Analysis of Halal Supply Chain in Chicken Meat Products using Human Error Perspective

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Abstract

One of the livestock commodities that have high potential in Indonesia is broiler chicken. According to the Bureau of Statistics, the consumption rate per capita/ year of broiler chicken meat for Indonesians in 2017 was 5.68 kg, an increase of 573 grams (11.2%) compared to the previous year's consumption. From preliminary observations, it is known that there are managers of chicken slaughterhouses who do not know exactly how to slaughter chicken according to Sharia principles. Chicken meat which is a halal substance may turn out to be non-halal for consumption if the handling process is not following the Sharia principle. The cause of non-halal can be due to improper processes or human error. This cause can be traced from the chickens sourced from the farm, the slaughtering process at the slaughterhouses, to the delivery process. To be able to minimize risk, chicken slaughtering is required to further improve its performance, one of which is through its supply chain management. The role of humans in the supply chain still has vital value. In this study, human errors were identified in the supply chain of halal chicken meat products by adopting the SCOR model, namely plan, source, make, deliver, and return. The results showed the types of human errors that occurred in the supply chain of halal chicken meat, probability error, critical level, and improvement strategy.

Keywords
Chicken meat product, human error, halal supply chain, SCOR Model

1. Introduction

Protein is needed by the body because protein functions as a building block and regulates body functions. Chicken meat is a food source of animal protein and contains essential amino acids that are needed by the body. Essential amino acids are obtained from food because they cannot be produced by the body itself (Aisyah and Hiola 2017).

According to the Bureau of Statistics (2018), the per capita/ year consumption rate of purebred chicken meat for Indonesians in 2017 was 5.68 kg, an increase of 573 grams (11.2%) compared to the previous year's consumption. Meanwhile, the consumption of free-range chicken meat was 782 grams per capita/year, an increase of 156 grams (24.9%) from the previous year.

Amid the need for meat, especially chicken meat, the slaughtering business is increasingly dominant because of the profitable strategy and simple process. The results of field observations in several chicken slaughter businesses, it was found that there were still many breeders and traders who did not understand the concept of halal, lack of information on halal certification procedures, and so on. So that many of them do not know for sure the misfortune

that may occur starting from livestock, slaughtering procedures according to Islamic law to the delivery process. The halal production process is defined by each series of activities to ensure the halal of products containing ingredients, processing, storage, packaging, distribution, sale, and presentation of products. Products that are said to be halal indicate that the products produced from a series are halal from beginning to end (Ali 2016).

In an industrial process, every activity has the potential to experience errors. This error can be in the form of a system error or a human error. System error is an error caused by the system controlling the process and if it is corrected, the error will not appear again. Unlike human error, humans can be told the correct procedure and understand the procedure, but due to a complex system, something that should be done correctly cannot be done properly (Rahmania et al. 2013).

The Systematic Human Error Reduction and Prediction Approach (SHERPA) was developed by Embrey as a structured technique for predicting human errors as well as analyzing tasks and identifying potential solutions to errors. This technique is based on the human error taxonomy (Neville et al. 2005). Human error in the batik industry using the SHERPA method has been researched by Wahyuni et al (2020) and the identification of human error on the halal of bread products was researched by Wahyuni et al (2020) in the same year.

The concept of supply chain management (SCM) is a concept that sees all elements of activity as integrated parts. If the raw material provider (upstream) integrates with the manufacturer and the downstream in the process of product distribution and marketing, SCM can also be said to be a series of approaches that are applied to efficiently integrate suppliers, entrepreneurs, storage places so that the products produced and distributed are of good quality at the right time.

The halal supply chain is a series of processes starting from the source of supply until the product arrives at the customer, which must be guaranteed it's halal. The halal chicken supply chain will start from the chicken farm and slaughterhouse, and then the chicken meat is transported and stored before it reaches customers. Halal is not only applied to products or food but also to all activities in the supply chain which include product handling and management (inventory management and material handling). According to Zulfakar et. al (2014) all components in the supply chain, from upstream to downstream, must have individual and integrated responsibilities to protect halal food products from being cross-contaminated, either intentionally or accidentally (Ma'Rifat and Rahmawan 2017). In the chicken supply chain, risks can be in the form of integration of food risk and halal risk (Wahyuni et al. 2020). Several things become a critical point in the halal chicken supply chain starting from livestock, namely halal certificate of livestock, animal welfare, then in the agent sector, namely transportation, then in the chicken slaughter business sector, namely slaughter tools, slaughter methods, butcher, after treatment slaughter, used prayer, and storage (Anwar 2017).

