Risk Identification in Cassava Chip Supply Chain Using SCOR (Supply Chain Operation Reference)

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Abstract. UD JM is a producer of cassava chips located in Malang, Indonesia. In 2016 to 2017, UD JM experienced a decrease in the amount of production which resulted in the production target not being achieved. The decrease in production was caused by uncertainty in the supply of cassava raw materials from suppliers, and during the rainy season cassava demand from small businesses or street vendors of fried vendors to cassava suppliers increased, resulting in competition in obtaining raw materials from other cassava processing industries and businesses. Another obstacle experienced by UD JM is the inaccuracy of workers in the production section, causing foreign objects to be found in one of the packages of cassava chips exported to companies in Singapore so that UD JM has to pay the company a fine. In order to create a reliable supply chain flow against various kinds of risk disruptions, UD JM requires supply chain evaluation and management by analyzing and evaluating the risks that have the potential to arise in the supply chain. Based on the results of the risk event identification and risk agent in each process in the supply chain flow using the SCOR (Supply Chain Operation Reference) approach, 47 risk events and 34 risk agents have the potential to cause disruption to the supply chain flow. UD JM.

Keywords: Supply Chain, Risk, SCOR (Supply Chain Operation Reference)

1. Introduction

Along with the emergence of new companies in the industrial world, this business competition is increasing. The company must have the right strategy to be able to compete with its competitors. This competition requires the company to be able to meet customer desires with increasingly high standards. Customers want to get products that are cheap, quality, and fast response. This requires industry players that to continue to meet the needs of their customers, the participation of all actors in the supply chain is needed, from upstream to downstream.

Every process in supply chain activity has the potential to face risks. Some examples of risks in the supply chain perspective are the lack of raw materials, increasing raw material prices, engine damage, uncertain demand, inaccurate forecasting, order changes, and transportation failure. Risk management in supply chain becomes an important issue and requires serious attention from company managers, in
addition to the risk that it often occurs, also the significant impact of potential risk events on the overall performance of the company [3].

This study took data in a cassava chip company, UD JM, located in Turen, Malang. UD JM processes cassava raw materials into cassava chips that are marketed to supermarkets in the Greater Malang area to be exported to Singapore. UD JM has a target market, namely for the snack food industry and directly to the end consumers. Products that are marketed to end consumers for direct consumption are cassava chips products processed from cassava raw materials to various flavored spices and packed with Ultra Mass brands. While products that are marketed to the snack food industry are cassava chips processed from raw cassava to just frying, after that fried cassava chips will be packaged directly into a plastic bag without the seasoning process being carried out and then the delivery process.

In running its business, the production of UD JM cassava chips is always sold out so that UD JM sets a production target that is the amount of production each year must exceed or minimum equal to the amount of production from the previous year. In Table 1 it can be seen that UD JM had experienced a peak in production in 2015, but several obstacles arose which resulted in UD JM experiencing a decline in the number of production until 2017. The decline in production resulted in the achievement of the UD JM production target for the last 2 years namely in 2016 and 2017 as shown in ‘figure 1’. The decrease in production was caused by uncertainty in the supply of cassava raw materials from suppliers and during the rainy season, the demand for cassava from small businesses or street vendors of fried vendors to cassava suppliers increased resulting in competition in obtaining raw materials from businesses and other cassava processing industries. This shows that the actual consumer demand for UD JM cassava chips is very large, it’s just that due to the difficulty of obtaining cassava raw materials that cause UD JM to be less able to maximize the amount of production to meet all customer requests that have the potential to cause UD JM to be unable to meet market and customer demands can switch to competitor products.

