



## SUPPLY CHAIN RISK ANALYSIS IN KUB – IK MATARAM MACOA WITH *HOUSE OF RISK* (HOR)

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### ABSTRACT

(KUB - IK) Mataram Macoa is a cocoa industry. The cocoa industry can produce chocolate with a cocoa material capacity of 87 kg per month or 1.0444 tons per year. Based on data from the Polewali Mandar Regency Statistics Agency, in 2018 the chocolate industry has a prospect that is still less proven with the data from BPS Polewali Mandar Regency, there is only 1 group of cocoa industry centers and the number of business units is 1 unit (BPS Polewali Mandar Regency, 2018). The company does not currently have a structured risk management to identify and mitigate risks that occur, especially in the supply chain function. By using the House of Risk method, the risks that may arise and their causes can be identified to simultaneously find ways to mitigate these risks to improve the operational quality of the Kelompok Usaha Bersama Industri Kecil Mataram Macoa and open opportunities to detect profitable business opportunities for the company. The purpose of this paper is to determine the causes of the dominant risk and design response measures in the Kelompok Usaha Bersama Industri Kecil Mataram Macoa. The basic method of writing is descriptive method and is implemented by using a case study method through a quantitative approach. The selection of respondents was carried out using purposive sampling technique. Methods of data collection by observation, in-depth interviews, questionnaires and literature study. The results of this paper indicate that in the activity plan there are 2 risks, in source activity there are 5 risks, in make activities there are 5 risks, in delivery activities there are 3 risks, and in return activities there is 1 risk. The risk treatment plan is designed to reduce the risk status for each risk event using a risk matrix.

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## I. INTRODUCTION

Along with its development, the supply chain, which initially focused on management aspects, has now begun to include risk aspects, so that there is collaboration between the concepts of supply chain management and risk management.

Risk can be created due to two things, namely the uncertainty condition of an experiment and the results generated by the experiment can be an advantage or a loss [1]

Supply chain is a series of activities or activities that distribute goods or services from producers to consumers. Utilization of supply chain management to determine the relationship between product flow, financial flow and information flow from farmers to end consumers and in this supply chain will form an activity that can produce value added products [2].

With the existence of supply chain risk management, it is hoped that it can overcome risk problems from a supply chain point of view. In supply chain activities, it is always possible process of the risks that can upset the balance of the system.

In general, the supply chain risk management process consists of risk identification, risk analysis, risk evaluation and risk mitigation. Risk identification is suggested as a fundamental step in the risk management process [3]. Supply chain risk management is controlling supply chain risk through coordination or collaboration between supply chain partners to ensure a level of profit and continuity. [4]. Companies need to understand risks in order to properly implement risk management [5].

KUB - IK Mataram Macoa has coordinated with other supply chain players such as suppliers and retailers. However, the coordination that has not been fully formed is neat, one example is coordination with one of its suppliers in Majene Regency regarding the limited availability of fermented cocoa beans raw material and some other risks that force KUB - IK Mataram Macoa to find it difficult to meet the demand from distributor. If this continues, the KUB-IK Mataram Macoa will suffer both operational and financial losses. This condition can illustrate that a number of risks in the supply chain of KUB-IK Mataram Macoa are not yet fully understood clearly. Therefore, this study was conducted to determine the risks that may occur and provide treatment for these risks.

HOR is a modification of FMEA (Failure Modes and Effect of Analysis) and the quality house model (HOQ) to prioritize which risk

sources are first selected to take the most effective action in order to reduce the potential risk from risk sources. House of Risk is a model based on the need for risk management that focuses on preventive measures to determine which risk causes are a priority which will then be given risk mitigation or countermeasures [6].

It is hoped that the handling of risks that arise can minimize the possibility of the impact of losses.

## II. RESEARCH METHODS

### 2.1 Time and place of research

The place of research in this writing was conducted in KUB- IK Mataram Macoa. The research time was one month (March-April 2020).

### 2.2 Type of data

- Quantitative data is data obtained from KUB-IK Mataram Macoa in the form of weighted severity and Occurance data..
- Qualitative data, namely data obtained in the form of information both written and oral

### 2.3 Data Collection

The type of data used in this study, namely quantitative data consisting of activity information data at 5 stages of the planning process, source, make delivery, and returns on the Mataram Macoa KUB- IK business, Risk Event and Risk Agent data, severity weighting data and occurrence. The data used in this study are sources or experts. The HOR method applied includes [7].

$$ARP = O_j \times \sum S_i R_{ij} \dots\dots\dots (1)$$

Where :  
 $O_j = Occurance$   
 $S_i = Severity$   
 $R_{ij} = ARP$

$$TE_k = \sum_j ARP_j E_{jk} \dots\dots\dots (2)$$

Where :  
 $ARP_j = ARP$   
 $E_{jk} = Correlation$

$$ETD_k = \frac{TE_k}{D_k} \dots\dots\dots(3)$$

Where :  
 $TE_k = Total Effectiveness$   
 $D_k = Degree of Difficulty$

## III. RESULTS AND DISCUSSION

### 3.1 RESULTS

## 1. Severity Risk Event and Occurance Risk Agent Weighted Data

After the identification is done, then weighting (assessing) the severity level is calculating how much impact or intensity of impact or intensity of events affects the operational process. The scale used for severity assessment is the Likert scale, namely a scale of 1-5.

