

RISK MANAGEMENT IN ORGANIC FERTILIZER SUPPLY CHAIN ACTIVITIES**Irine Octaviani, Djoko Koestiono, Anisa Aprilia**Departement of Socio Economics, Faculty of Agriculture, Brawijaya University, Jl. Veteran, Malang
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ABSTRACT

Supply chain management is not easy because there are two challenges that must be faced, namely, the complexity of the supply chain structure and the uncertainty that occurs suddenly, therefore these conditions are vulnerable to various forms of risk. The research was conducted by the aim of identify the risks, causes of risk and determining the right strategy to deal with the causes of risk in supply chain activities at PT. MBA. House of Risk (HOR) was used by five indicators in the SCOR (Supply Chain Operation Reference) model, consists of plan, source, manufacture, distribution and return. Risk events were identified and considered priorities, namely delays in receiving raw materials from suppliers, implementation of production not on schedule, no production process activities, unable to meet all demands, decreasing product quality during the process, product quality not in accordance with existing standards and delays product delivery (finished good) to PT. PKG. The priority risk agent is a risk agent to check inaccurate raw materials. Meanwhile, the handling strategy that is a priority to be implemented, with the hope of being able to prevent the causes of risk is coordination, stock strategy and flexible supply base.

Keywords: *supply chain, house of risk, risk management strategy*

INTRODUCTION

Companies in running a business are required to have the right strategy to survive in business competition. The strategy that can be conducted is to manage the supply chain appropriately (Tampubolon et al., 2013). According to Pujawan (2005) and Punniyamoorthy et al., (2013), factors that cause risk in the supply chain include increasingly complex supply chain networks, high dependence on suppliers and differences in organizational interactions in the supply chain. If the risks to the supply chain are not immediately addressed, disruption to the supply chain has the potential to be very dangerous and expensive, resulting in low service levels and high costs (Blackhurst & Handfield, 2005).

Anatan & Ellitan (2008) and Pujawan (2005) states that the complexity of the supply chain structure is due to the involvement of many parties inside and outside the company, each of which has different interests and often conflicts between one and the other. The challenge that must be faced in managing the supply chain in addition to the complexity of the supply chain structure is uncertainty. Uncertainty in the supply chain can be classified into 3, that is demand uncertainty, supplier uncertainty and internal uncertainty.

PT. MBA is one company that produces organic fertilizer, under PT. PKG. PT. MBA is required to increase productivity in every process of production, both in terms of increasing production yields, quality and quantity of production and efficient use of

resources. Uncertainty in raw materials with company demands, lack of coordination between PT. MBA with raw material suppliers and a high dependence on suppliers creates a risky occurrence. In addition, business activities at PT. MBA involve various actors, ranging from procurement of raw materials, flow of raw materials from suppliers to factories and then processed and then distributed. The chain of activities is defined as a supply chain. Meanwhile, supply chain is a series of activities that cover the process of transformation and distribution of goods, ranging from raw materials to finished products to end consumers (Anwar, 2011).

The level of dependence and complexity in the supply chain causes the overall supply chain to be more susceptible to disruptions. Disruptions that occur in one supply chain actor can affect the supply chain as a whole, such as the flow of information and resource from upstream to downstream (Suharjito et al., 2010). According to Kersten et al., (2007), supply chain risk is the possibility of damage caused by an event or action from supply chain actors and their environment that causes a negative influence on business processes in the supply chain network.

The emergence of risk in supply chain activities must be estimated and handled thus it is not to interfere with company objectives. Therefore, companies need to manage supply chain risk at PT. MBA than so that the company can survive and continue efforts to achieve profits. Supply Chain Risk Management (SCRM) deals with the risks that occur in the flow of products, information and raw materials for the delivery of the final product (Juttner et al., 2003). There are four elements in supply chain risk management, namely risk identification, risk assessment, risk mitigation and responses to risk incidents stemming from operational risks derived from supply and demand uncertainty and disaster risk (Tang & Nurmaya Musa, 2011).

