the fish cracker supply chain. This identification is carried out to map the parties involved, the activities carried out, the relationships between parties, and the halal risk in each activity in the supply chain. Identification is carried out through observations and interviews with halal managers on the object of research. Each party in this supply chain has a different role and scale of halal risk. The results of the identification of risky activities in the fish cracker supply chain are shown in Table 1.

Table 1 shows that there are 26 risky activities in the supply chain system of fish crackers. There are 9 risky activities attached to the raw material supplier, seven risky activities in the manufacturing process, and 10 risky activities in the distribution / retail system. Furthermore, the risk measurement for these activities will be carried out in Stage 2.

Stage 2

The risk measurement in stage 2 is carried out by the person in charge of activities for each actor in the supply chain. Measurements are made through S, O, and D assessments for each

Table 1. Fish cracker supply chain risky activities

Actor	Risk Event	Code
Suppliers (S)	The risk of fish food comes from non-halal materials	S1
	The risk of sending fish food ingredients mixed with non-halal products without separation	S2
	The risk of the fish food storage system mixing with non-halal products without separation	S3
	Labor risk to suppliers not understanding halal provisions	S4
	Labor risk to suppliers not implementing halal provisions	S5
	Labor risk to suppliers who have not received training on halal	S6
	The risk of means of transportation to send fish to companies is mixed with non-halal products.	S7
	The risk of fish packaging materials at the time of delivery containing non-halal elements	S8
	The risk of fish being mixed with non-halal products at the supplier departure terminal/waiting room	S9
Process (P)	The risk of fish mixing with non-halal products in the company's raw material storage space	P1
	The risk of additional food ingredients for fish crackers containing non-halal elements	P2
	The risk of additional food ingredients mixed with non-halal products in the warehouse for storing materials	P3
	The risk of additional food ingredients mixed with non-halal products during the delivery process	P4
	The risk that company employees do not understand the halal provisions	P5
	The risk of company employees not implementing halal regulations	P6
	The risk that company employees have not received training on halal	P7
Distributor/ Retail (D1)	The risk of mixing crackers with non-halal products at the time of delivery to distributors / retails	D1
	The risk that the cracker packaging material to the distributor contains non-halal elements	D2
	The risk of mixing crackers with non-halal products in the waiting room for the arrival of goods at the distributor	D3
	The risk of crackers mixed with non-halal products when in storage	D4
	The risk of materials for packaging containing non-halal elements in the distributor's warehouse	D5
	The risk of crackers mixed with non-halal products on delivery to retail/retailers	D6
	The risk of crackers mixed with non-halal products in the distributor/retail shelf space	D7
	The risk of employees at distributors/retailers not understanding halal provisions	D8
	The risk of employees at distributors/retail not implementing halal provisions	D9
	The risk that employees at distributors/retail have not received halal training	D10

exercise using a scale of 1-10 (Silva et al., 2014). The risk assessment results are used to determine the risk classification--as shown in Table 2. Based on the assessment with this scale, the value of each risky activity is as in Table 3.

The results in Table 3 show the risk score for each activity in the fish cracker supply chain. Based on these results, it is known that all activities have a potential risk (possible risk). In the table above, it is shown that the value of O is 1 for all risks. This illustrates if the company has never had a change in its halal status to non-halal. This condition demonstrates if all activities in the cracker supply chain have the opportunity to change their halal status to non-halal. This change is driven by mixing crackers with non-

Table 2. Risk score interpretation (Berezutskyi et al., 2015)

Risk Score	Description
>400	Very high risk: Consider stopping the operation process
200-400	High risk: Immediate corrective action is needed
70-200	Substantial risk: Needs improvement
20-70	Possible risk: Need special attention
<20	Risk: There are chances of being accepted