Table 1. Total Production of Cassava Chips UD JM 2013-2017

| Years | Total Production of Cassava Chips |
|-------|----------------------------------|
| 2013  | 596,698 kg                       |
| 2014  | 681,664 kg                       |
| 2015  | 707,441 kg                       |
| 2016  | 510,935 kg                       |
| 2017  | 291,480 kg                       |

Another obstacle experienced by UD JM is the presence of foreign objects or dirt found in one of the packages of cassava chips exported to a company in Singapore in January 2018, so that it causes the reject product and UD JM to pay a fine of Rp. 20,000,000 to the company. In addition, there are still many problems that have the potential to arise in the supply chain flow that can cause losses for UD JM.
Based on this, to be able to create a reliable supply chain flow against various kinds of risk disruptions, UD JM requires identification of risks that have the potential to arise in the entire process starting from receiving raw materials to packaging. At present, UD JM does not have risk management to manage risk in the supply chain and its handling strategies are needed so that the risks that arise cannot be resolved properly. Therefore, this research will identify the risk events that could potentially arise in the supply chain flow and what factors cause these risks to occur.

This study uses the Supply Chain Operation Reference (SCOR) approach which divides the supply chain process into 5 core processes, namely plan (planning), source (procurement), make (manufacture), deliver (delivery), and return (return) to identify risk events (risk event) and risk agent (cause of risk) in each process in the supply chain flow [2]. By using the SCOR approach, it is expected that this study will provide benefits to UD JM, namely to be able to find out the risks that could potentially arise in the supply chain flow.

2. Research Methods
This research is a type of descriptive research, which is research intended to investigate the circumstances, conditions, or other things, the results of which are presented in the form of research reports as straightforward as they are [1]. This research was conducted to provide an objective explanation and evaluation as material for making decisions on problems that occurred at UD JM.

The steps taken in this study are as follows:
1. Field Study
Field studies are intended to find out the condition of the object under study, so that there can be known problems that exist in the object of research.

2. Literature Study
Literature study is an activity to find information that can be obtained from reference books, journals, theses, internet, or other sources related to the problem. Literature study is used as a reference in solving problems that exist in the object of research.

3. Identification of Problems
Problem identification is a stage of research in understanding the problems that occur in the object of research.

4. Problem Formulation
After the problem is identified, then detailed to facilitate the resolution of the problem.

5. Determination of Research Objectives
The research objective is determined based on the problems that have been formulated previously. The research objective is determined so that research can be directed towards solving existing problems.

6. Data Collection
Data collection is done to get the information needed in order to achieve the research objectives. The data collection process can be done by recording things about the characteristics of some or all elements of the population that will support the research. The data collected at this stage will be used as input for data processing to resolve the issues raised. Data collected in this study are object profile data, raw material procurement data, production flow data, and distribution flow data.

7. Data Processing
At this stage data processing is done with relevant methods to solve the problems faced by the following steps:
   a. Mapping Supply Chain Activities
      At this stage an initial mapping of supply chain activities is carried out. The supply chain activity mapping process is carried out to find out the parties involved and how the flow in the supply chain flow at UD JM. So with this mapping, it will be easier to identify the risks of UD JM supply chain in the next stage.
   b. Identification of Supply Chain Risk
      At this stage identification of risks that will be handled at the supply chain flow is carried out by conducting an interview with UD JM about what risks have the potential to occur, the source of the causes of risk, and how these risks arise. This risk identification phase uses the development method of
SCOR which divides business activities into five namely plan, source, make, deliver, and return. At this stage there will also be known sources or factors that cause risk.

8. Closing
Closing is the final stage of this research. The conclusions were obtained from the results of the collection, processing, and analysis that answered the research objectives.

3. Result and discussion

Data processing stages are explained as follows:

3.1 Supply Chain Activity Identification

UD JM's supply chain activity starts from incoming requests from customers. UD JM will check the amount of inventory for production needs and then order cassava raw materials, plastic packaging, cardboard packaging, firewood to each supplier, and purchase complementary materials such as seasoning and cooking oil to retail stores. After delivery by the supplier to the UD JM production location, then the raw material inspection and payment to the supplier is carried out. After that the cassava chips production process is carried out where there is a stage of re-inspection of the quality of cassava in the frying process by checking whether cassava can expand well in accordance with UD JM quality standards. Cassava chips with standard quality will be exported and sold to supermarkets, while cassava chips that do not meet quality standards or reject will be sold directly to the end customer who is a community around the production location.