Based on the background of this research, the purposes of the research were identify the causes of risk in supply chain activities and

determine the right strategies to deal with the causes of risk in the supply chain activities at PT. MBA. The scope of this research were focus on supply chain activities at PT MBA. Thus, it was expected that this research can provide advice and recommendations for companies in managing and resolving the risks that occur and can help PT. MBA to deal with the risks that arise in the supply chain, reduce or even eliminate events and causes of risk in the supply chain. Thus, PT MBA can compete with other organic fertilizer companies, increase and / or stabilize organic fertilizer production.

RESEARCH METHODS

The method of determining the location of the research was conducted purposively at PT. MBA with consideration, that is: (1) PT. MBA is one of the companies that produce organic fertilizer and partnered with PT. PKG. Given that PT. The MBA is one company that produces agricultural inputs that are always needed to meet the demand for organic fertilizer to be subsidized by the government, meanwhile in companies that produce organic fertilizer such as PT. MBA, organic fertilizer supply chain activities have the opportunity to arise risks. (2) PT. The MBA has not applied risk management in the organic fertilizer supply chain, (3) research has never been conducted in relation to risk analysis in supply chain activities at PT. MBA, (4) Positive company response in research on risk analysis in the supply chain.

The method of determining informants was conducted by purposive sampling technique with the type of judgment sampling. Informants were production and logistics managers of PT. MBA and determined based on the consideration that the production and logistics manager of PT. MBA was aware of supply chain activities, thus they can identify risks for supply chain activities. The method used in data collection was interviews, conducted to determine the company's supply chain activities and to identify risks that occur in the company's

supply chain activities and the causes of risk. Data collection methods with documentation were used to obtain secondary data in the form of general company data which includes company history and data flow of raw material procurement, and distribution.

Data analysis method used in this study was the House of Risk (HOR) method developed by Pujawan and Geraldin (2009). The House of Risk (HOR) method was a method that focuses on preventive actions, that is reducing the possible causes of risk (Pujawan & Geraldin, 2009).

According to Pujawan (2005), the application of the SCOR (Supply Chain Operation Reference) model is one of the supply chain operating models used to measure supply chain performance based on the process. The SCOR model integrates three main elements in management, that is business process reengineering, benchmarking and measuring processes into a cross-functional framework in the supply chain. Based on research conducted by Astutik et al (2010); Luthfi & Irawan (2012); Tampubolon et al., (2013); Kristanto & Hariastuti (2014); Ulfah & Syamsul (2016); Citraresmi (2017); Ummi et al., (2017); Immawan & Putri (2018), the SCOR model can be used to analyze risks in supply chain activities without initiating a supply chain performance analysis of the three elements.

According to Pujawan & Geraldin (2009) and Tampubolon et al., (2013) the application of the HOR method has two stages:

A. House of Risk 1 (HOR 1)

HOR 1 was used to identify risks and causes of risk events thus from HOR 1, the cause of prioritized risks can be generated to take precautions in accordance with ARP values. The HOR 1 process has several stages of work:

1) Identifying risk events that can occur in each business process. This was conducted through the supply chain mapping process of the SCOR model including (plan, source, make, deliver and return) and then identify what is missing / wrong in each process.

2) Assess the severity if a risk event occurs,

using a scale of 1-5 where 5 is very severe.

3) Identification of the causes of risk and the value of possible causes of risk using a 1-5 scale where 1 means that almost never occurs and a value of 5 means often.

4) Develop matrix relationships. The relationship between each cause of risk and each risk event, R_{ij} (0, 1, 3, 9) where 0 shows no correlation and 1, 3, 9 show the low, medium and high correlations respectively.

5) Calculates the ARP_j value as in equation (1).

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

6) The rating of the causes of risk was based on the potential risk from the biggest value to the lowest value.

B. House of Risk 2 (HOR 2)

HOR 2 was used to design strategies to deal with the causes of priority category risks. Action strategies were carried out by considering the involvement of resources and the level of difficulty in the implementation. The output from HOR 1 will be used as input for HOR 2. The application of HOR 2 includes several stages of work:

1) Choose the cause of risk starting from the highest to lowest ARP values that might use a pareto diagram.

2) Identify actions that was considered relevant (PAk) to prevent the cause of risk. It should be noted that one cause of risk can be handled with more than one action and one action simultaneously can reduce the likelihood of more than one cause of risk.

