Implementation of Supply Chain Risk Management (SCRM) Using House of Risk (HOR): Case Study on Supply Chain of Craft Bag Industry

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Abstract. The length of supply chain at Ajeng Gallery causes emergence of risks that can harm the company. Moreover, the company has not implemented risk management properly so that the purpose of this study is to implement supply chain risk management properly. By using House of Risk, it is obtained 10 risk events and 9 risk agents. 2 risk agents that have the largest percentage are mitigated. There are 4 priority mitigation strategies to overcome risk agents. The implementation of mitigation strategy can reduce risk levels in risk map based on previous research that discusses the same mitigation plan.

1. Introduction

Supply chain is a very interesting thing to be discussed. Given the many opportunities that can be achieved from the optimal supply chain. In its development, Supply Chain activities involve many business operations and manufacturing activities which are seen as activities that have brought many changes to the environment [1]. The process in the supply chain is quite complex, including product development, procurement, planning & control, production, and distribution [2]. Because the system is so complex, there are many risks that may occur and disrupt business processes in the supply chain.

Risk is uncertainty and can have negative or positive effects. Risk is also a combination of the likelihood and severity of an event. Meanwhile, supply chain risk is the uncertainty of an event that can result in disruption to the smooth supply chain in a company. Risk in the supply chain can be reduced when company implements Supply Chain Risk Management Process [3].

Ajeng Gallery is a company engaged in manufacturing bags-based crafts. Due to the unique and high-quality bag products, this has led to high demand. However, demand is very volatile. The length of the supply chain at Ajeng Gallery and the high dependence on suppliers makes it vulnerable to possible risks. Moreover, the company does not have good risk management. Therefore we need risk management to overcome this problem.

Based on the background description, this study aims to design a supply chain risk management strategy at Ajeng Gallery with the House of Risk (HoR) approach. House of risk is a method that is focused on formulating preventive, reduce and handling risk agents that have the potential to cause more than one risk [4]. In simple terms, the HoR consists of 2 phases, in phase 1 a risk assessment will be carried out where the output is a risk agent priority which is then made an input in phase 2 HoR where the output is a priority mitigation strategy.
2. Research methods

In this study, researchers conducted risk mitigation with a bottom-up approach to the supply chain of Ajeng Gallery which is a handicraft bag company based on cowhide in Yogyakarta.

2.1. Company supply chain mapping

Before conducting risk assessment on the supply chain, knowledge of the existing supply chain system is needed. Ajeng Gallery supply chain network is in Figure 1.

![Supply chain network](image)

**Figure 1. Supply chain network**

2.2. Risk assessment

After understanding the supply chain system in the company, the next step is to identify the risk event and severity assessment, then identify the risk agent and occurrence assessment. Risk event identification is done by interviewing the expert. The expert is one of the company's managers who understands the Ajeng Gallery supply chain system. Whereas risk agent identification is carried out using Risk Cause Analysis (RCA). Severity (Si) and occurrence (Oj) assessments are carried out by distributing questionnaires to experts in the form of rating ratings from 1-10 where 1 is the smallest and 10 is the largest. After that, the degree of correlation (Rij) between the risk event and the risk agent is given with the assessment criteria in Table 1. House of Risk (HoR) 1 mapping was then carried out. The output of HoR 1 is the aggregate risk potential (ARPj) which is used to determine the priority of treatment for risk agents that need to be given risk prevention measures first. ARP calculation is obtained using equation 1.

| Weight | Information   |
|--------|---------------|
| 0      | No relationship |
| 1      | Low           |
| 3      | Moderate      |
| 9      | High          |

\[
ARP_j = O_j \sum S_i R_{ij}
\] (1)

From the calculation of ARP then calculated the percentage of each risk agent. The risk agent chosen has the largest percentage based on the Pareto principle. The Pareto principle is well-known with 80/20, where the failure of 80% is represented by 20%. Therefore, in this study, all risk agents will not be taken to mitigate, but only a few.
2.3. Risk mitigation