**Table 1. Severity Weighted**

Kode	Risk Event	Severity
E1	calculations in planning material stock requirements	5
E2	Planning planning for maintaining production equipment	2
E3	Delivery of raw materials is not on time	4
E4	The supplier did not fulfill the order	3
E5	The quality of raw materials from suppliers is not appropriate	5
E6	The quantity of raw materials from suppliers is not suitable	3
E7	Lack of certification of raw materials	2
E8	Defective products	3
E9	The production machine is damaged	5
E10	Product trial failed	1
E11	Power outage	5
E12	The mixing process is hampered	4
E13	Delivery process to consumers is hampered	3
E14	Product damaged in the shipping process	5
E15	Order delay	3
E16	Return of defective products from customers	4

Furthermore, the identification of risk agents is carried out in each existing risk event, 23 risk agents have been identified. Each risk is further analyzed to find the consequences caused by these risks.

**Table 2. Occurance Weighted**

Kode	Agen atau Penyebab Resiko	Occurance
A1	Lack of employee involvement and concern in supporting activities within the company	3
A2	Inaccuracy in material planning	2
A3	Scarcity of raw materials	3
A4	Lack of planning experience	2
A5	The quality of raw materials is not appropriate	2
A6	Misunderstanding of information	2
A7	There is no halal label	1
A8	The supplier adds his own order quantity	2
A9	Procedure error	2
A10	Imperfect product making	1
A11	Machine maintenance is not routine	2
A12	The electricity has stopped	1
A13	Using third party transportation	4
A14	Machine settings are not accurate	1

A15	Not in accordance with the product SOP	2
A16	The supplier is waiting for another order to be worked on at the same time	2
A17	Consumers cannot pay for orders	1
A18	Capital flow is not smooth	2
A19	There are accounts payable	1
A20	The product is too hot	2
A21	Sudden change in orders from consumers	2
A22	Consumer needs increase / decrease	3
A23	Defective / expired product	1

In this stage, identification of risks that may occur in each business process is carried out. This stage can be started by mapping each stage of the business process. HOR 1 focuses on ranking on ARP which consists of 3 factors, namely occurrence, severity and interrelationship, or in other words occurrence, severity and interrelationship, or in other words, this phase focuses on the risk identification process which includes risk agents and risk events [8].

From each risk event and risk agent, the measurement of the correlation value between a risk agent and the cause of the risk is then continued. If a risk agent causes risk, it is thought that there is a correlation. There are 4 kinds of correlation values in this matrix, namely

### 2. House Of Risk Phase 1

- A value of 0 indicates there is no correlation between risk agents and risk events
  - A score of 1 indicates a weak correlation between risk agents and risk events
  - A score of 3 indicates a moderate correlation between risk agents and risk events.
  - A score of 9 indicates a strong correlation between risk agents and risk events.
- From each risk event and risk agent, then it is followed by mapping the Aggregate Risk Potential

value. The calculation of the ARP value is used as an input in determining the priority of risk agents that need to be handled first and given preventive measures against risk agents. Each ARP value is obtained through calculations using the formula:

$$ARP = O_j \times \sum Si Rij$$

Here is the calculation result of ARP:

$$ARP1 = 3 \times (5 \times 1 + 2 \times 1) = 21$$

**Table 3. House of risk Model Phase 1**

Risk Agent (n)																					Severity			
Risk Event (n)	A 1	A 2	A 3	A 4	A 5	A 6	A 7	A 8	A 9	A 10	A 11	A 12	A 13	A 14	A 15	A 16	A 17	A 18	A 19	A 20	A 21	A 22	A 23	
E1	1	3		9		1	3	3																5
E2	1	3							3		1													2
E3			3			1	3						9											4
E4				9									3											3
E5					9	3																		5
E6			9			3		9																3
E7							9																	2
E8									3	9		9		3										3
E9										9		1	3				3	3						5
E10									3					9										1
E11											9													5
E12											9					1								4
E13															3	3	1	1			9	1		3
E14																			9				1	5
E15																9		3	3	3				3
E16															1								9	4
Occurrence	3	2	3	2	2	2	2	1	2	1	2	1	4	1	2	2	1	2	1	2	2	3	1	