3) Determine the relationship between each precautionary measure and each cause of risk, E_{jk} . Its value (0, 1, 3, 9) which shows no consecutive, low, medium and high relationships between actions k and causes of risk j. The relationship (E_{jk}) will be a consideration in determining the degree of effectiveness of the action k in reducing the likelihood of risk-causing events.

4) Calculate the total effectiveness (TEk) of each action, using the following calculation:

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

- 5) Assess the level of difficulty in the application of action handling, Dk. The level of difficulty can be represented by the level of difficulty scale. The scale consists of (3,4 and 5) which shows that the strategy is easily realized, strategies are difficult to realize and strategies are difficult to realize.
- 6) Calculate the effectiveness of the total difficulty ratio:

$$ETD_k = \frac{Tek}{Dk} \dots\dots\dots(3)$$

- 7) Determining the priority ranking for each action (Rk) was the first rank that gives the highest meaning of action with ETDk.

RESULTS AND DISCUSSIONS

Structure of Organic Fertilizer Supply Chain

PT. MBA only works with one supplier for each raw material. Risk management in the organic fertilizer supply chain activities in this study only covers the upstream supply chain and internal supply chain. The role of

each party involved in the organic fertilizer supply chain at PT. MBA as follows:

1. Suppliers: PT. MBA only works with one supplier for each raw material, that is chicken manure collectors, cow manure collectors, while blotong is supplied directly from Sugar Factory (PG).
2. PT. MBA: has a role as a processor in the organic fertilizer supply chain and does not have the power to market its production fertilizer.
3. PT. PKG: Organic Fertilizer from PT. MBA will be sent to PT. PKG. The warehouse in the organic fertilizer supply chain serves to connect PT. PKG with distributors.

Mapping Supply Chain Activities

Supply chain activity mapping is the initial stage in the House of Risk (HOR) method, mapping activities based on SCOR, namely plan, source, make, deliver / distribution and return (Pujawan & Geraldin, 2009). Mapping supply chain activities at PT. MBA based on the SCOR model as in Table 1, as follows:

Table 1. Mapping of Supply Chain Activities at PT. MBA Based on SCOR Model

Major Processes/ Concept of SCOR	Sub Processes/ Activities of PT. MBA
<i>Plan</i>	Forecasting the demand for organic fertilizer from PT. PKG
	Organic fertilizer production planning
	Production capacity planning
	Raw material planning
<i>Source</i>	Receive of raw material delivery
	Checking of raw material delivery
	Authorizing payment of raw materials sent by suppliers
<i>Make</i>	Production scheduling
	Production processes
	Checking of product quality
	Packaging process
<i>Delivery</i>	Delivery selection
	Warehouse of finished products
	Shipping goods / products
<i>Return</i>	Handling of defect products from PT. PKG
	Handling delivery of new products to PT. PKG

Source: primary data processed (2018)

Identify Risk Events in Supply Chain Activities

Risk event identification was carried out to determine the risks that occur and the risks that have the potential to occur in supply chain activities of the company PT. MBA. Identification of risk events for each business process that has been identified was an event that may arise / arise and cause disruption of supply chain activities that result in company losses (Geraldin et al., 2007); (Luthfi & Irawan, 2012); (Tampubolon et al., 2013); (Ulfah & Syamsul, 2016). The following were risk events in supply chain activities at PT. MBA.

Based on the results of the analysis in table 2 there were 23 risk events identified in all stages of the organic fertilizer supply chain

activity process at PT. MBA using the SCOR model which consists of five business processes (plan, source, make, deliver and return). Risk events that have been identified in the supply chain activities of PT. The MBA is in the activity plan there are 5 risk events. In the source activity there are 3 risk events. In the make activity there are 6 risk events. On deliver activities there are 6 risk events. In return activity there are 2 risk events
 Identification of Risk Causes in Supply Chain Activities

The risk agent identification was carried out to find out what factors cause the occurrence of the risk events that have been identified. Risk agents are things that can cause a risk event to occur thus it can disrupt the company's supply chain activities

Table 2. Identification of Risk Events Based on Supply Chain Activities in PT. MBA