After obtaining a dominant risk agent, the next step is to plan risk mitigation to overcome the existing risk agents. At this stage the House of Risk (HoR) phase 2 is also produced. HoR phase 2 is a risk management phase where a selection of treatment strategies that are considered effective to reduce the probability and/or impact caused by the risk agent will be carried out. Handling/mitigation strategies are obtained from Focus Group Discussions with experts. This is because the expert knows more about the possibility of implementing the handling strategy in the company in terms of its financial and technical aspects. The strategies obtained are then determined by the degree of correlation between the existing strategies and all risk agents. The assessment of the degree of correlation is the same as before, which can be seen in Table 1. In addition, the granting of a Degree of Difficulty (DoD) which is the difficulty level of the mitigation design is implemented at the company. DoD was obtained from interviews by the expert with DoD criteria such as Table 2. Then an assessment of the Total Effectiveness (TEk) of each action is based on the correlation of risk agents with a mitigation strategy along with the Effectiveness to Difficulty (ETDk) which is the basis for determining the priority of mitigation handling. The TEk formula uses equation 2 and ETDk in equation 3.

Table 2. Degree of difficulty.

| Weight | Information                                      |
|--------|------------------------------------------------|
| 3      | Mitigation actions are easy to implement         |
| 4      | Mitigation actions are rather difficult to implement |
| 5      | Mitigation actions are difficult to implement    |

\[
TE_k = \sum_j ARP_j 
\]

\[
ETD_k = \frac{TE_k}{DoD}
\]

3. Results and discussion

The results obtained from the identification of risk events can be seen in Table 3. Risk agents are sought using RCA. The risk agents at Ajeng Gallery can be seen in Table 4.

Table 3. Risk events

| Code | Risk Events                                                                  | Severity |
|------|------------------------------------------------------------------------------|----------|
| E1   | Mistaken of planning for maintenance on production equipment                  | 6        |
| E2   | Delayed in design planning                                                   | 8        |
| E3   | Mistaken in production planning                                              | 4        |
| E4   | Raw materials and supporting materials do not meet the quality desired by the company | 8        |
| E5   | Lack of raw materials and supporting materials                              | 6        |
| E6   | Company’s internal communication system is not good                          | 3        |
| E7   | Mistaken of budget planning that will be used                                | 6        |
| E8   | Uncertainty of orders from customers                                         | 8        |
| E9   | Delay in planning the selection and use of transportation equipment / logistics providers to customers | 6        |
| E10  | The production is late                                                       | 4        |

Table 4. Risk agents

| Code | Risk Agents                                                                 | Occurrence |
|------|-----------------------------------------------------------------------------|------------|
| A1   | Lack of involvement and concern of workers in supporting activities in the company | 3          |
| Code | Risk Agents                                             | Occurrence |
|------|--------------------------------------------------------|------------|
| A2   | Lack of quality control process                        | 7          |
| A3   | Suppliers cannot meet company demand in terms of quantity or quality | 4          |
| A4   | Mistaken in maintenance planning on production equipment | 2          |
| A5   | The company's internal communication system is not going well | 3          |
| A6   | The number of orders from customers is uncertain       | 8          |
| A7   | Uncertainty of logistics providers to deliver products to customers | 3          |
| A8   | Damage to raw materials and or supporting materials during shipping | 2          |
| A9   | Delayed in supplier delivery                           | 3          |

### 3.1. House of risk 1

After scoring the severity and occurrence, the researcher analyzes the correlation between the risk event and the risk agent and then mapping the House of Risk Phase 1 and evaluating the ARP (Aggregate Risk Potential) using equation 1. HoR 1 can be seen in Table 5. Based on the ARP values that have been obtained from the calculation of the Table 5, the next is to determine the dominant risk agent with the Pareto approach. Pareto diagrams can be seen in Figure 2.

From the Pareto diagram, it is known that there is 1 risk agent (A3) out of 9 risk agents which is the dominant cause in the Ajeng Gallery supply chain because it has taken 25.6% of the total risk agents. However, in this study 2 risk agents will be taken so that added risk agents A2 to be mitigated. This is because it provides more comprehensive advice to companies.