ARP	2 1	4 2	1 4 4	1 1 7	9 0	6 6	9 0	4 2	3 0	3 0	9 4	1 0 8	2 0	2 4	2 8	2 8	3 8	3 8	1 8	1 0 8	7 2	3 8	4 1
Rank	2 2	1 1	2 3	3 7	7 1 0	1 8	8 1	1 2	1 7	1 3	6	4	1	2 0	1 9	2 1	1 4	1 5	2 3	5 9	1 6	1 3	1 3

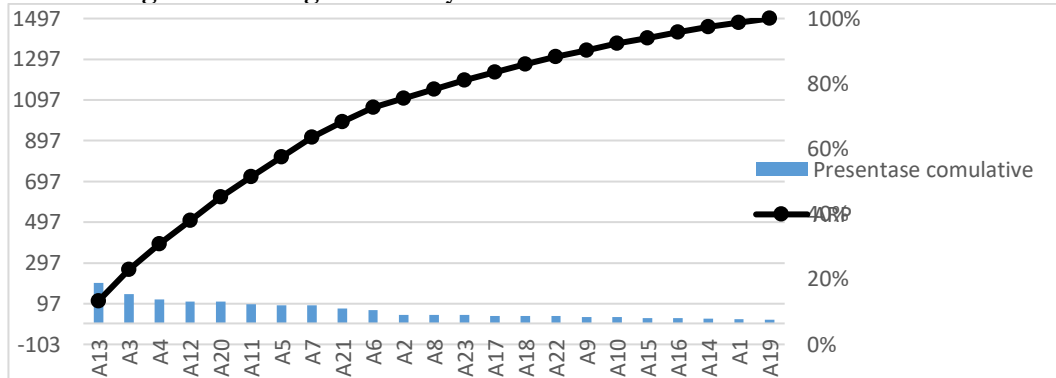
Information :

- E1, E2,..., En = risk event (risk event)
- A1, A2,..., En = risk agent (risk agent)
- R11, R12,..., Rnm = the relationship between the risk agent and the risk event
- Si = severity risk event
- Occurance = occurrence risk agent
- ARPj = Aggregate Risk Potential value
- Rank = the ranking of the risk agent based on the ARPj value.

resources used and the level of performance of the related object or project. The organization or company must determine the appropriate form of risk response or mitigation where the form of mitigation must be easy to apply but can reduce the probability of a risk trigger (risk agent) occurring. easy to apply. Pareto diagram (Pareto Analysis) is a method for managing errors, problems for defects to help focus on problem solving efforts. This diagram is based on the work of Vilfredo Pareto, an economist in the 19th century. Joseph M. Juran popularized Pareto's work by stating that 80% of company problems are the result of only 20% of causes [9].

### 3. House Of Risk Phase 2

In this phase, it focuses on determining what is the most appropriate step to take first by considering the effectiveness of the Pareto Diagram Risk Agent Priority



Based on the calculation of Aggregate Risk Potential in HOR 1, a Pareto diagram is made to determine which risk agents have an effect on causing risk to the system. In accordance with the principle of the Pareto 80-20 diagram, the priority problems that

must be resolved are problems with a percentage of up to 80%, can be seen in table 6. Pareto diagram gets 8 risk agents which are the main causes in the supply chain flow in KUB-IK Mataram Macoa.

**Table 4. Risk Agent Priority Based On Pareto Diagram**

Code	Risk Agents	ARPj
A13	Using third party transportation	200
A3	Scarcity of raw materials	144
A4	Lack of planning experience	117
A12	The electricity has stopped	108
A20	The product is too hot	108

A11	Machine maintenance is not routine	94
A5	The quality of raw materials is not appropriate	90
A7	The supplier adds his own order quantity	90

Based on the risk agent obtained, there are countermeasures that can be applied in activities to solve problems that occur. This can be seen in Table 7. Then the

correlation matrix between risk agents and preventive action in HOR 2 is mapped, as stated in Table 5

**Table 5. Treatment Measures Design**

Treatment Measures Design	Kode
Maintain permanent cooperation with freight forwarders	PA1
Cooperating with suppliers from outside West Sulawesi	PA2
-Recruit new employees who are more experienced before	PA3
	PA4
-Consulting those who are experts in their fields	PA5
Switch on the generator	PA6
	PA7
- Increase the boiling point of chocolate by replacing cocoa butter with vegetable fat	PA8
- Increase the moisture content in chocolate by replacing raw sugar with palm sap sugar	PA9
- Establish good communication with the supplier	PA10
- Routinely reconfirm with the supplier	PA11

Next is the identification of mitigation actions which are then mapped to the phase 2 HOR model together with the selected risk agent. In this second phase, the total value of the effectiveness of mitigation actions (TE<sub>k</sub>) is calculated, the degree of difficulty in carrying out mitigation actions (D<sub>k</sub>) and the total effectiveness of the degree of difficulty in carrying out mitigation actions (E<sub>TDk</sub>) [10].

