HALAL PRODUCT TRACEABILITY SYSTEM MODELING USING INTERPRETIVE STRUCTURAL MODELING (ISM) IN BANGKALAN HALAL INDUSTRIAL AREA

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Abstract

Requirements for listing halal products are regulated in the Undang-undang Jaminan Produk Halal No. 33 of 2014. Fraud in the form of counterfeiting products labeled halal starts from not opening the entire halal production process from upstream to downstream of the supply chain. Therefore, to maintain product halalness, it is necessary to apply the traceability of halal products in the food supply chain as an effective tool to ensure product halalness and ensure food safety. The main objective of a traceability system is to record and document the product including all materials used in the production process. The method used to model the traceability system of Halal supply chain products is the Interpretive Structural Modeling (ISM) approach. Elements of the Halal Supply Chain Traceability System include Halal Procurement, Halal Manufacturing, Halal Logistics, Halal Distribution, Supplier Traceability, Manufacturer Traceability, Logistics Traceability and Distribution Traceability. Halal Product Traceability System Modeling aims to accelerate the development of the Bangkalan Halal Industrial Estate. Modeling of the Supply Chain halal traceability system in maintaining the integrity of halal products in the Bangkalan halal industrial area is located in the Power Driver Quadrant, namely Logistic Traceability, Distribution Traceability, Producer traceability, and supplier traceability. Quadran Strong Driver-Strongly Dependent Variable (Linkage), consisting of halal distribution and halal manufacturing elements. Quadran II Driver Power, namely halal logistics and halal procurement. And there are no elements in Quadran I. It can be concluded, the Bangkalan halal industrial area requires all elements to be related. So as not to make tourists visiting Bangkalan worry about the halal guarantee system for Bangkalan regional products.

Keywords **:** *Halal, Supply Chain, Interpretive Structure Modelling*

INTRODUCTION

Halal is one aspect that needs to guarantee the supply of food and beverage raw materials. Based on the Decree of the Minister of Religion of the Republic of Indonesia Number 518 of 2001 article 1 it states that halal food is food that does not contain haram elements or ingredients or is prohibited for consumption by Muslims, and its processing does not conflict with Islamic law.(Faridah, 2019) As for the legal basis for Muslims to always consume halal food, one of which is in Q.S An Nahl verse 114.

In the process of obtaining a halal certificate, one aspect that needs to be known is the halal critical point of the food production process. In addition, referring to the criteria for the halal assurance system by BPJPH, companies are required to have written procedures to guarantee the traceability of certified products originating from materials that meet the criteria and are produced in production facilities that meet the criteria.(Faridah, 2019) To assist the company's internal auditors in carrying out In the audit process, it is necessary to have a halal traceability system where this system will focus on tracing the halalness of the raw materials used and creating integrated master data.(Haryono & Handayani, 2018)

This popular system can be relied upon to increase halal transparency and strengthen the integrity of halal products, by using an Interpretive Structural Modeling approach to model the halal supply chain traceability system.(Haryono & Handayani, 2018) ISM in identifying and modeling critical barriers to cloud in MSMEs.(Ahmad & Qahmash, 2021) So this study will use ISM in identifying relationships between variables between elements of a system related to the halal traceability system.(Arsiwi & Adi, 2020) therefore this study aims to create a model of the Halal Supply Chain Traceability system in maintaining the integrity of halal food products.

Elements of the traceability system for halal supply chain products include: halal procurement, halal manufacturing, halal logistics, halal distribution, supplier traceability, producer traceability, logistics traceability, distribution traceability.(Zulfakar et al., 2014) By modeling this halal product traceability system, it is expected can accelerate the development of the Bangkalan halal industrial area.