### 3.2. House of risk 2

Based on the two risk agents shown in the Pareto diagram, the researcher will then design several mitigation plans or treatment strategies in order to reduce the appearance of these risk agents. The following are mitigations designed by researchers for Ajeng Gallery which can be seen in Table 6. After that the DoD value is given from the mitigation plan, as well as the calculation of Total Effectiveness (TEk) and Effectiveness to Difficulty (ETDk) using equations 2 and 3. The calculation results are mapped into House of Risk 2 in Table 7.

| Risk Agent | Mitigation                                                                 | Mitigation Code (PAi) |
|------------|----------------------------------------------------------------------------|-----------------------|
| A3         | Make a cooperation agreement (MoU) to ensure the availability of raw materials from suppliers | PA1                   |

![Figure 2. Pareto diagram](image-url)
Based on HoR 2, it shown the priority order of mitigation strategies that can be applied in advance at Ajeng Gallery. This does not mean that the most recent priority sequence is not done, priority here means the sequence that will be implemented after the next one follows. Implementation The priority order of mitigation plans are PA3, PA2, PA1, and PA4. By carrying out the mitigation strategy the company is expected to be able to reduce and even eliminate the highest risk agent for the company, that is, suppliers cannot meet the company's demand in terms of quantity or quality (A3) and the lack of quality control (A2) processes, which in turn will have an effect on reducing the level of risk events.

4. Conlusion

From the previous discussion, we get the priority order of the mitigation plan. The measurement of mitigation success that is applied at Ajeng Gallery is based on trusted journals related to the mitigation strategies offered that can be seen in Table 8. After implementation, it is estimated that the reduction of risk level can be seen in Figure 3.

### Table 8. House of risk 2

| Risk Agent | Mitigation | Mitigation Code (PAi) |
|------------|------------|-----------------------|
| A2         | Cooperating with more than 1 supplier | PA2 |
| A2         | Create product standardized quality  | PA3 |
| A2         | QC process procurement of raw materials before and during the production process | PA4 |

| Risk Agent | Mitigation | PA1 | PA2 | PA3 | PA4 | ARP |
|------------|------------|-----|-----|-----|-----|-----|
| A2         | 3          | 9   | 768 |
| A3         | 9          | 3   | 630 |
| TEk        | 2304       | 6912 | 5670 | 1890 | 1890 |
| DoD        | 4          | 4   | 3   | 3   |
| ETDk       | 576        | 1728 | 1890 | 630 |
| Rank of Priority (Rk) | 3 | 2 | 1 | 4 |

### Table 8. Implementation of mitigation

| Code | After Implementation |
|------|----------------------|
| PA3  | By providing a standardized product quality, customer satisfaction will increase. This is in line with the opinion of Naser et al. in Wibowo (2009) namely in his research produced that customer satisfaction is very dependent on how the level of product quality offered by the company [5]. |
| PA2  | According to Govindaraju and Sinulinga (2017) to maintain optimal supply of raw materials, schedule for purchasing raw materials and good cooperation with suppliers. So, collaborating with > 1 supplier is certainly an effective step can help companies achieve the desired production results [6]. |
| PA1  | Based on the results of research conducted by Jati (2008), it shows that the indicator of willingness to make cooperation agreements is one of the factors that has a large correlation to long-term relationships with suppliers. That is, if the company cooperates with the supplier, the company will get a guarantee of the availability of raw materials needed by the company for a long period of time [7]. |
| PA4  | From the results of research conducted by Elmas (2017), it can be concluded that quality control can minimize failed products. By minimizing failed products, the higher company goal is to provide quality convection products [8]. |
Figure 3. Risk map comparison

So it can be concluded, that there are 9 risk agents that cause risk events. ARP calculation shows that A3 and A2 are the biggest risk agents so the mitigation plan is focused on the two risk agents. There are 4 mitigation plans that can be implemented by companies which based on HoR 2 get priority rankings starting from PA3 PA2 PA1 and PA4. Implementing a mitigation plan can reduce the level of risk agents based on literature studies that discuss the same mitigation efforts.

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