In this study, the identification of a human error in the supply chain of halal chicken meat was carried out using the SCOR model approach and human error analysis using SHERPA.

2. Methods

This research was conducted in 3 chicken slaughtering businesses. The objects observed were the activities in the halal chicken supply chain, especially in the production section. The data collected and used in this study is human error data in chicken slaughtering with the adoption of the SCOR (Supply Chain Operations Reference) model, namely plan, source, make, deliver, and return obtained through observation and interviews. Furthermore, the analysis was carried out using SHERPA. The data processing steps use the SHERPA method, namely:

1. Hierarchical Task Analysis (HTA): compile a list of jobs in a hierarchical form
2. Job classification: classifies work into five error categories, namely category A (Action), R (Retrieval), C (Checking), S (Selection), and I (Information)
3. Identification of a human error
   Human Error Identification (HEI) is carried out by compiling a list of jobs that have been classified into several types of errors in the previous stage. The error action categories based on the SHERPA method are as follows:
   A1: Operation too long / fast
   A2: The wrong act of dividing time
   A3: Actions in the wrong order

A4: Too little / too much action
A5: Incompatible action
A6: Correct action but on the wrong object
A7: Wrong action but on the right object
A8: Actions are negated
A9: Incomplete action
A10: Wrong action on the wrong object
C1: Examination is nullified
C2: Incomplete examination
C3: Exact check but on the wrong object
C4: Incorrect checks but on the right object
C5: An incorrect check-in dividing the time
C6: Incorrect check on the wrong object
R1: Information obtained accordingly
R2: The information obtained is incorrect
R3: Information receipt is incomplete
11: Information not conveyed
12: Information is conveyed incorrectly
13: Information submission is incomplete
S1: Selection is nullified
S2: Wrong in choosing

4. Consequence analysis: compiling a list of consequences, both for humans, machines, equipment, environment, and work systems, in the event of a human error
5. Recovery analysis: what you can do to fix the error
6. The ordinal error probability assessment is divided into three categories, namely:
   - Low ordinal probability (L), error percentage 0-30%
   - Medium ordinal probability (M), error percentage 31-60%
   - High ordinal probability (H), the percentage of error is 61-100%
7. Critical level analysis
   The consequence of the error is critical if it can cause large losses (in this case it cause not halal) and is given an exclamation mark (!). If the error is not critical, it is given a dash (-).
8. Strategies for correcting errors: developing a repair strategy and actions that need to be taken to reduce and correct errors.

