House of risk approach for assessing supply chain risk management strategies: A case study in Crumb Rubber Company Ltd

Taufiq Immawan* and *Dea* Kusuma Putri

Industrial Engineering Department, Faculty of Industrial Technology, Universitas Islam Indonesia, Indonesia

Abstract. Risk is an uncertain and can have both negative and positive impacts. If the risks have a negative impact then a company will incur losses. CRUMB RUBBER COMPANY LTD is one of crumb rubber company in West Kalimantan. The length of the supply chain contained in CRUMB RUBBER COMPANY LTD and the high dependence on suppliers leads to vulnerability. So the purpose of this research is to identify the risk and determine the priority of source of risk along with the priority of handling it on CRUMB RUBBER COMPANY LTD supply chain with House of Risk approach. House of risk approach consists of two phases. Phase 1 is used to determine the dominant risk agent and phase 2 determines the effective action to deal with the dominant risk agent. From the research results, there are 19 risk events and 29 risk agents identified. The result of house of risk in phase 1 is known that 13 of 28 risk agents are dominant risk agent. Then the priority handling strategy in house of risk in phase 2, in this phase obtained 18 priority risk handling strategies.
Keywords: HOR, risk management, SCM

1 Introduction

The term SCM was first proposed [2]. Supply chain is a physical network, such as companies involved in supplying raw materials, producing goods, or sending, while SCM is a method, tool, or management approach. Supply chain management is very important to support the smoothness of business activities in the company because supply chain management pay attention to the scope from upstream to downstream.

Risks are uncertain and can have both negative and positive impacts. According [1] the risk is the amount of deviation between expected return and actual return. Meanwhile, supply chain risk is the uncertainty of an event that can lead to disruption of a smooth supply chain in the company.

CRUMB RUBBER COMPANY LTD is a company engaged in manufacturing. This company is one of the manufacturers of crumb rubber which supplies its products to domestic and foreign. The length of the supply chain at CRUMB RUBBER COMPANY LTD and the high dependence on suppliers lead to vulnerability to possible risks. The factors causing the risk of supply chain activity according to [3] include a very complex supply chain network, high dependence on suppliers, the existence of organizational interaction interactions within the supply chain, the short life cycle of a product. Thus, the risk that may occur can adversely affect the company. Therefore, the need for supply chain management to overcome the risks may occur so that companies do not lose and do not hinder the achievement of corporate goals.

Currently PT XYZ does not yet have a structured supply chain risk management in handling the risks. Supply Chain Risk Management or a risk management strategy that can be controlled by a company. The benefits of supply chain risk management are to identify and assess supply chain disruptions and address them.

Based on the background description, it is known that the importance of risk management in the supply chain, so that this study aims to identify the risks and determine the priority of the source of risk along with the priority of the handling of CRUMB RUBBER COMPANY LTD supply chain with the House of Risk approach.

2 Research Methods

According to [4] House of risk is a method focused on formulating preventive, reduction and handling of risk factors that potentially lead to more than one risk. House of risk or HOR consists of 2 phases, namely phase 1 and phase 2. In the first phase of House of risk, first mapping supply chain activity and risk identification at CRUMB RUBBER COMPANY LTD by using Supply Chain Operation Reference (SCOR) model. Then performed risk assessment using Failure Mode and Effect Analysis (FMEA) method. This phase is used to determine priority risk agents for precautionary measures. Table 1 is a HOR phase 1 template [4].

Table 1. HOR Phase 1

Proses	Risk Event (Ei)	Risk Agent (Ai) A1	A2	A3	An	Severity of risk event i (Si)
Plan	E1	R11	R12		Rnn	S1
	E2	R21				S2
Source	E3					S3
Make						
Deliver						
Return	En					Sn
Occurance of agent j		O1	O2	O3	On	
Aggregate risk potential j		ARP1	ARP2	ARP3		
Priority rank of agent j		P1	P2	P3	Pn	

Information:

A1, A2, A3…An = Risk Agent
E1, E2, E3….En = Risk Event
O1, O2, O3,…On = Occurrence value of the risk agent (Ai)
S1, S2, S3…Sn = Severity value of risk event (Ei)
ARP1, ARP2, …ARPn = Aggregate Risk Priority
P1, P2, P3…Pn = Ranking of risk agents based on ARP values

Then perform a 2nd phase HOR calculation which in this phase determines to the priority of risk management strategies of identification risk agents at high risk level. Where the output of HOR phase 1 will be used as input on this 2nd phase. Table 2 below is a HOR phase 2 template [4]:

Table 2. HOR Phase 2

To be treated risk agent (Ai)	Preventive Action (PAk) PA1	PA2	PA3	PAN	Aggregate risk priority (ARP)
A1	E11	E12	E13	PAn	ARP1
A2	E21				ARP2
A3					ARP3
An				Enn	ARPn
Total Effectiveness of Action (TEk)	TE1	TE2	TE3	TEN	
Degree of Difficulty preforming action (Dk)	D1	D2	D3	Dn	
Effectiveness to Difficulty Ratio (ETD)	ETD1	ETD2	ETD3	ETDn	
Rank	R1	R2	R3	Rn	

Information:

- A1, A2, A3…An =Risk agent who was elected to do the handling of
- P1, P2, P3 …Pn =Preventive action to be performed
- E11, E12,… Enn =Correlation between preventive action and risk agent
- ARP1, ARP2,..ARPn =Aggregate Risk Priority from risk agent
- TE1, TE2, TE3…Ten =Total effectiveness of preventive action
- D1, D2, D3…Dn =Degree of difficulty in the implementation of preventive action
- ETD1, ETD2, ETD3…ETDn =Total effectiveness of divide by degree difficulty
- R1, R2, R3…Rn =Rank of preventive action based on sequence of grades ETD highest

3 Result

Based on observation and interview with expert, it can be identified the HOR 1 and HOR 2.