Table 3. Assess the risk of each activity in the fish cracker supply chain

Code	S	O	D	Risk Score	Risk Classification	Impact
S1	9	1	3	27	Possible risk	discarded product
S2	6	1	4	24	Possible risk	discarded product
S3	3	1	9	27	Possible risk	discarded product
S4	5	1	5	25	Possible risk	discarded product
S5	4	1	6	24	Possible risk	discarded product
S6	5	1	6	30	Possible risk	discarded product
S7	3	1	7	21	Possible risk	discarded product
S8	4	1	6	24	Possible risk	discarded product
S9	6	1	4	24	Possible risk	discarded product
P1	6	1	5	30	Possible risk	discarded product
P2	6	1	6	36	Possible risk	discarded product
P3	5	1	6	30	Possible risk	discarded product
P4	7	1	4	28	Possible risk	discarded product
P5	4	1	7	28	Possible risk	discarded product
P6	5	1	6	30	Possible risk	discarded product
P7	6	1	7	42	Possible risk	discarded product
D1	8	1	6	48	Possible risk	discarded product
D2	9	1	3	27	Possible risk	discarded product
D3	9	1	6	54	Possible risk	discarded product
D4	8	1	7	56	Possible risk	discarded product
D5	5	1	7	35	Possible risk	discarded product
D6	9	1	7	63	Possible risk	discarded product
D7	5	1	6	30	Possible risk	discarded product
D8	4	1	8	32	Possible risk	discarded product
D9	4	1	6	24	Possible risk	discarded product
D10	3	1	7	21	Possible risk	discarded product

halal products or by adding additional ingredients that contain crackers. Therefore, if a change in halal status occurs, the product must be discarded and cannot be reprocessed. Disposal of products that have changed their halal status to non-halal is an obligation because halal is absolute.

Next, a risk value ranking is compiled based on Table 2. This ranking arrangement serves to determine risk priorities in determining the mitigation strategy. These priorities need to be arranged so that companies can regulate the use of limited resources. The ranking based on the risk score is shown in Figure 2, Figure 3, and Figure 4.

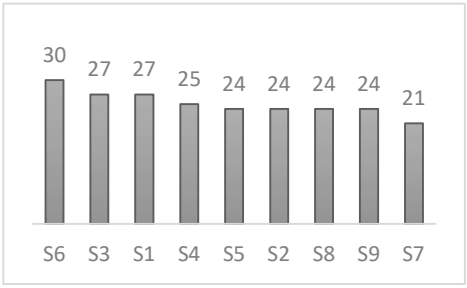

Figure 2. Supplier Risk Priority

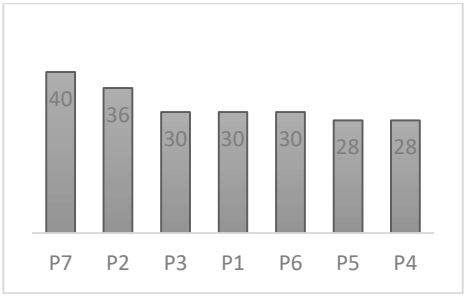

Figure 3. Process Risk Priority

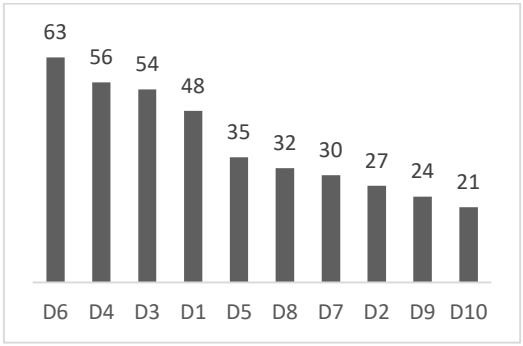

Figure 4. Distributor Risk Priority

Figure 2 shows the priority risks for suppliers. It appears that S6 (Labor risk to suppliers who have not received training on halal) has the highest risk value. In the process (Figure 3), the biggest risk lies in P7 (The risk that company employees have not received training on halal). Whereas for distributors/retail (Figure 4), the highest risk is in D6 (The risk of crackers mixed with non-halal products on delivery to retail/retailers).

In the context of the fish cracker supply chain system that involves suppliers, companies, and distributors/retailers, the risk of changing the status of halal products to non-halal occurs in the delivery process. This can be understood because there are many parties involved in the delivery process, including company employees, drivers, and types of vehicles. In this section, the transportation policy for shipments is carried out in various forms, including with third-party services. Delivery is made by company-owned or distributor-owned vehicles. During the Covid-19 pandemic, differences in policies for entering and leaving different areas resulted in changes to the product distribution system. One of the changes is to add several types of products to the exact vehicle. This is done so that the operational process can be carried out effectively and efficiently. In the mixing process, it is often done without paying attention to the composition of the raw material and its halalness. This condition causes the highest risk to the supply chain in the delivery process. Therefore, to avoid losses due to these risks, it is necessary to take mitigation actions based on actual conditions in the product supply chain system.