Major Processes	Sub Processes	Risk Event	Code	Severity Value
Plan	Forecasting the demand for organic fertilizer from PT. PKG	Determine the inappropriate amount of demand for organic fertilizer from PT. PKG (error forecasting)	E1	2
	Raw material planning	The gap between the recorded stock and available stock (incompatibility between total capacity and existing conditions)	E2	2
		Inaccurate inventory parameters	E3	1
	Planning for organic fertilizer production	Errors / changes in plans for production of sudden organic fertilizer	E4	3
	Production capacity planning	Capacity planning is not conducted as planned	E5	2
Source	Acceptance of raw material delivery	Delays in receiving raw materials from suppliers	E6	4
	Checking raw material shipments	Errors in raw materials received from suppliers (the quality received is not suitable and the amount of raw material received is not in accordance with the order)	E7	3
	Provision of payment authorization for raw materials sent by suppliers	Error in authorizing payment of raw materials sent by suppliers	E8	1

Make	Production scheduling	Delay in production schedule / production implementation is not on schedule	E9	4
	Production implementation	There are no production process activities	E10	4
		Not able to meet all demands / production unable to meet demand (incompatibility production capacity by the number of products to be produced)	E11	4
	Product quality check Quality	The decline in quality throughout the process	E12	4
		The quality of the product does not comply with existing standards	E13	4
	Packaging process	Leakage of product packaging	E14	1
		Dirty packaging	E15	1
Deliver or Distribution	Selection delivery	Data incompatibility of product number on the system with existing conditions	E16	1
	Warehouse of finished good	The product is not handled	E17	2
	Delivery of goods/	Delay in the delivery of organic fertilizer products to PT. PKG	E18	4
		Error (in quantity) of product delivery to PT. PKG	E19	2
		Products sent to the wrong destination	E20	2
		Product damage during the trip	E21	2
Return	Handling of defect products from PT. PKG	Late in handling organic fertilizer returns from PT. PKG	E22	3
	Handling the delivery of defect products to PT. PKG	Delay in the delivery of defect products to industry users of PT. PKG	E23	3

(Geraldin et al., 2007); (Tampubolon et al., 2013). According to Pujawan & Geraldin (2009) a risk agent can induce more than one risk event and the presence of a risk event cannot be separated from the accompanying risk agent (Luthfi & Irawan, 2012).

Based on Table 3, it can be seen that there are 35 risk agents that have the potential to trigger risk events in supply chain activities of PT. MBA.

Assessment of the Relationship Level between Risk Events and Risk Agents

According to Ulfah & Syamsul (2016), a risk cause causes a risk event, so there is a correlation. The higher the correlation shows the greater correlation between the incidence of risk and the cause of risk. Aggregate Risk Potentials (ARP) are used to determine the priority of risk agents that need to be handled / designed by the strategy (Geraldin et al., 2007); (Luthfi & Irawan, 2012); (Pujawan & Geraldin, 2009); (Ulfah &

Syamsul, 2016).

Based on Table 4, it was obtained information that the highest ARP value has a value of 495 which indicates that the risk agent has the highest priority for handling compared to other risk agents. Risk agent that

has the highest value is A21, a risk agent code for checking raw materials that are not accurate.

According to Luthfi & Irawan (2012) the higher the ARP value of a risk agent will be directly proportional to the level of impact