After cassava chips are processed properly and carried out packaging, then storing the product into the warehouse and shipping the product to the customer. After the cassava chips product reaches the customer, then the inspection is carried out whether the product conforms to the standard or not and the bill is paid by the customer. If the product is not in accordance with the standard, the customer returns the process to UD JM. This return process can occur after a few days the product is received by the customer. This can be caused by the product being damaged due to poor storage by the customer. The mapping of UD JM supply chain activities can be seen in Table 2 as follows.

| SCOR | Supply Chain Activities                  |
|------|------------------------------------------|
| Plan | Planning production                       |
|      | Checking inventory                       |
| Source | Ordering raw materials                        |
|       | Purchasing support materials                |
|       | Accepting raw materials                      |
|       | Raw material inspection                      |
| Make | Production process                          |
|       | Product inspection                           |
|       | Packaging product                            |
|       | Storing product                              |
| Delivery | Product delivery to customers              |
|        | Billing to customers                         |
| Return | Identify returns product                     |
|        |Returning raw materials to suppliers         |

3.2 Risk Event Identification

At this stage risk event identification has the potential to occur in UD JM supply chain flow. Based on the results of the supply chain activity mapping with the SCOR (Supply Chain Operation Reference) model in Table 2, then identify the risk events for each activity. Risk event identification is obtained through discussions with UD JM owners. Risk events are all events that have the potential to arise and cause disruptions in the supply chain flow. The following is the result of risk event identification on the UD JM supply chain flow shown in Table 3.
3.3 Risk Agent Identification

At this stage the risk agent is identified which is the cause of the risk event in the UD JM supply chain flow. Identification of risk agents is obtained through discussions with UD JM owners. A risk agent can cause one or several risk events and one risk event can be caused by one or several risk agents. The following is the result of risk agent identification on UD JM supply chain flow shown in Table 4.

Table 3. Risk Event Identification

| SCOR | Supply Chain Activities | Code | Risk Event |
|------|-------------------------|------|------------|
| Plan | Planning production     | E1   | Mistake in planning production schedule |
|      |                         | E2   | Incompatibility allocation of human resources |
|      |                         | E3   | Make mistake in raw material planning |
|      | Checking inventory      | E4   | Incompatibility between actual inventory and recorded inventory |
|      | Ordering raw materials  | E5   | The supplier cannot fulfill the number of cassava requests |
|      |                         | E6   | Increase in cassava raw materials price |
|      |                         | E7   | The supplier plastic packaging cannot meet the demand |
|      |                         | E8   | Increase in the plastic packaging price |
|      |                         | E9   | The supplier cardboard packaging cannot meet the demand |
|      |                         | E10  | Increase in the cardboard packaging price |
|      |                         | E11  | The supplier cannot meet the demand for firewood |
|      |                         | E12  | Increase in the firewood price |
|      | Purchasing support materials | E13 | Difficulty getting support materials in the retail market / shop |
|      |                         | E14  | Increase in the support material price |
|      | Accepting raw materials | E15  | Delay delivery of raw materials from cassava suppliers |
|      |                         | E16  | Delay delivery of raw materials from plastic packaging suppliers |
|      |                         | E17  | Delay delivery of raw materials from cardboard packaging suppliers |
|      |                         | E18  | Delay delivery of raw materials from firewood suppliers |
|      | Raw material inspection | E19  | The cassava fulfillment does not match with the order |
|      |                         | E20  | Cassava quality is not in appropriate with the standard |
|      |                         | E21  | The number of plastic packaging does not match with the order |
|      |                         | E22  | The quality of plastic packaging is not suitable with the standard |
|      |                         | E23  | The number of cardboard packaging does not match with the order |
|      |                         | E24  | The quality of cardboard packaging is not suitable with the standard |
| SCOR  | Supply Chain Aktivities              | Code | Risk Event                                                                 |
|-------|-------------------------------------|------|---------------------------------------------------------------------------|
|       |                                     | E25  | The amount of firewood does not match the order                           |
|       |                                     | E26  | The quality of firewood is not suitable with the standard                 |
|       |                                     | E27  | Delay in production from the predetermined schedule                       |
|       |                                     | E28  | An accident occurred during the production process                        |
|       |                                     | E29  | The amount of human resources is not appropriate with planning             |
|       |                                     | E30  | Produce reject products                                                   |
|       |                                     | E31  | Production area is not clean                                               |
|       |                                     | E32  | Additional costs in the production process that are beyond expectations    |
|       | Production process                   | E33  | Reject products passed inspection                                          |
| Make  |                                     | E34  | The foreign objects contained in the product passed inspection             |
|       | Product inspection                   | E35  | The packaging process is less than perfect                                 |
|       | Packaging product                    | E36  | Production results are not on target                                       |
|       | Storing product                      | E37  | Product damage during storage in the warehouse                             |
|       | Product delivery to customers        | E38  | Delay in product delivery to customers                                     |
|       |                                       | E39  | Product damage during the shipping process                                 |
|       |                                       | E40  | An accident occurred during the shipping process                           |
|       |                                       | E41  | Additional costs for the shipping process are beyond expectations          |
|       | Billing to customers                 | E42  | Late payment from customer                                                 |
|       | Identify returns product             | E43  | Product returns from customers cannot be repaired                          |
|       | Returning raw materials to suppliers | E44  | Cassava suppliers cannot replace reject cassava                            |
|       |                                       | E45  | Plastic packaging suppliers cannot replace reject plastic packaging        |
|       |                                       | E46  | Cardboard packaging suppliers cannot replace reject cardboard packaging   |
|       |                                       | E47  | Firewood suppliers cannot replace reject firewood packaging                |