3.1 Risk Identification

Risk identification is using Failure Mode and Effect Analysis approach. According to [5] that the reason of FMEA usage is FMEA is a technique that can be used to analyze the potential cause of a disturbance, the probability of its emergence and how to prevent it. Giving the value of the variable is done by expert judgment method. Expert judgment is a collection of data provided by an expert on a technical problem [6]. The following is a list of identified risk:

Table 3 Risk Event

Process	Activity	Risk Event	Code
Plan	Production planning	Forecasting improper demand	E1
		Sudden production changes	E2
	Inspection of raw material inventory	The actual amount of stocks recorded	E3
Source	Procurement process	Price negotiations do not reach agreement	E4
		No offer from supplier	E5
	Arrival of raw materials	Delay of raw material arrival	E6
		Non-conformity of raw materials ordered	E7
		Mismatch amount ordered	E8
Make	Production process	Raw material damage	E9
		Defective product	E10
		Delayed production	E11
		Accident workers	E12
		Engine failure	E13
		Production is not on target	E14
	Quality control	Not testing product quality during process	E15
Delivery	Delivery of product to buyer	Delivery to buyer late	E16
		Product damage during shipment	E17
Return	Return of raw material to supplier	Delay in complaint to suppliers	E18
	Handling of products returned from buyers	Delay of product return from buyer	E19

Table 3 Risk Agent

Risk Agent	Code
A mistake in forecasting	A1
Demand a sudden products	A2
Lacking capacity supply raw materials in a warehouse	A3
Record-keeping error in raw materials in and out	A4
Less coordination between parties internal	A5
The company did not take into account price increases that significant	A6
Lack of communication with external sides	A7
Accident occurs transportation	A8
Supplier not fulfill a promise	A9
The supplier in producing fluctuant	A10
The storage of the raw material that inadequate	A11
A mistake in selected raw materials	A12
Contaminated with other objects	A13
A mistake in setting an oven manual	A14
The quality of raw materials low	A15
Natural disasters	A16
To limited human resource	A17
Employees arrived late	A18
Occurring bottle neck	A19
The machine breaks	A20
Employees disobedient in used a protective own according to standard operating procedures	A21
Not held routine maintenance	A22
Limited machine capacity	A23
Schedule a ship erratic	A24
Production late	A25
Interruption along the way	A26
Delays in dealing with the raw material come	A27
Inspection acceptance of raw materials not scrupulous	A28

3.2 House of Risk Phase 1

Assessment of risk event and risk agent is done by field observation, interview to company side by forming team and questionnaire data for severity assessment from risk event and occurrence valuation from risk agent and correlation from both. Based on ARP values that have been obtained from the calculation of HOR phase 1, then further determine the dominant risk agents with pareto approach. According to [7] pareto diagrams are created using the cumulative percentage of each ARP from the risk agent. Figure 1 below shows the pareto risk agent diagram:

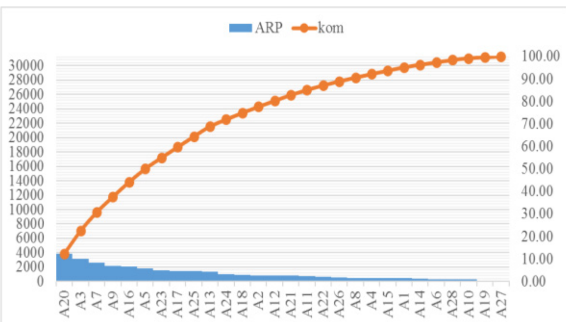

Figure 1 Pareto diagram

From the results of pareto known there are 13 dominant risk agent, including the troubled engine, lack of capacity to supply raw materials in warehouses, lack of communication with external parties, supplier not fulfill the promise, natural disasters, lack of coordination between internal parties, limitations of engine capacity, limitations of human resource, late production, contaminated with other objects, ship's erratic schedule, the employee was late coming, and demand a sudden products After knowing the dominant risk agent then further create a risk map. The risk map is useful to see the risk condition before handling. Here is a risk maps before drafting strategy priority handling:

