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The Main Critical Risk in the Supply Chain of Component Automotive Industry: A Case Study

F Alitosa[1] and L H Kusumah[1]

Industrial Engineering Department, Mercu Buana University, Indonesia

alitosa.feri@gmail.com

Abstract. In automotive component company that produce electric components their supply activities have the opportunity to arise risks. Therefore, is necessary to identify and analyze critical risks or disturbances that are likely to arise and mitigate risks in operational activities in the component automotive supply chain.This research was conducted with using a house of risk model consisting of 2 phases. The first phase is identifying risk and agent risk, which then measure the severity and insurance level and calculate the aggregate risk priority (ARP) value. The second phase is handling risk. After doing research risk mitigations which were prioritized to be realized were review the current SOP and control the implementation, make punishment policy that does not to according to the SOP, maximize supervision to subordinates, discussions with customers for specific policy change in each issue, improve production and inventory control performance, arrange engine maintenance programs according to production capacity, discussion to review contracts with suppliers, strengthen implementation TQM in supplier and look forward to more long term potential supplier.

1. Introduction

Many automotive products of various types and variations are offered in Indonesia, one of them is motorcycle. The motorcycle industry in Indonesia today shows an interesting phenomenon. The Indonesian Motorcycle Industry Association (AISI) targets to sell solid motorcycle in 2018 to reach 5.9 - 6.1 million units [1]. Increased motorcycle sales will be followed by competition in the automotive component industry. Competitive prices, on time delivery and good quality as requirement in competition among the industry's components of the motorcycle.

The case study is carried out at one of the component industry of motorcycle. The main product of this Company is electric component for motorcycle. To be able to compete among the competitors, companies must be able to keep up with changes in demand from customers and must ensure the quality of their products. The company has also implemented a Quality Management System, but there are still quality problems that arise both from suppliers or internal process causing delays in delivery to the customer, besides that many time production stop due to machine trouble and material shortage. Since the switching from carburetor to injection system on Motorcycle, there are difficult to procurement electric part components (MLCC Ceramic Layer Capacitor) due to supplier capacity. Current capacity 80% was available for supply of electronics industry and 20% for the automotive industry, where the lead time order is six months. When there is an increase in demand the company does not fulfill it so become stop production at customer

Based on this problem, it necessary to do more observation about risk management related to operational process, which involves the supply chain. The main object is to minimize product reject, machine downtime and material shortage, so that company losses can be eliminated so that company profits increase.

The study of supply chain risk management includes Laudine et al [2], FMEA and QFD to design a framework for mapping proactive strategies to reduce emerging risks and create a strong supply chain at Gresik Petrochemical Plant. Pujawan and Laudine [3] to design a risk mitigation framework at fertilizer plants. A similar study conducted by Kurniasari [4] on mitigating risk in highway construction projects Gempol Pasuruan by using Model House of Risk (HOR). These three studies used the same method but the differences in this study were conducted in the field of automotive component manufacturing industry, where in the automotive component manufacturing industry requires stability in terms of production capacity, quality and product delivery due to changes in customer demand.

The supply chain risk management process consists of risk identification, risk analysis, risk evaluation and risk mitigation. Risk identification is suggested as a fundamental stage in the risk management process [5]. Most potential risk do not only in organization, but also between member supply networks as well as between supply network and the environment must be identified. That risk not identified can cause and error direction in the supply chain risk management process plan, an incompatible strategies in risk control can cause more losses for the company. The purpose of research is to identify and analyze critical risks or disturbances that are likely to arise and mitigate risks in operational activities in the component automotive supply chain.

This chapter presents theoretical studies related to risk and supply chains, namely:

1.1. Risk and risk management

Risk is always associated with uncertainty that the probability of reality is not in line with expectations [6]. Risks can have positive meanings and opportunities as opportunities if they are managed well and are negative if the risk is likely to be a threat or threat [7]. According to ISO 3100 ISO Guide 73: 2009 states that risk is uncertainty that impacts on goals [8]. Basic concept of risk management according [9] that can be understood by company management is that risk management is only an approach, but risk management is a flexible strategy that can be applied to various industrial scales. Risk management is an attempt to find out, analyze and control risks in each company activity with the aim of obtaining higher effectiveness and efficiency [10].

Based on ISO 31000-2018, the risk management process is a critical activity in risk management, because it is an application of the principles and frameworks that have been built. The risk management process consists of three major processes, namely: Context implementation (establishing the context); Risk assessment; and Risk treatment. The three major processes are accompanied by two processes, namely: Communication and Consultation and Monitoring and review (monitoring and review).

1.2. Supply chain operation reference (SCOR)

The SCOR model was developed to provide a method of assessing supply chain activities and performance as a supply chain management standard [11].
In SCOR, supply chain activities are classified into these following categories:
1. Plan, is process that balances demand and supply to determine the best action in meet the needs of procurement, production and delivery;
2. Source, namely the process of procuring goods and services to meet demand;
3. Make, which is the process transforming raw materials/ component into products to customer;
4. Deliver, which is a process to fulfill the demand for goods and services;
5. Return, which is the process of returning or accepting return of product from customers.