### 3.4 Analysis and discussion

Based on the mapping of UD JM’s supply chain activities using the SCOR (Supply Chain Operation Reference) approach which divides the supply chain process into 5 core processes, namely plan, source, make, deliver and return, obtained a total of 14 activities from the 5 core processes. There are 2 activities in the plan process, namely production planning and checking the amount of inventory. There are 4 activities in the source process, namely ordering raw materials, purchasing supporting materials, receiving raw materials, and inspecting raw materials. In the make process there are 4 activities, namely the production process, product inspection, product packaging, and product storage. In the delivery process there are 2 activities, namely the delivery of the product to the customer and sending the bill to the customer. In the return process there are 2 activities, namely product identification return and return of raw materials to suppliers.
Based on the results of risk event identification that has the potential to appear in UD JM's supply chain using the SCOR (Supply Chain Operations Reference) model, 47 risk events are obtained from the entire supply chain activity, namely plan, source, make, deliver, and return. In the activity plan, there are four risk events, namely the error of planning the production schedule, the allocation of human resources that are not in accordance with their expertise, errors in planning raw material needs, and the discrepancy between the actual inventory amount and the recorded one.

| Code | Risk Agent | Code | Risk Agent |
|------|------------|------|------------|
| A1   | Lack of worker's concern in supporting the company's progress | A18 | Poor communication with cassava suppliers |
| A2   | Lack of worker experience | A19 | Poor communication with plastic packaging suppliers |
| A3   | Human error on workers | A20 | Poor communication with cardboard packaging suppliers |
| A4   | A structured recording system has not been carried out | A21 | Poor communication with firewood suppliers |
| A5   | Lack of human resources | A22 | Poor communication with customer |
| A6   | The completion of production does not meet the target time | A23 | There is no inspection process from the cassava supplier |
| A7   | Poor internal communication | A24 | There is no inspection process from the plastic packaging supplier |
| A8   | Workers do not use Personal Protective Equipment | A25 | There is no inspection process from the cardboard packaging supplier |
| A9   | Scarcity of cassava | A26 | There is no inspection process from the firewood supplier |
| A10  | Scarcity of plastic packaging | A27 | Traffic congestion |
| A11  | Scarcity of cardboard packaging | A28 | Natural disasters occurred |
| A12  | Scarcity of firewood | A29 | Transportation equipment is damaged |
| A13  | Scarcity of support materials | A30 | Machine or production equipment is damaged |
| A14  | Dependence on one cassava supplier | A31 | Warehouse entered accidentally rats |
| A15  | Dependence on one plastic packaging supplier | A32 | The condition of the building is damaged |
| A16  | Dependence on one cardboard packaging supplier | A33 | Expired product |
| A17  | Dependence on one firewood supplier | A34 | Damaged product packaging |