Stage 3.

Stage 3 aims to develop a mitigation strategy based on the risk priorities identified in stage 2. Mitigation strategies are needed to avoid the negative impact of risks and increase consumer confidence (Soon et al., 2020). In addition, the implementation of mitigation strategies has a significant effect on the occurrence of risks and company operating costs (Dadsena et al., 2019).

Tabel 4. Risk priority in the fish cracker supply chain

Risk Priority	Risk Code	Risk Priority	Risk Code	Risk Priority	Risk Code
1	D6	11	P3	21	S5
2	D4	12	P6	22	S8
3	D3	13	D7	23	S9
4	D1	14	P4	24	D9
5	P7	15	P5	25	S7
6	P2	16	S1	26	D10
7	D5	17	S3		
8	D8	18	D2		
9	S6	19	S4		
10	P1	20	S2		

Tabel 5. Risk mitigation strategy

Aspect	The parties involved	Mitigation activities
Technology	Government	Formulating policies on the use of technology in the coordination process between parties involved in the supply chain, especially information technology
		Facilitating research and development in the field of technology by providing funds, equipment, and other infrastructure.
		Prepare a policy on technology standardization in the halal supply chain system.
	Supplier	Prepare technology as a means of communication and coordination between suppliers, companies, and distributors/retailers.
	Company	
	Distributor/ retail	
Human Resources	Government	Formulate policies on the standardization of human resource competencies involved in the halal supply chain system
		Facilitating parties involved in the halal supply chain in increasing competence through training, workshops, etc.
	Supplier	Facilitating employees to improve their competence through training, workshops, etc.
	Company	
	Distributor/ retail	Develop a performance evaluation policy based on a risk assessment involving employees
Infrastructure	Government	Formulate the standard of infrastructure used in the halal supply chain system. Build infrastructure that all people can use to maintain halal products.
	Supplier	Prepare facilities and infrastructure used in the halal supply chain system according to government regulations.
	Company	
	Distributor/ retail	

To reduce the risk of changing the status of halal to non-halal in the fish cracker supply chain during this pandemic, it is necessary to involve several parties to coordinate with each other. The government, suppliers, company management, distribution system managers, and retail owners are the parties that need to coordinate to reduce halal risk. In addition, for the efficiency and effectiveness of implementing the mitigation strategy, some strengthening is required in technology, human resources, infrastructure, and policies. At this stage, the halal risk mitigation strategy based on the identification of activities and risk priorities is shown in Table 5.

Mitigation activities require resources and investment from all parties involved. Therefore, mitigation activities must be following the type of product, supply area, distribution system, etc.

IV. CONCLUSION

This study indicates that there is a risk of changing the status of the product (fish crackers) from halal to non-halal. These changes can occur along the fish cracker supply chain. The identification results in the fish cracker supply chain show that three actors play a role in the process, namely suppliers, processes, and distributors/retail. Every actor has a risk of changing their halal status. For suppliers, there are 9 risks, 7 risks to the process, and 10 risks to the distributor. In total, there are 26 halal risk activities.

The results of the risk assessment show that all activities are included in the category of possible risk. This means that the risk of changing the status from halal to non-halal can occur along the supply chain. The risk priority that needs to be mitigated at suppliers and processes is employees

who have never attended halal training. Meanwhile, for distributor actors, the preference for risk mitigation is sending products to distributors. This delivery process is also a top priority that needs improvement in the fish cracker supply chain. Products that have changed to non-halal must be discarded. They cannot be reprocessed. Halal is absolute.

The risk priority is used to determine the mitigation strategy by involving several parties: government, suppliers, companies, and distributors. The mitigation strategy is prepared based on the technological aspects, human resources, and infrastructure used in the fish cracker supply chain.

Research development can be carried out in the process of determining the ranking of mitigation strategies. The ranking of mitigation strategies can be done using a weighting method to describe the level of importance.

ACKNOWLEDGMENT

On this occasion, we would like to thank the Universitas Muhammadiyah Sidoarjo for facilitating funding and other research facilities through the 2020 research institution grant.

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