LITERATURE REVIEW

Halal Products

Halal products are a necessity for Muslims and their availability is a must in countries that recognize the presence of Muslims. The halal industry has grown to 1.8 billion consumers globally with an estimated value of USD 2.1 trillion. Halal food products are products that meet halal requirements in accordance with Islamic law, including:

a. Does not contain pork and ingredients derived from pork.
b. Does not contain ingredients that are forbidden, such as ingredients derived from human organs, blood and feces.
c. All ingredients come from halal animals slaughtered according to Islamic law procedures.
d. All storage places, sales places, processing places, management and transportation places may not be used for pigs and/or other non-halal goods. If it has ever been

used for pork and/or other non-halal goods, it must first be cleaned according to Islamic law procedures.

e. All food and drinks that do not contain khamr.(Faridah, 2019)

Halal Certification and Labeling

Products circulating in Indonesia are very diverse, both local products and imported products from abroad. Each of these products requires a halal marker to make it easier for consumers to choose halal products. Therefore, there is a need for product certification and labeling to provide halal guarantees to the public, especially Muslims. Certification and labeling are two different but interrelated things.(Atiah et al., 2019)

Halal certification is the process of obtaining a certificate through several inspection steps to prove that raw materials, production processes and the halal guarantee system for a company's products are in accordance with the stipulated regulations. Certification is carried out by carrying out a series of checks by competent auditors in their fields for later halal status in order to make a written product halal fatwa in the form of a certificate. The halal certificate is valid for several years, then it can be extended. Companies must provide halal guarantees to maintain product halal consistency. Periodically every six months, companies are required to report the implementation of the halal assurance system.

Halal labeling is the inclusion of labels or logos on halal product packaging. This label is used to show consumers that the product has halal status. The agency authorized to issue permits for labeling is the Food and Drug Supervisory Agency. A halal certificate issued by the MUI is to include a halal logo or label on the product.(Faridah, 2019)

Supply Chain Management

Supply Chain is a network of companies that work to make and deliver products to end users. These businesses typically include suppliers, manufacturers, stores, or retailers, as well as support businesses such as logistics service companies. If the supply chain is a physical network, to the companies involved in supplying raw materials, producing goods, or shipping them to end users, SCM is a method, tool, or a management approach. Thus, supply chain management is not oriented towards the company's internal affairs, but also external affairs related to the relationship with the company. Therefore, it requires understanding, trust and transparency, partner companies must protect this information from those who might misuse it.

Ideally, the relationship between parties in a supply chain lasts long term. However, it should be noted that the long-term orientation in the context of the supply chain in the field must still be interpreted flexibly. Supply chain management is not synonymous with software, but there is a lot of software that can be used as a tool to assist in managing the supply chain. When returning to the definition of supply chain and supply chain management above, it can be said in general that all activities related to the flow of materials, information and money along the supply chain are activities within the scope of SCM. When referring to a manufacturing company, the main activities included in the SCM classification are (Rejeb, 2018):

a. Activities to design new products (product development)

b. Activities to get raw materials (procurement, purchasing or supply)
c. Production planning and inventory activities (planning and control)
d. Production activities
e. Activities to carry out delivery / distribution (distribution)
f. Product/goods return management activities (return)

Traceability

Traceability is defined as the ability to trace the history, application or location of what is being considered according to the International Organization for Standardization and traceability is a series of recorded identification. Some define traceability as the ability to follow and document the origin and history of food products. Traceability is a method of providing a safer food supply and connecting producers and consumers. The application of a traceability system has been widely applied by the industry to guarantee counterfeiting protection and ensure that shipments are made safe and secure. Traceability systems can also be used as a strategic tool to improve inventory management.