The strategy to be implemented for risk treatment is calculated based on its total effectiveness. The effectiveness itself considers the degree of difficulty of the company being measured. Therefore, the weighting of the degree of difficulty in implementing the strategy here uses a Likert scale in its measurement.

Calculate the Total Effectiveness of all the proposed handling strategies using the formula:

$$TE_k = \sum_j ARP_j E_{jk}$$

$$TE_1 = [(200 \times 9)] = 1800$$

**Table 6. House of risk Model Phase 2**

Information :

- A1, A2, ..., An = risk agent which is given action
- PA1,PA2,...,Pan=mitigation actions that will be carried out
- Rn = rating of each action starting from the highest ETD.
- Enm =relationship mitigation action and risk agent
- ARPN = aggregate risk potential risk agent
- TEn = total effectiveness of mitigas action
- Dn = mitigation action difficulty level
- ETDn = total comparable effectiveness

Risk Agent (n)												
Risk Event (n)	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	Severity
A1	9											5
A2		9								3	3	2
A3		3	9	9						1		4
A4					9			1				3
A5						9	9		3			5
A6			9					9				3
A7									9		3	2
A8									9	3	3	3
Occurance	3	2	3	2	2	2	2	1	2	1	2	
ARP	21	42	144	117	90	66	90	42	30	30	94	
Rank	22	11	2	3	7	10	8	12	17	13	6	

Based on the calculation of the effectiveness of the difficulty ratio (ETD), it is possible to obtain countermeasures in order to prevent risk events in the supply

chain flow at KUB - IK Mataram Macoa in the following order, which is shown in Table 7.

**Table.7 Priority Countermeasures Plan**

No.	Kode	Priority Countermeasures Plan
1	PA9	Establishing product quality standards for raw materials
2	PA2	Cooperating with suppliers from outside West Sulawesi
3	PA1	Maintain permanent cooperation with freight forwarders
4	PA8	Make a regular machine maintenance schedule
5	PA4	Consult with those who are experts in their fields
6	PA5	Switch on the generator
7	PA3	Recruit new employees who are more experienced before

8	PA11	Routinely reconfirm with the supplier.
9	PA6	Increase the boiling point of chocolate by replacing cocoa butter with vegetable fat
10	PA7	Increase water content in chocolate by replacing raw sugar with palm sap sugar
11	PA10	Establish good communication with the supplier

### 3.2 Discussion

The results obtained after the handling strategy data were processed with the Pareto diagram, the highest percentage of the type of handling strategy was PA5, reaching 70%. This is followed by PA4 65%, PA8 50%, PA1 40%, PA2 35% and PA9 20%. Then for the types of handling strategies are as follows; activate the generator set, which is 70%, followed by consulting with experts in their fields with 65%, making periodic machine maintenance schedules 50%, establishing regular cooperation with 40% freight forwarding, cooperating with suppliers from outside West Sulawesi 35%, and the lowest is to establish good communication with suppliers 20%.

## IV CONCLUSION AND ADVICE

### 4.1 Conclusion

The conclusion that can be drawn through research at KUB - IK Mataram Macoa regarding company risk analysis is 23 causes of risk (risk agent) in the supply chain of KUB - IK Mataram Macoa were identified, which were then divided into 8 causes of dominant risk based on the Pareto diagram, namely:

Using third party transportation (A13), Scarcity of Raw Materials (A3), Lack of planning experience (A4), The power supply has stopped (A12), the product is too hot (A20), machine maintenance is not too routine (A11), The quality of raw materials is not appropriate (A5), the supplier increases the quantity of his own order (A7).

Then based on the 8 causes of the dominant risk above, it is recommended that some treatment measures be recommended in order to prevent these risks from appearing as follows:

Establish permanent cooperation with freight forwarders (PA1), collaborate with suppliers

from outside West Sulawesi (PA2), recruit new employees who are more experienced before (PA3),

Consult with those who are experts in the field (PA4), Activate the generator (PA5), Increase the boiling point of chocolate by replacing cocoa butter with vegetable fat (PA6), Increase the moisture content in chocolate by replacing raw sugar with palm sugar (palm sap sugar) (PA7), Make regular machine maintenance schedules (PA8), Set product quality standards for raw materials (PA9), Establish good communication with suppliers PA10), Routinely re-confirm with suppliers (PA11)

### 4.2 Advice

As a company that is still medium-sized or is still in the form of a CV, the company is very vulnerable to risks that may arise along the supply chain. Therefore, the authors expect the company to accept the proposed handling strategy. In addition, companies are also expected to have other risk management strategies to mitigate or reduce the emergence of these risk

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