Table 3. Assessment Risk Agent

No.	Code	Risk Agent	Occurrence Value
1.	A1	Significant increase in demand for organic fertilizer.	2
2.	A2	Seasonal factors.	2
3.	A3	Lack of information and communication.	2
4.	A4	Sudden demand of organic fertilizer	2
5.	A5	Raw material inventory data is not immediately in up to date.	3
6.	A6	Sudden raw material / material demand.	4
7.	A7	Delays in the procurement of raw materials.	5
8.	A8	The ability of suppliers to meet demand on schedule is low.	5
9.	A9	Poor coordination in the warehouse of raw material storage.	4
10.	A10	Incorrect price reference.	1
11.	A11	Lack of raw materials supply in warehouses.	2
12.	A12	The occurrence of trouble / damage to the engine.	2
13.	A13	Factor reliability of machine tools during the process.	1
14.	A14	Power supply is interrupted.	1
15.	A15	Coal supply is disrupted.	1
16.	A16	Shut down production.	2
17.	A17	Demand for sudden purchase of raw materials.	4
18.	A18	Interference with raw materials during the trip.	4
19.	A19	Depends on one supplier.	5
20.	A20	List of raw material purchases is not clearly specified.	4
21.	A21	Checking the quality of raw materials that are not accurate.	5
22.	A22	Lack of maintenance management.	1
23.	A23	Unused raw materials.	1
24.	A24	Error in sampling.	2
25.	A25	The occurrence of packaging contamination during the storage process.	2
26.	A26	Checking the quality of the final product that is not accurate	2
27.	A27	Error input data of finished products (organic fertilizer)	1
28.	A28	Data on the results of finished products are not immediately up to date	1
29.	A29	Limited warehouse area of production.	4
30.	A30	Limited transportation.	1
31.	A31	Transport equipment is damaged.	1
32.	A32	Lack coordination in shipping.	2
33.	A33	Natural disasters.	1
34.	A34	Disturbance during the product delivery.	4
35.	A35	Transportation means that are not safe from environmental factors.	1

Source: primary data processed (2018)

that will be caused in the company's supply chain activities. However, Luthfi & Irawan

(2012) also mentioned that not all risk agents get a handling, it is caused by several factors,

Table 4. Risk Agent

No.	Risk Agent	ARP	Rank	Cumulative ARP	% ARP	% Cumulative ARP
1.	A21	495	1	495	16.47%	16.47%
2.	A7	395	2	890	13.14%	29.62%
3.	A19	315	3	1205	10.48%	40 , 10%
4.	A12	246	4	1451	8.19%	48.29%
5.	A16	158	5	1609	5.26%	53.54%
6.	A17	144	6	1753	4.79%	58.34%
7.	A1	132	7	1885	4.39%	62.73%
8.	A4	102	8	1987	3.39%	66.12%
9.	A15	111	9	2098	3.69%	69.82%
10.	A32	96	10	2194	3.19%	73.01 %
11.	A9	92	11	2286	3.06%	76.07%
12.	A34	92	12	2378	3.06%	79.13%
13.	A14	88	13	2466	2.93%	82.06%
14.	A5	54	14	2520	1 , 80%	83.86%
15.	A11	54	15	2574	1.80%	85.66%
16.	A2	38	16	2612	1.26%	86.92%
17.	A20	36	17	2648	1.20%	88.12%
18.	A26	36	18	2684	1.20%	89.32%
19.	A13	33	19	2717	1.10%	90.42%
20.	A8	30	20	2747	1.00%	91.41%
21.	A31	30	21	2777	1.00 %	92.41%
22.	A3	24	22	2801	0.80%	93.21%
23.	A6	24	23	2825	0.80%	94.01%
24.	A22	24	24	2849	0.80%	94.81%
25.	A24	24	25	2873	0.80%	95.61%
26.	A29	24	26	2897	0.80%	96.41%
27.	A30	21	27	2918	0.70%	97.10%
28.	A33	21	28	2939	0.70%	97 , 80%
29.	A18	16	29	2955	0.53%	98.34%
30.	A25	12	30	2967	0.40%	98.74%
31 .	A35	11	31	2978	0.37%	99.10%
32.	A27	9	32	2987	0.30%	99.40%
33.	A28	9	33	2996	0.30%	99.70%
34.	A23	8	34	3004	0.27 %	99.97%
35.	A10	1	35	3005	0.03%	100.00%

Source: primary data processed (2018)

that is in terms of the costs incurred in the handling process and the level of impact caused is considered too small. The results of calculating the ARP value were then ranked using the Pareto diagram shown in Figure 1.

Determination of the priority risk agent category was conducted by using the pareto principle 80:20. The principle states that 80% of the company's losses were caused by 20% of crucial risk agents, meaning that by focusing 20% of the risk agents that were crucial, the impact of the company's risk or 80% risk event can be overcome (Luthfi & Irawan, 2012); (Pujawan & Geraldin, 2009). Based on Table 4 and Figure 1 it can be seen that with the Pareto 80:20 principle, 12 risk agents were obtained from 35 risk agents which were the cause of the risk of supply chain activities at PT. MBA and made into consideration in the preparation of risk management strategies.