3. Results and Discussion

3.1 Supply Chain Flow Pattern of Halal Chicken

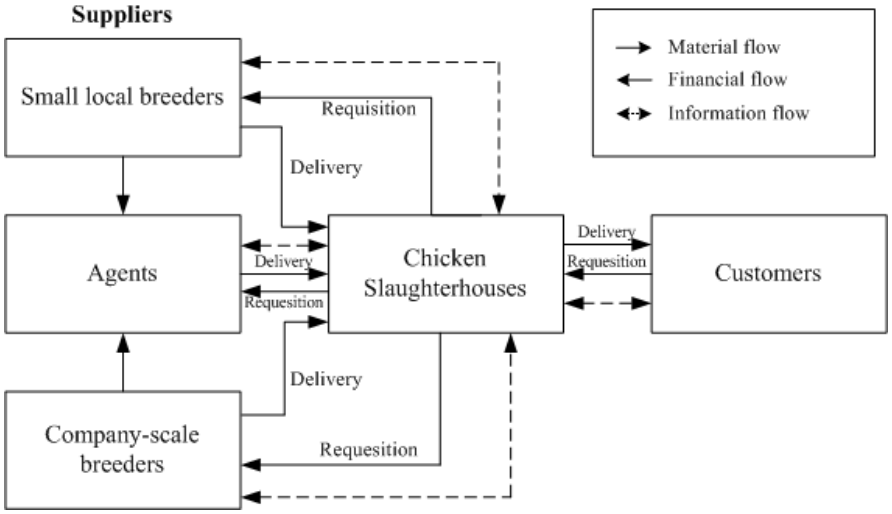

Figure 1 Mapping of Chicken Meat Supply Chain Flow Patterns

This observation was carried out at several chicken slaughterhouses located in Medan and its surroundings. The chicken meat supply chain model can be seen in Figure 1.

The flow of the supply chain starts from the supplier of chicken raw materials. All raw materials will be accepted for processing by the chicken slaughterhouse. If the production target or demand for chicken meat products exceeds the raw material capacity, the company will order and buy back the raw materials from suppliers. The purchase price for raw materials is determined based on an agreement between the chicken slaughterhouse business and the raw material supplier. Supply chain activities using the SCOR approach can be seen in Table 1.

Table 1. Chicken Meat Supply Chain Activities using the SCOR Approach

No	Process	Sub Process
1	Plan	The selection of supplier
		Production planning
		Inventory planning
		Product delivery planning
2	Source	Purchase requisition
		Acceptance of chickens
		Chicken storing
3	Make	Antemortem check
		pre-slaughter handling
		Slaughtering process
		Blood draining
		Pre-boiling
		Feather plucking
		Innard removing
		Carcass cleaning
4	Deliver	Customer addresses checking
		Determining delivery courier
5	Return	Return of defective goods to the supplier
		Replacement of defect product to the customer
		Replacement duration

From the five basic processes of the SCOR approach, there are 20 sub-processes in the chicken meat supply chain. In each sub-process will identify potential human errors that may occur.

3.2 Identification of Human Error in the Supply Chain of Halal Chicken by Adopting the SCOR Model

The human error identification model resulting from the adoption of the SCOR model makes it easy to identify the types of errors based on the sub-process classification in the supply chain. This classification will help the chicken slaughter business manage human error more specifically, systematically, and effectively. Activities that critically affect halal are given an exclamation mark (!), While activities that are not critical are given a dash (-). Activities that affect halal means that these activities can affect the halal status of the product (the product becomes non-halal). The potential for human error in the chicken meat supply chain can be seen in Table 2.

Table 2. Human Error Potential in Chicken Meat Supply Chain

No	Process	Work Description	Description of Error	Halal Critical Point
1	Plan	The selection of supplier	The mistake of choosing a supplier that does not have a halal certificate	!

Table 2. Human Error Potential in Chicken Meat Supply Chain

No	Process	Work Description	Description of Error	Halal Critical Point
			The mistake of choosing a supplier that is not able to meet the demand	-
		Production planning	Communication errors related to the number of products to be produced	-
			Error in calculating customer demand	-
		Inventory planning	Error in checking inventory	-
			Error in calculating the shortage of orders	-
		Product delivery planning	The mistake of choosing the appropriate transportation	!
2	Source	Purchase requisition	Error calculating the number of chickens ordered	-
		Acceptance of chickens	Error in counting the number of chickens received	-
			Error in checking the health condition of chickens	!
			Error in recording the chicken	-
		Chicken storing	Error checking the chicken in storage	-
			Record error in storage	-
			Incorrect placement of chickens in storage	-
3	Make	Antemortem check	Error/ omission to check antemortem	!
			Error establishing the antemortem check procedure	!
			Error selecting competent personnel in antemortem check	-
			Error placement if the chicken is declared sick	-
		pre-slaughter handling	Mistake in determining the position of the chicken so that the halal slaughter process is easy to do	!
			Errors in determining officers who have adequate skills	!
		Slaughtering process	The error in determining the slaughterer must be following fiqh	!
			Error in ensuring that the chicken is still alive when it is slaughtered	!
			The mistake of separating chickens if they are found dead before slaughter	-
			The mistake of the slaughterer is not saying basmallah at the time of slaughtering	!
			The slaughterer's mistake in cutting 3 channels in the chicken neck	!
			Mistakes in choosing a slaughtering tool	!
		Blood draining	Error checking the blood has come out until it runs out	!
		pre-boiling	Error putting in chickens into the container	-
			Error checking the condition of the chicken is dead before putting it in hot water	!