Traceability on Halal Traceability

Halal traceability can be used as a medium for tracking the halal status of a food product, by recording all information on activities in producing a product from upstream, namely the origin of raw materials to downstream. All information flow activities from upstream to downstream can be properly recorded and documented so as to provide transparency of halal products. Although at this time it is also suspected that there are a lot of additional food ingredients used by manufacturers in the products they sell. Meanwhile for cosmetics and medicines, consumers find it difficult to be sure whether the products they use are really safe and halal. Several experts have conducted system studies in the food industry. Traceability system design requires identification of data requirements.(Samsi et al., 2011)

Interpretive Structural Modeling (ISM)

Interpretive Structural Modeling (ISM) is a modeling technique developed for strategic policy planning.(Arsiwi & Adi, 2020) ISM was first created by J. Warfield in 1973, where Warfield defined ISM as a computer-assisted learning process that allows individuals or groups to develop maps of complex relationships between various elements involved in complex situations.(Ahmad & Qahmash, 2021) ISM is a sophisticated planning methodology used to identify and conclude various kinds of relationships between factors in a particular problem or issue.(Rusydiana, 2018)

Interpretive Structural Modeling is a sophisticated interactive planning methodology that enables a group of people, working as a team, to develop a structure that defines the relationships among the elements in a set. Structures are obtained by answering simple questions. The elements to be structured are determined by the group at the start of the ISM planning session. ISM is a model that describes specific relationships between variables, an overall structure and has outputs in the form of graphical models in the form of quadrants and variable levels.(Attri et al., 2013) In terms of decision making, ISM has little in common with the Analytic Network Process method developed by Thomas L. Saaty. The basic idea is to use experienced experts and practical knowledge to decompose a complex system into several sub-systems and build a multilevel structural model.(Rusydiana, 2018)

The first step in processing ISM is to create a Structural Self Interaction Matrix (SSIM), in which contextual relations are made for these variables by making one variable i and one variable j. Next is to make a reachability matrix (RM) by changing V, A, X and O with the numbers 1 and 0. The final step is to make a Canonical Matrix to determine the level through iteration. After there are no more intersections, then the model produced by ISM is created which is a model to solve the problem, in this case the development of the cash waqf model. From this model, a road map for institutional development (level) will be made.

Relations Between Elements in ISM

According to Marimin (2004) the process of the ISM method is to do calculations according to the Transivity Rules where corrections are made to the SSIM until a closed matrix occurs. SSIM modification requires input from panelists/experts, with special notes given so that attention is directed only to certain sub-elements. The results of the revised SSIM and matrices that meet the requirements of the Transivity Rules are further processed. For revision, matrix transformation can also be done with a computer program. The Transivity rule is a completeness rule for a causal-loop, for example:

A influences B
B influences C
Then A (supposedly) affects C
D increases E
E increases F
Then D (shouldn't) scale down F.

No.	Jenis	Interprestasi
1.	Pembandingan (*Coperative*)	. A lebih penting/besar/indah, daripada B
2.	Peryataan (*Definitive*)	. A adalah atribut B . A termasuk didalam B . A mengartikan B
3.	Pengaruh (*Influence*)	. A menyebabkan B . A adalah debagia penyebab B . A mengembangkan B . A menggerakan B . A meningkatkan B
4.	Ruang (*Spiral*)	. A adalah selatan/ utara B . A diatas B . A sebelah kiri B
5.	Waktu (*Temporate/Time Scale*)	. A mendahului B . A mengikuti B . A mempunyai prioritas lebih dari B

Figure 1 Interrelationships Between Sub-elements in the ISM Technique

Further processing of the Reachability Matrix which has complied with the Transivity Rules is the determination of the level partition. Processing is tablative by filling in the format, and can be assisted by a computer. Based on the choice of levels, a schematic description of each element can be described according to vertical and horizontal levels.

For various sub-elements in an element based on RM, Driver-Power-Dependence is arranged. The sub-element classification is presented in the following 4 sectors:

Sector 1 : Weakdriver-weak dependent variables (AUTONOMOUS). Changes in this sector are generally unrelated to the system, and may have a small, though strong, relationship.
Sector 2 : Weak driver-strongly dependent variables (DEPENDENT). Generally changes here are not free.
Sector 3 : Strong driver-strongly dependent variables (LINKAGE). Variables in this sector must be studied carefully because the relationship between variables is unstable. Every action on that variable will have an impact on the other and the feedback effect can increase the impact.
Sector 4 : Strong drive weak dependent variables (INDEPENDENT). The variables in this sector are the remaining part of the system and are called independent variables. (Halim et al., 2021)