Risk Management Strategy

Based on Figure 4, there were 12 risk agent priorities that were used as consideration in the preparation of risk management strategies. According to Pujawan & Geraldin (2009) one risk agent can be handled with more than one action and one

action simultaneously can reduce the possibility of more than one risk agent. A plan of handling strategies to be carried out to deal with the risk agent can be seen in Table 5.

Risks cannot be avoided but can be minimized by handling appropriate risks so as to minimize costs, time and performance in supply chain activities (Handayani, 2016). Assessment of risk management strategies was based on the level of difficulty in each strategy (Nurlela & Suprpto, 2014).

Based on the value of ETD (Effectiveness to Difficulty) contained in the number 6 risk management strategies that have the highest value, namely coordination (PA5) with a value of 3943. Those strategy was used to handle several risk agents and can be applied easily in terms of costs and resources.

The value of effectiveness to difficulty showed that the level of effectiveness of the strategy after consideration of the ability to be applied to a business entity. The higher the value of effectiveness to difficulty, the strategy is increasingly a priority to be applied. The risk management strategy that has the lowest ETD (Effectiveness to Difficulty) value was flexible transportation (PA9) with a value of 69. The following was

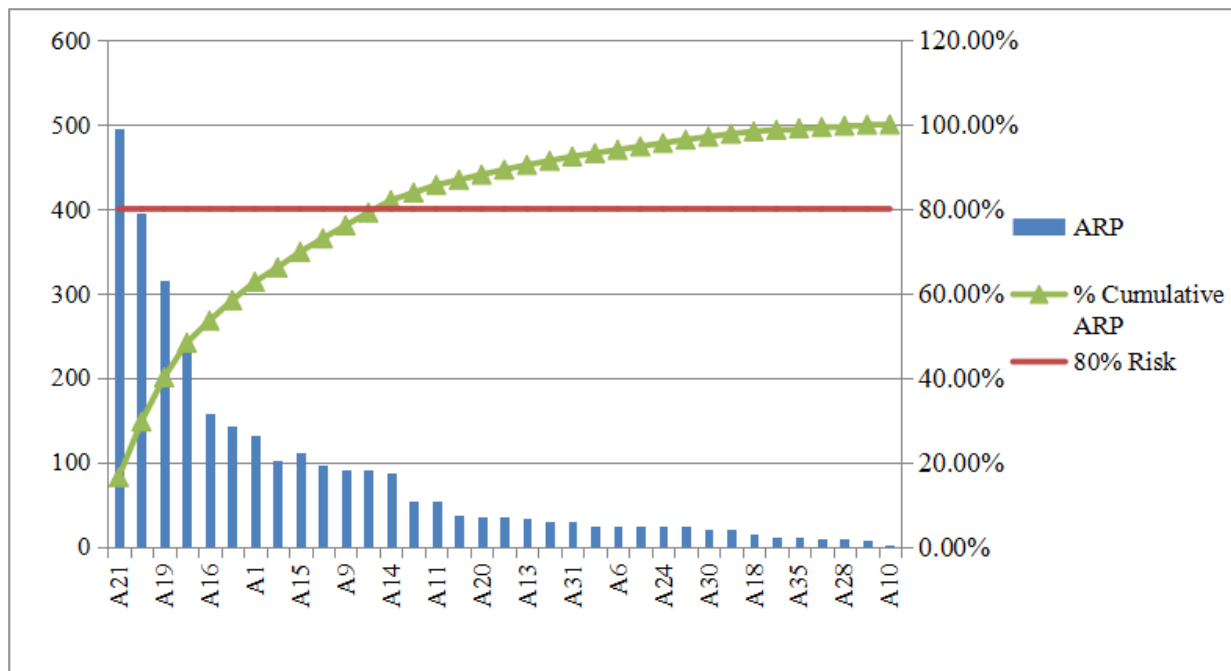


Figure 1. Pareto Diagram of ARP Risk Agent

Table 5. Risk Agent and Risk Management Strategy

No.	Code	Risk Agent	ARP	Management Strategy	Code
1.	A21	Checking the quality of raw materials that are not accurate	495	Apply SOP to determine the quality of raw materials	PA1
				Forming part of the quality control of raw materials	PA2
2.	A7	Delays in procuring raw materials	395	Strategy stock	PA3
				Flexible supply base	PA4
				Coordination	PA5
3.	A19	Depending on one supplier	315	Strategy stock	PA3
				Flexible supply base	PA4
				Coordination	PA5
4.	A12	The occurrence of trouble / damage to the engine	246	Engine maintenance periodically	PA6
				Provide sufficient spare parts or engine components	PA7
5.	A16	Shut down production	158	Engine maintenance periodically	PA6
				Provide sufficient spare parts or engine components	PA7
				Provides power generator for backup	PA8
				Coordination	PA5
6.	A17	Demand for sudden purchase of raw materials.	144	Strategy stock	PA3
				Flexible supply base	PA4
				Coordination	PA5
7.	A1	Significant increase in demand for organic fertilizer.	132	Strategy stock	PA3
				Coordination	PA5
8.	A4	Sudden demand of organic fertilizer	102	Strategy stock	PA3
				Coordination	PA5
9.	A15	Coal supply is disrupted	111	Strategy stock	PA3
				Flexible supply base	PA4
				Coordination	PA5
10.	A32	Lack coordination in shipping	96	Coordination	PA5