Table 2. Human Error Potential in Chicken Meat Supply Chain

No	Process	Work Description	Description of Error	Halal Critical Point
		Feather plucking	Error in entering the number of chickens into the feather plucker machine	-
			Mistakes in ensuring that the feather plucking process is thorough	-
		Innard removing	Errors in removing innards	-
		Carcass cleaning	Error in ensuring that the chicken is still hygienic	-
4	Deliver	Customer addresses checking	Customer address writing error	-
		Determining delivery courier	Error in choosing a delivery courier	!
5	Return	Return of defective goods to the supplier	Errors in determining the criteria for return to the supplier	-
		Replacement of defect product to the customer	Errors in determining the criteria for return from customers	-
		Replacement duration	Error in return time	-

From Table 2, it can be seen that 15 potential critical errors can affect the halal of chicken meat, while 23 other potential errors do not directly affect the halal of the chicken meat produced.

3.3 Human Error Analysis on Halal Chicken Supply Chain Using the SHERPA Method

This process begins with work activity analysis using Hierarchical Task Analysis (HTA) or in other words, HTA is the input of SHERPA actions. The hierarchical structure of the analysis describes activities in greater detail. The analysis begins with the overall objectives of the task which are then broken down into subordinate goals. By decomposing tasks into a hierarchy of operations and sub-operations, it is hoped that it can identify the people and stages of the task that are prone to errors so that solutions can be proposed that can reduce these errors. HTA for the Halal chicken supply chain is shown in Figure 2.