In the source activity there are 22 risk events, namely the supplier cannot meet the demand for cassava, the price of cassava raw material increases, the supplier cannot meet the demand for plastic packaging, the price of plastic packaging increases, the supplier cannot meet the cardboard demand, the price of cardboard packaging, supplier unable to meet the demand for firewood, increase in firewood.
prices, difficulties in obtaining supporting materials in the market / retail stores, rising prices of supporting materials, delays in the delivery of raw materials from cassava suppliers, delays in the delivery of raw materials from plastic packaging suppliers, delays in the delivery of raw materials from cardboard packaging supplier, late delivery of raw materials from firewood suppliers, the number of cassava is not in accordance with the order, the quality of cassava is not according to standards, the number of plastic packaging is not in accordance with the order, the quality of plastic packaging is not according to the standard, the number of cardboard packaging does not match the order, the amount of firewood is not in accordance with the order, and the quality of firewood is not in accordance with the standards.

In the make activity there are eleven risk events, namely the delay in the implementation of production from a predetermined schedule, an accident occurred during the production process, the number of human resources that are not in accordance with the planning, the production process produces reject products, the production area is not clean, the additional costs in the production process are unexpectedly, there is a reject product that passes inspection, there is foreign material / dirt on the product that passes the inspection, the packaging process is not perfect, the production is not according to the target, and the product is damaged during the storage process in the warehouse. On deliver activities there are four risk events, namely the delay in product delivery to customers, product damage during the shipping process, an accident during the shipping process, and additional costs in the shipping process beyond expectations. In return activities there are six risk events, namely late payment from customers, product returns from customers cannot be repaired, cassava suppliers cannot replace raw materials, plastic packaging suppliers cannot replace raw materials, cardboard packaging suppliers cannot replace raw materials, and wood suppliers fuel cannot replace raw materials.

Based on the results of the identification of risk agents (risk agents) that cause the emergence of risk events in the UD JM supply chain, 34 risk agents were obtained. The risk agent is the lack of workers' concern in supporting the company's progress, the lack of experience of workers in work, human error on workers, the absence of a structured recording system, lack of human resources, completion of production not according to time targets, poor internal communication, workers not using PPE (Personal Protective Equipment), scarcity of cassava raw materials, scarcity of plastic packaging raw materials, scarcity of cardboard packaging raw materials, scarcity of cardboard packaging raw materials, scarcity of fuel wood raw materials, scarcity of supporting materials, dependence on one cassava supplier, dependence on one plastic packaging supplier, dependence on one cardboard packaging supplier, dependence on one firewood supplier, poor communication with cassava suppliers, poor communication with plastic packaging suppliers, poor communication with cardboard packaging suppliers, poor communication with firewood suppliers, lack of communication with the customer, there is no inspection process from the supplier of cassava, there is no inspection process from the supplier of plastic packaging, there is no inspection process from the cardboard packaging supplier, there is no inspection process from the wood fuel supplier, traffic congestion, natural disruption or natural disasters, damage to transportation equipment, damage to machinery or production equipment, entry of animal parasites (mice), damage to building conditions, expired products, and damage to product packaging.

4. Conclusion

In order to create a reliable supply chain flow against various kinds of risk disruptions, UD JM requires supply chain evaluation and management by analyzing and evaluating the risks that have the potential to arise in the supply chain. Therefore, it is necessary to identify risk events that have the potential to arise in the supply chain flow and what factors cause the risk to occur. Based on the mapping of UD JM supply chain activities with the SCOR (Supply Chain Operation Reference) approach in the process plan there are 2, the source process has 4 activities, the make process has 4 activities, the delivery process has 2 activities, and the return process is 2. After mapping the activity supply chain, then the risk event identification that has the potential to arise in UD JM supply chain is obtained by 47 risk events and risk agent identification (risk agent) which causes the emergence of risk events in the UD JM supply chain as much as 34 risk agent.

By knowing the risk event and risk agent in the supply chain flow, it is expected that UD JM can determine the right strategy to handle potential risks. So that by implementing the right strategy, UD
JM can create a reliable supply chain flow against a variety of risk disorders.

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