1.3. House of Risk (HOR)

HOR is a modification of FMEA (Failure modes and Effect Analysis) and QFD (Quality Function Development) developed by [3]. This model to prioritize the source of risk which is first chosen for the most effective measures to reduce the potential risks and sources of risk In FMEA, risk assessment can calculated through the calculation of RPN (Risk Potential Number) obtained from three multiplication factors, namely the probability of occurrence of risk, impact damage produced, and risk detection. But in the house of risk approach calculation RPN value is obtained from the probability of the source of risk and the impact of risk-related damage occurs. In this case to look for possible sources risk and severity of risk events. If O_i is possibility of occurrence of sources of risk **j**, S_i is the severity of the influence if the risk event **i**, and R_j is the correlation between sources of risk **j** and **i** risk event (which shows how much) it is likely that the risk source is entered risk event **i** then **ARP$_j$** (Aggregate Risk Potential of risk agent **j**) can be calculated by formula:

$$ARP_j = O_j \ \Sigma \ S_i \ R_j$$

Ranking for each source of risk based on the amount of Aggregate Risk Potential (ARP). Therefore if there are many sources of risk, companies can choose the top priority from some considerations that have potential big risk. In this study proposed two deployment model called the HOR both are based on the modified HOQ. HOR-1 is used to determine the source which risks are prioritized precautionary measures while HOR-2 is to give priority to action with consider cost effective resources.

2. Method

This study conduct supply chain research at an component automotive company. The method uses the House of Risk Model (HOR). Following are the stages in the research methodology used:

1. Supply chain activity mapping, at this stage the SCOR model maps the initial activities. SCOR model can be used to map the current supply chain process and the process is divided into sub-process of Plan, Source, Creation, Delivery and Returns. Supply chain activity starting from receiving raw material from supplier to the end customer. Where in this activity refers to a study of previous research in the supply chain risk management in automotive industry [12][13][14][15][16] to determine the risk agent.
2. Risk identification, identification that might arise along supply chain activities. Risks are identified by doing brainstorming and direct observation and validated by interviewing management representative in each department.
3. Risk analysis & evaluation, the aim to show priority of risk to be addressed further. The output of this step is HOR-1 which includes the risk agent rating (Aggregate Potential Risk), the most critical risk agent and the Pareto diagram.
4. Risk mitigation, to decide risk agents, this study using the output of the risk evaluation process and the Pareto diagram.

From the result of the pareto diagram it is known the priority of risk agent to be mitigated use HOR-2, which is to determine the mitigation strategy plan to be carried out. At the end of the study there were several action that would be carried out in the automotive component company. At the end of the study there were several action plants that would be carried out in the automotive component company

3. Result

3.1. Supply chain activity mapping

In the supply chain of automotive components industry have a flow of goods that must be managed starting from suppliers, companies, logistic partners and customers. Based on the SCOR model, supply chain processes are divided into five core processes, plan, source, make, delivery and return. In the term of plan there are six sub-processes such as decreased production capacity, capacity not meet with customer demand, fluctuation customer demand, miss calculation material, ordering plan are incorrect

and miss calculation labor cost. In the source category there are five sub-processes such as material shortage, increase raw material price, poor delivery supplier, supplier bankrupt and supplier dependence. In the make category there are six sub-processes such as mall function IT system, working accident, machine breakdown, operator speed performance decrease, accuracy of material stock and packing process. For delivery category there are two sub-processes such as transportation and shipping failure and customs and regulation problem. And, for the return category there are two sub-processes such as returning reject product to supplier and handling return from customers.

3.2. Risk Identification

Identification risks through direct observation, analyze historical data and interviewing with management representatives. In these identification where the risk identified are not only seen from the form of the risk event but also are identification by the risk agent. Risk variables include work unit of production planning, warehouse, production, procurement, maintenance and logistic. From the result of the identification of the next steps to validate all identified potential risk where manager in each department are involved in the validation process. This phase identified six potential risks in plan, five risks in source, six risks in make, two risks in return and two risks in delivery.

3.3 Risk Analysis & Evaluation

Risk analysis is a process for analyzing qualitatively and quantitatively the impact of risk (severity) and the probability of occurrence on goal that have been set. This risk analysis process is carried out by analyzing the causes of the risk that have been identified and the calculating the aggregate risk potential (ARP) value using the HOR-1model. This ARP value is obtained from the sum of the results of multiplying the degree of severity with the level of occurrence. The results of thing risk analysis phase are in the form of risk priorities and classification of the rating. The highest ARP score is the operator does not work correctly (or they do not work according to the SOP), which requires 13% of the total ARP score. The risk agents occur by human factors through the supply chain, especially in the production process. **Table 1** represents the five most critical risk agents.