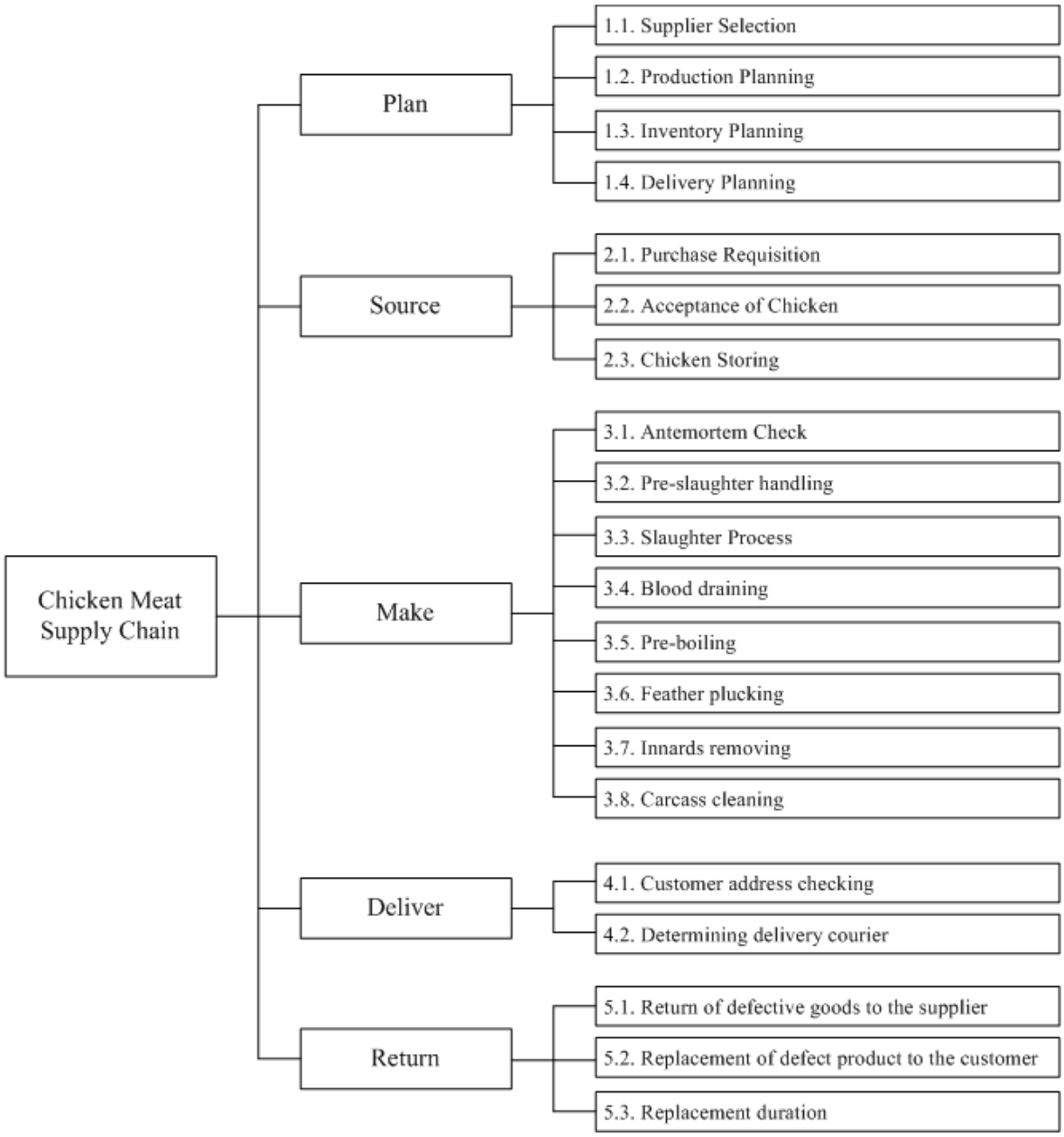

Figure 2. Hierarchical Task Analysis on Supply Chain of Halal Chicken

Processing using the SHERPA method begins by describing each process of the supply chain for halal chicken in the form of a Hierarchical Task Analysis (HTA), which aims to describe a systematic and detailed job description. Then the human error analysis is carried out using systematic steps in the SHERPA method. Data processing with the SHERPA method produces a description of the error, its consequences, the probability of ordinal error, the critical level, and a strategic plan to minimize the occurrence of errors. A high probability of ordinal error and a critical level can be seen in Table 3.

The ordinal probability value used in the SHERPA method is low symbolized by L, the medium is symbolized by M, and high is symbolized by H. Ordinal error probability assessment is carried out based on observations and interviews with workers serving in the supply chain activities. For each error description that may occur, a corrective strategy is drawn up so that the error can be reduced or eliminated.

Table 3. Human Error Analysis in Halal Chicken Meat Supply Chain

Code	Error category	Description of Error	Error Probability	Critical Level	Strategic of Improvement
1.1.	S2	The mistake of choosing a supplier that does not have a halal certificate	L	!	Ask to show a halal certificate from the supplier
	S2	The mistake of choosing a supplier that is not able to meet the demand	L	-	Looking at the track record of the supplier to meet demand
1.2.	12	Communication errors related to the number of products to be produced	L	-	Clear communication with customers
		Error in calculating customer demand	M	-	Do repetitive calculations
1.3.	C3	Error in checking inventory	L	-	Checks periodically
	A5	Error in calculating the shortage of orders	M	-	Doing recount
1.4.	S2	The mistake of choosing the appropriate transportation	M	!	Check whether the transport is used exclusively for transporting halal products
2.1.	A5	Error calculating the number of chickens ordered	L	-	Do a recalculation
2.2.	A5	Error in counting the number of chickens received	M	-	Do a recalculation
	C2	Error in checking the health condition of chickens	L	!	Establish SOP for a health check
	A5	Error in recording the chicken	M	-	Create clear document archives
2.3.	C4	Error checking the chicken in storage	L	-	Re-check
	A7	Record error in storage	L	-	Make a clear document archive
	A6	Incorrect placement of chickens in storage	L	-	Using the 5S method
3.1.	C2	Error/ omission to check antemortem	M	!	Re-check
	A5	Error establishing the antemortem check procedure	L	!	Give a firm warning if it does not meet the SOP for the chicken health check
	A5	Error selecting competent personnel in antemortem check	L	-	The workers must have a background in chicken health
	A6	Error placement if the chicken is declared sick	M	-	Make a special place for unhealthy chickens
3.2.	A7	Mistake in determining the position of the chicken so that the halal slaughter process is easy to do	L	!	Halal slaughterers are recommended to have the slaughterer certificate
	A5	Errors in determining officers who have adequate skills	L	!	Halal slaughterers are recommended to have the