RESEARCH METHOD

Data Collection

At this stage, a literature study is carried out related to the traceability system and the halal assurance system at the company through several references in the form of books, journals or previous research. In addition, a field study was also carried out by conducting a Group Discussion Forum with experts, namely the head of the Halal Center at Trunojoyo University, Madura. So it was agreed that there are 8 halal elements that are used, including Halal Procurement, Halal Manufacturing, Halal Distribution, Halal Logistics, Supplier Traceability, Producer Traceability, Distribution Traceability, Logistic Traceability

Contextually Determine The Type Of Relationship

Contextual relationship is determined based on elements by comparing elements of the Halal traceability system in a relational matrix using contextual relationships.

Creating a Structural Self-Interaction Matrix (SSIM) By Means Of Pairwise Comparisons

This step creates pairs between the elements described in Table 1. By paying attention to the contextual relationship in each element the existence of a relationship between the two sub-elements (i and j) and the direction of the related relationship in question. (Attri et al., 2013)

Symbols are used to indicate the direction of the relationship between elements i and j. Four symbols are used to indicate the direction of the relationship between elements i and j :
V - for the relationship from i to j but not in both directions;
A - for a relationship from j to i but not in both directions;
X - for the relationship in both directions from i to j and j to i; And
O - if the relationship between elements doesn't appear to be valid.

Table 1 Structural Self-Interaction Matrix (SSIM)

Variable	A1	A2	A3	A4	A5	A6	A7	A8
A1		V	A	V	V	V	V	V
A2			A	X	V	V	V	V
A3				V	V	V	V	V

Variable	A1	A2	A3	A4	A5	A6	A7	A8
A4					V	V	V	V
A5						A	X	X
A6							X	V
A7								X
A8								

Create Reachability Matrix (RM) and check transitivity

The fourth phase is related to the construction of the reachability matrix M. This matrix is binary because the entries V, A, X and O from SSIM are converted to 1 and 0 according to the rules in Table 2 below:

1) If relation (i, j) is denoted as V then input (i, j) in RM becomes 1 and (j, i) becomes 0
2) If relation (i, j) is denoted as A then input (i, j) in RM becomes 0 and (j, i) becomes 1
3) If the relation (i, j) is denoted as X then the input (i, j) in RM becomes 1 and (j, i) becomes 1
4) If relation (i, j) is denoted as O then input (i, j) in RM becomes 0 and (j, i) becomes 0

Table 2 Reachability Matrix (RM)

Variables	A1	A2	A3	A4	A5	A6	A7	A8	Driving Power
A1	1	1	0	1	1	1	1	1	7
A2	0	1	0	1	1	1	1	1	6
A3	1	1	1	1	1	1	1	1	8
A4	0	1	0	1	1	1	1	1	6
A5	0	0	0	0	1	0	1	1	3
A6	0	0	0	0	1	1	1	1	4
A7	0	0	0	0	1	1	1	1	4
A8	0	0	0	0	1	0	1	1	3
Dependence Power	2	4	1	4	8	6	8	8	

Determine the partitionary level of the reachability matrix

This step involves decomposing the RM hierarchical sequence with the level partitions described in Table 3 and carrying out several iterations, which are described in tables 4 to 7, to obtain the level of each element. The purpose of this step is to provide initial input for creating a digraph from RM. Slices of planes use the elementary set sj in si. The reachable set R(si) consists of the element itself and other elements reachable from si. Likewise, there are some elements that reach the element si, which is defined as the ancestor of A(si). Then the interaction of reachable sets and antecedents (R(si) A(si)). Elements for which R(si) = R(si).

A(si) is the top element of the ISM hierarchy. The top element has no relationship with other elements above its level. When parent elements are identified, they are separated from other elements. Then the same process is repeated until the level of all elements is reached. Identifying these levels helps build the final ISM digraph and model.