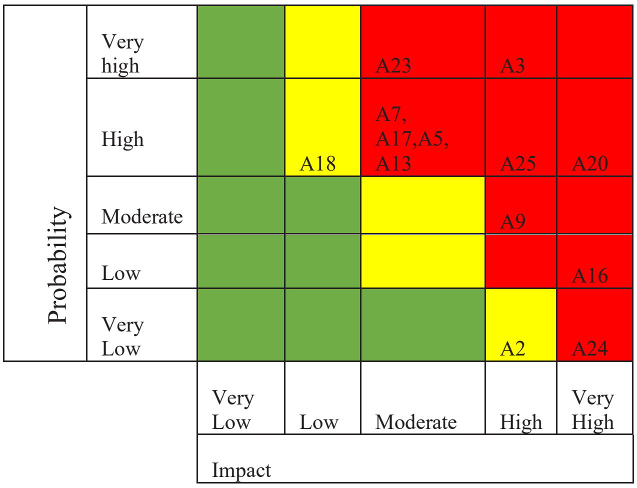

Fig 2. Risk maps before drafting strategy priority handling

3.3 House of Risk Phase 2

After completing phase 1 of HOR phase then subsequently entering phase HOR phase 2. From result of focus group discussion resulted 18 strategy preventive action. The following Table 4 of HOR phase 2

Table 4. Result of HOR Phase 2

	Preventive Action (PAk)																		
Ai	PA1	PA2	PA3	PA4	PA5	PA6	PA7	PA8	PA9	PA10	PA11	PA12	PA13	PA14	PA15	PA16	PA17	PA18	ARP
Troubled engine	9	9																	**3888**
Lack of capacity supply raw materials in a warehouse			9																**3150**
Lack of communication with external parties				9	9														**2600**
Supplier not fulfill the promise					9	9	9												**2148**
Natural disasters			3					9	9										**2045**
Lack of coordination between internal parties										9	3								**1841**
Limitions of engine capacity		9																	**1539**
Limitions of human resource												9	9						**1470**
Late production										9				9					**1464**
Contaminated with other objects								9							9				**1407**
Ship's erratic schedule							9									9			**972**
The employee was late coming																	9	9	**910**
Demand a sudden products			9	1			3		9										**864**
Total Effectiveness of Action (TE_k)	34992	48843	42261	24264	42732	19332	30672	31068	26181	29745	5523	13230	13230	13176	12663	8748	8190	8190	
Degree of Difficulty preforming action (D_k)	3	5	3	3	3	3	4	5	4	3	3	5	4	3	4	3	3	4	
Effectiveness to Difficulty Ratio (ETD)	11664.0	9768.6	14087.0	8088.0	14244.0	6444.0	7668.0	6213.6	6545.3	9915.0	1841.0	2646.0	3307.5	4392.0	3165.8	2916.0	2730.0	2047.5	
Rank	3	5	2	6	1	9	7	10	8	4	18	16	12	11	13	14	15	17	

It is expected that after conducted design priority handling this, agent risk no in the category of red area. So some changes good to overcome a source of risk potential to appear. Figure 3 under showed position risk agent after conducted design priority strategy handling.

Probability		Very Low	Low	Moderate	High	Very High
	Very high					
	High		A3, A24			
	Moderate	A2				
	Low	A9, A23, A25		A20, A7, A16, A13		
	Very Low	A5, A18		A17		
		Impact				

Fig 3. Risk map after conducted design priority strategy handling

4 Conclusion

Based on the results of the test which has been done we can conclude that:

1. There are 19 risk event and 29 risk agent identified. From the house of risk phase 1 which has been pareto to come by 13 risk agent that are risk agent priority to handling.
2. After conducting calculation using the house of risk phase 2, obtained priority strategy handling risk of them building relationships closely and communication with supplier, do management safety stock raw materials, discipline implement routine maintenance, improve coordination among parts, buying new machinery, building relationships closely and communication with buyer, make and obey MOU with related parties, planning safety stock finished products, evaluate performance supplier, redesign a work environment where better, rescheduled production, the use of labor off, the use of transportation closed which protected from heat and rain, coordination with the transporters, guidance individual regarding the responsibility of the and discipline time, the addition of labor, the provision of rewards for civil servants discipline and sanctions to did not act discipline, and do briefing routine before activity.

References

1. Hanafi, M. M. (2012). *Manajemen Risiko.* Yogyakarta: UPP STIM YKPN.
2. Oliver, R. K., & Webber, M. D. (1982). *Supply chain management: Logistics catches up with strategy.* London.
3. Punniyamoorthy, M., Thamaraiselvan, N., & Manikandan, L. (2013). Assessment of Supply Chain Risk: Scale Development and Validation. *Benchmarking: An Internation Journal*, 79-105.
4. Pujawan, P. I., & Geraldin, L. H. (2009). House Of Risk: A Model For Proactive Supply Chain Risk Management. *Jurnal Businnes Process Manegement*, 963-967.
5. Christopher, M., & Peck, H. (2004). Building the Resilient supply chain. *International Journal Logistics Management*.
6. Meyer & Booker. (1991). *Eliciting and Analyzing Expert Judgement: A Practical Guide.* London: Academia Press Limited.
7. Caesaron, D., & Tandianto. (2014). Penerapan Metode Six Sigma Dengan Pendekatan DMAIC Proses Handling Painted Body BMW X3 (Studi Kasus: PT. Tjahja Sakti Motor). *PASTI*, 248-256.