Table 3. Human Error Analysis in Halal Chicken Meat Supply Chain

Code	Error category	Description of Error	Error Probability	Critical Level	Strategic of Improvement
					slaughterer certificate
3.3.	A5	The error in determining the slaughterer must be following fiqh	H	!	Halal slaughterers are recommended to have the slaughterer certificate
	C2	Error in ensuring that the chicken is still alive when it is slaughtered	L	!	Halal slaughterers are recommended to have the slaughterer certificate
	A5	The mistake of separating chickens if they are found dead before slaughter	L	!	Re-check the condition of the chicken before slaughtering
	A5	The mistake of the slaughterer is not saying basmallah at the time of slaughtering	M	!	Halal slaughterers are recommended to have the slaughterer certificate
	A5	The slaughterer's mistake in cutting 3 channels in the chicken neck	M	!	Halal slaughterers are recommended to have the slaughterer certificate
	A5	Mistakes in choosing a slaughtering tool	H	-	Halal slaughterers are recommended to have the slaughterer certificate
3.4.	C2	Error checking the blood has come out until it runs out	H	!	Calculates the average time the blood runs out
3.5.	A7	Error putting in chickens into the container	M	-	Measure the maximum number of chickens that can be placed in the container
	C2	Error checking the condition of the chicken is dead before putting it in hot water	H	!	Knowing the characteristics of chickens that have died from being slaughtered
3.6.	C2	Error in entering the number of chickens into the feather plucker machine	M	-	Repeat the process
	A7	Mistakes in ensuring that the feather plucking process is thorough	L	-	Measure the maximum number of chickens that can be put in the container
3.7.	A5	Errors in removing innards	L	-	Repeat the process
3.8.	C2	Error in ensuring that the chicken is still hygienic	L	-	Applying the 5S Concept
4.1.	A5	customer address writing error	L	-	Check again
4.2.	S2	Error in choosing a delivery courier	L	!	Ensure delivery couriers only take halal products
5.1.	12	Errors in determining the criteria for return to the supplier	M	-	Clearly define return criteria
5.2	I2	Errors in determining the criteria for return from customers	L	-	Clearly define return criteria
5.3.	12	Error in return time	L	-	Check again

3.4 Discussion

There are several halal critical points in the chicken meat supply chain that were found and could interfere with the halal **status** of the chicken meat product. Human error identification in the supply chain of halal chicken meat with the adoption of the SCOR model resulted in 38 types of errors, wherein the planning process there were 7 types of errors, in the sourcing process, there were 7 types of errors, in making there were 19 types of errors, on delivering there were 2 errors and on return there are 3 errors. The number of critical errors is 15 items. In the Plan process, there are 2 errors which is a critical point for halal, in the sourcing process there is 1 error which is a critical point for halal, in the making process there are 11 errors which are critical points for halal, in the delivery process there is 1 error which is a critical point for halal while in the process return there is no error which is the critical point of halal.

The probability of high ordinal error means that the error in the analyzed work occurred some time ago with a high frequency. The critical level in Table 3 means that if an error occurs in this activity, it will interfere with the halal status of the fresh chicken meat product. The implementation of an improvement strategy in the chicken butchering business can eliminate or reduce human error. Ideally, all potential errors can be eliminated, but priority can be given to high probability errors and critical errors. So far, there has been no study on human error in halal chicken meat products, so the results of this study can be input for business actors to improve their business activities so that the halal status of the product can be maintained.

4. Conclusions

There is a lot of potential for human error in handling halal chicken meat products, both in the plan, source, make, deliver, and return activities. The potential for human error is critical, which can interfere with the product's halal status. Correction strategies are proposed for each error and priority can be given to high and critical error probabilities.

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