11.	A9	Poor coordination in the warehouse of raw material storage	92	Coordination	PA5
12.	A34	Disturbance during the product delivery	92	Flexible transportation	PA9

Sources: primary data is processed (2018)

Table 6. The Rank of Supply Chain Risk Management Strategy

Code	Strategy	TEk	DEk	ETD	Rank
PA5	Coordination	11829	3	3943	1
PA3	Strategy stock	6279	3	2093	2
PA4	Flexible supply base	8685	5	1737	3
PA1	Apply SOP to determine the quality of raw materials	4455	3	1485	4
PA6	Engine maintenance periodically	3636	3	1212	5
PA7	Provide sufficient spare parts or engine components	3636	3	1212	6
PA2	Forming part of the quality control of raw materials	1485	3	495	7
PA8	Provides power generator for backup	474	4	118.5	8
PA9	Flexible transportation	276	4	69	9

Source: primary data is processed (2018)

the order of priority ranking of recommendations for risk management strategies that have been designed, namely: 1) coordination, 2) strategy stock, 3) flexible supply base, 4) apply SOP to determine the quality of raw materials, 5) maintenance of the machine periodically, 6) provide spare parts or sufficient engine components, 7) establish QC parts of raw material, 8) provide power plants / generators for backup, 9) flexible transportation.

CONCLUSION

There were 23 risk events and 35 risk agents identified at all stages of the process of organic fertilizer supply chain activities at PT MBA using the SCOR model which consists of five business processes (plan, source, create, send and return). Risk events identified in supply chain activities PT. MBA was on 5 risk activity plans. In source activities there were 3 risk events. On make activities, there were 6 risky events. In deliver activities there were 6 risk events. In the return activity there were 2 risk events. Meanwhile, 12 risk agents that were a priority and need to design risk management

strategies, as follow, 1) checking the quality of raw materials that are not accurate, 2) delays in procuring raw materials, 3) depending on one supplier, 4) occurrence of trouble / damage to the engine, 5) shut down production, 6) demand for sudden purchase of raw materials, 7) significant increase in demand for organic fertilizer, 8) sudden demand for products / organic fertilizers, 9) supply of coal is disrupted, 10) lack of coordination in shipping parts, 11) lack of coordination in the warehouse storing raw materials, 12) disturbance during the product delivery. However, the implementation of risk management strategies in supply chain activities was based on the highest to lowest ETD values sequentially including coordination, strategy stock, flexible supply base, implementing SOP to determine the quality of raw materials, periodically maintaining machinery, providing spare parts or sufficient engine components, forming the raw material of QC section, provides electricity generator sets for reserves and flexible transportation.

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