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.

Keywords: Risk, Risk Analysis, Supply Chain, House Of Risk, Pareto Diagram.
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 next, 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
a. Quantitative data is data obtained from KUB-IK Mataram Macoa in the form of weighted severity and Occurance data.
b. 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].

\[ ARP = O_j x \sum Si R_{ij} \]  \hspace{1cm} (1)

Where :
\( O_j \) = Occurance
\( Si \) = Severity
\( R_{ij} \) = ARP
\( T_{Ek} = \sum_{j} ARP_j E_{jk} \]  \hspace{1cm} (2)

Where :
\( ARP_j \) = ARP
\( E_{jk} \) = Correlation
\( ETD_k = \frac{T_{Ek}}{D_k} \]  \hspace{1cm} (3)

Where :
\( T_{Ek} \) = Total Effectiveness
\( D_k \) = Degree of Difficulty

III. RESULTS AND DISCUSSION
3.1 RESULTS
1. Severity Risk Event and Occurrence

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. Occurrence Weighted

| Kode | Agen atau Penyebab Resiko                                      | Occurrence |
|------|-----------------------------------------------------------------|------------|
| 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          |
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

- 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:

$$\text{ARP} = O_j \times \sum S_i R_{ij}$$

Here is the calculation result of ARP:

$$\text{ARP}_1 = 3 \times (5 \times 1 + 2 \times 1) = 21$$

Table 3. House of risk Model Phase 1

| Risk Agent (n) | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | A11 | A12 | A13 | A14 | A15 | A16 | A17 | A18 | A19 | A20 | A21 | A22 | A23 |
|---------------|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Risk Event (n) | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10  | 11  | 12  | 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  |
| E1            | 1  | 3  | 9  | 1  | 3  | 3  |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| E2            | 1  | 3  | 9  | 1  | 3  | 3  | 1  |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| E3            | 3  | 1  | 3  |    | 9  |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| E4            | 9  |    | 3  |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| E5            |    | 9  | 3  |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| E6            |    |    | 9  |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| E7            |    |    |    |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| E8            |    |    |    |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| E9            |    |    |    |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| E10           |    |    |    |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| E11           |    |    |    |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| E12           |    |    |    |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| E13           |    |    |    |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| E14           |    |    |    |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| E15           |    |    |    |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| E16           |    |    |    |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Occurrence    | 3  | 2  | 3  | 2  | 2  | 2  | 2  | 1  | 2  | 1  | 2  | 1  | 4  | 1  | 4  | 1  | 4  | 1  | 2  | 1  | 2  | 2  | 2  | 3  | 1  |

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Information:
E₁, E₂,…, Eₙ = risk event (risk event)
A₁, A₂,…, Aₙ = risk agent (risk agent)
R₁₁, R₁₂,…, Rₙₙ = the relationship between the risk agent and the risk event
Sᵢ = severity risk event
Occurrence = occurrence risk agent
ARPᵢ = Aggregate Risk Potential value
Rank = the ranking of the risk agent based on the ARPᵢ value.

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 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].

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-1K Mataram Macoa.

Table 4. Risk Agent Priority Based On Pareto Diagram

| Code | Risk Agents                          | ARPᵢ  |
|------|--------------------------------------|-------|
| 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   |
Machine maintenance is not routine 94
The quality of raw materials is not appropriate 90
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 |
| - Consulting those who are experts in their fields | PA5 |
| Switch on the generator | PA6 |
| - 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 (TEk) is calculated, the degree of difficulty in carrying out mitigation actions (Dk) and the total effectiveness of the degree of difficulty in carrying out mitigation actions (ETDk) [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:

$$TEk = \sum ARP_j E_{jk}$$

$$TE1 = [(200 \times 9)] = 1800$$
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 | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | A11 | Seve |
|---------------|------------|----|----|----|----|----|----|----|----|----|-----|-----|------|
| A1            |            | 9  |    |    |    |    |    |    |    |    |     |     | 5    |
| A2            |            | 9  | 3  |    | 3  | 2  |    |    |    |    |     |     | 2    |
| A3            |            | 3  | 9  | 9  | 1  |     |    |    |    |    |     |     | 4    |
| A4            |            |    |    | 9  | 1  |     |    |    |    |    |     |     | 3    |
| A5            |            |    |    | 9  | 9  |     |    |    |    |    |     |     | 3    |
| A6            |            |    |    |    |    | 9  |    | 3  |    |    |     |     | 2    |
| A7            |            |    |    |    |    |    | 9  | 3  |    |    |     |     | 3    |
| A8            |            |    |    |    |    |    |    |    | 9  | 3  | 3   |     | 3    |
| Occurance     |            | 3  | 2  | 3  | 2  | 2  | 2  | 1  | 2  | 1  | 2   |     | 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 |
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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