Table 3 Level Partitian Iterasi 1

Variabel	Reachability Matrix	Anteendent	Intersection	Level
1	1,2,4,5,6,7,8	1,3	1	
2	2,4,5,6,7,8	1,2,3,4	2,4	
3	1,2,3,4,5,6,7,8	3	3	
4	2,4,5,6,7,8	1,2,3,4	2,4	
5	5,6,7,8	1,2,3,4,5,6,7,8	5,6,7,8	I
6	5,6,7,8	1,2,3,4,5,6,7,8	5,6,7,8	I
7	5,6,7,8	1,2,3,4,5,6,7,8	5,6,7,8	I
8	5,6,7,8	1,2,3,4,5,6,7,8	5,6,7,8	I

Table 4 Level Partitian Iterasi 2

Variabel	Reachability Matrix	Anteendent	Intersection	Level
1	1,2	1,3	1	
2	2,4	1,2,3,4	2,4	II
3	1,2,3,4	3	3	
4	2,4	1,2,3,4	2,4	II

Table 5 Level Partitian Iterasi 3

Variabel	Reachability Matrix	Anteendent	Intersection	Level
1	1	1,3	1	III
3	1,3	3	3	

Table 6 Level Partitian Iterasi 4

Variabel	Reachability Matrix	Anteendent	Intersection	Level
3	3	3	3	IV

Table 7 Final Reachability Matrix

Variabel	Reachability Matrix	Anteendent	Intersection	Level
5	1,5,6	1,2,3,4,5,6,7,8	1,5,6	I
2	2	2,3,4,7,8	2	II
1	3	3,4,7,8	3	III
3	3,7	3,4,7	3,7	III
6	3,7	3,7,8	3,7	III
7	3,4,7	3,4,7	3,4,7	III

8	4,8	4,8	4,8	III
4	3,4,7,8	4,7,8	4,7,8	IV

Table 8 Cannonical Matrix

Variabel	5	6	7	8	2	4	1	3	DP	Level
5	1	1	1	1	0	0	0	0	4	**1**
6	1	1	1	1	0	0	0	0	4	**1**
7	1	1	1	1	0	0	0	0	4	**1**
8	1	1	1	1	0	0	0	0	4	**1**
2	1	1	1	1	1	1	0	0	6	**2**
4	1	1	1	1	1	1	0	0	6	**2**
1	1	1	1	0	1	1	1	0	7	**3**
3	1	1	1	1	1	1	1	1	8	**4**
Dependance	8	8	8	8	4	4	2	1		
Level	**I**	**2**	**3**	**3**	**3**	**3**	**3**	**4**		

RESULTS AND DISCUSSION

The Driver Power (DP) value is obtained from the sum of the values in the horizontal column j, while the Dependence Power value is obtained from the sum of the values in the vertical column i. The results of the canonical matrix have 4 levels. Level 1 is traceability logistics, traceability distribution, traceability supplier, and traceability producer. Level 2 is halal distribution and halal manufacturing. Level 3 is halal logistics, while level 4 is halal procurement. Furthermore, ISM modeling can be seen in Figure 2.

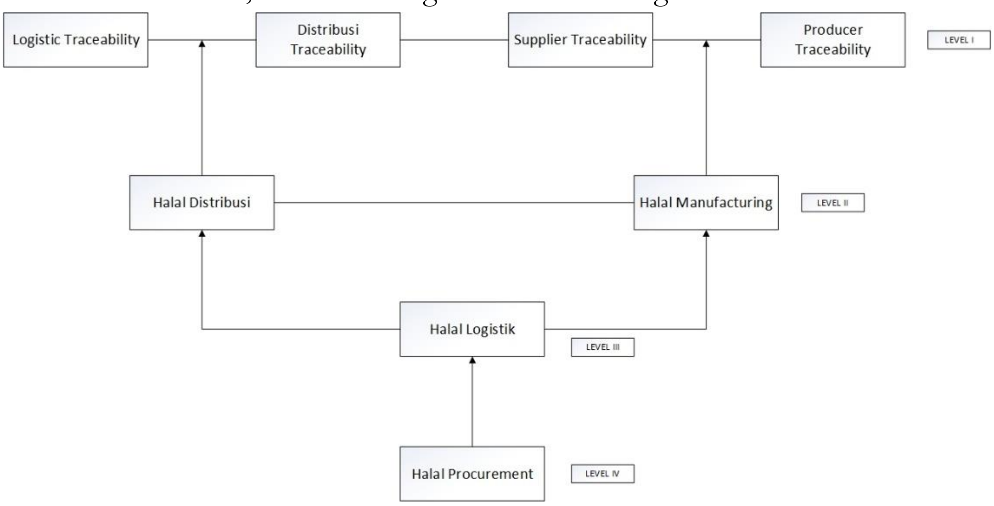

Figure 2 ISM Modeling

MICMAC Analysis

MICMAC analysis builds Driver Power and Dependence and classifies variables into four parts, namely Controller, Link, Autonomous and Dependent. (Haryono & Handayani, 2018) The dependency of the variables is described in this section Figure 3 which consists of four quadrants.

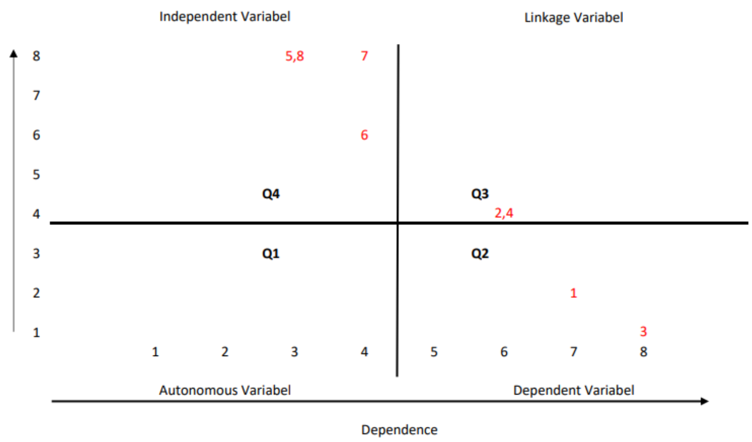

Figure 3 MICMAC Analysis

Quadran IV has high performance drivers, allowing these variables to influence other variables in the system and act as a master key to integrity. This quadrant consists of Logistic Traceability, Distribution Traceability, Producer traceability, and supplier traceability.

Quadrant III. Strong driver-strongly dependent variable (linkage) variables included in this quadrant will support the success of halal product integrity and have a strong dependency as a driver. This quadrant consists of halal distribution and halal manufacturing.

Quadran II has a low Driver Power so that this variable does not have the power to influence other variables in the system. This quadrant consists of halal logistics and halal procurement.

Quadrant I Weak driver-weak dependent variable (autonomus), this quadrant has a relatively small influence or has nothing to do with it. This quadrant has weak driving force and dependency and is relatively detached from the system which has almost no links.

CONCLUSIONS

Modeling of the Supply Chain halal traceability system in maintaining the integrity of halal products lies in Quadran IV which has high Driver Power, namely Logistic Traceability, Distribution Traceability, Producer traceability, and supplier traceability. Quadran III Strong Driver-Strongly Dependent Variable (Linkage), elements of the Halal Supply Chain Traceability system that are included in this quadrant will support the success of halal product integrity and have a strong dependency as a driver, this quadrant includes halal distribution and halal manufacturing. Halal supply chain traceability systems that do not affect the integrity of halal products are included in Quadran II which has low Driver Power, namely halal logistics and halal procurement. Quadrant I Weak driver-weak dependent variable (autonomus) has no halal supply chain elements, this quadrant has relatively little influence or has nothing to do with it.

It can be concluded, the Bangkalan halal industrial area requires all elements to be related. So as not to make tourists visiting Bangkalan worry about the halal guarantee system for Bangkalan regional products.

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