Table 1 Critical Risk Agent

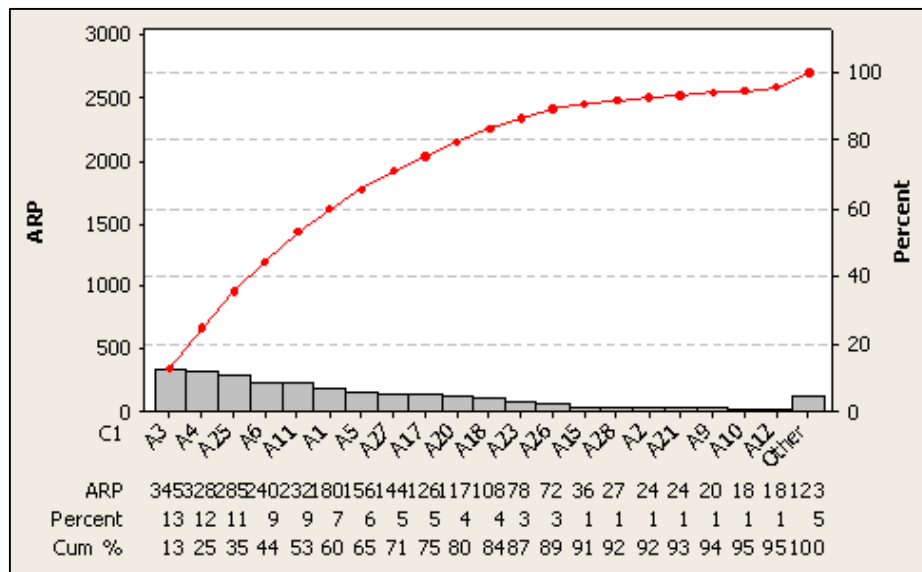| No	SC Activity	Risk Agent	Code	ARP	Rank
1	Make	Operator does not work correctly	A3	345	1
2	Plan	Sudden request from customers	A4	328	2
3	Plan	Machine maintenance does not match the schedule (Overload)	A25	285	3
4	Source	Fluctuation in production capacity from supplier	A 6	240	4
5	Source	Poor quality supplier	A 11	232	5

Figure 1 Pareto Diagram of ARP value

The results of this risk analysis in the form of risk priorities and classification of these ratings are based on Pareto 80:20 which is then used as a reference for preparing risk management plans. As shown in **Figure 1**, there is one of the most critical risk agents that affects 80% of risk events. Operator not working according SOP (A3) gets 13% of total ARP risk agent. Based on the SCOR model, A3 is identified only in make activities. However, in the supply chain, critical risk agents can significantly affect the entire system. Therefore, the most important things are how to mitigate A3, then four other critical agents.

3.4. Risk mitigation

Based on the output of HOR-1 ARP calculation there are five critical risk agents (see **Table 2**) that trigger the company's operational risk. HOR-2 focuses on determining the action to be taken firs with consider the level of effectiveness and the level of difficulty of each preventive action to do. The following are the result of preventive action identification that are used to control for prevent and minimize a risk agent.

Table 2 Mitigation planning of each risk agent

Risk Agent	Critical Risk Agent	Mitigation Planning	Correlation Score
A3	Operator does not work correctly	Review the current SOP and control the implementation (*1)	9
		Make a punishment policy that does not do according to the SOP(*2)	3
		Maximize supervision to subordinates (*3)	9
A4	Sudden request product from customers	Discussions with customers for specific policy changes in each issue (*4)	9
		Improve production and inventory control performance (*5)	3
A25	Machine maintenance does not match the schedule (Overload)	Arrange engine maintenance programs according to production capacity (*6)	9
		Maximize supervision to subordinates (*3)	3
A6	Fluctuation in production capacity from supplier	Discussion to review contracts with suppliers (*7)	9

		Look forward to more long term potential supplier (*8)	3
A11	Poor quality supplier	strengthen implementation of TQM in suppliers with an management audit (*9)	9
		Supplier Performance Measurement Based on Vendor Performance Indicators (*10)	9
		Look forward to more long term potential supplier (*8)	3

The next stage is determine the relationship or correlation with each risk agent that is priority at HOR-1 output, where the relationship of each preventive action and risk agent will be measured using scale of {0, 1, 3, 9}, correlation relationship planning that gets the highest score becomes a mitigation priority. For HOR-2 model (see **Table 3**) we measured the level of difficulty of the application of each preventive action variable. The level of difficulty is measured using the Likert scale 1 to 5. The scale of number 5 shows the most difficult level in implementing preventive action. Determination of the degree/level of difficulty in the HOR also uses the brainstorming method with the managers/field of expert.

Table 3 HOR 2 Analysis

Risk Agent	Mitigation Planning										ARP
	*1	*2	*3	*4	*5	*6	*7	*8	*9	*10	
A3	9	3	9								345
A4				9	3						328
A25			3			9					285
A6							9	3			240
A11								3	9	9	232
Total Effectiveness	3105	1035	3960	2952	984	2160	2160	1416	2088	2088	
Degree of Difficulties	2	3	3	2	4	2	3	4	3	2	
Effectiveness to difficulty Ratio	1553	345	1320	1476	246	1080	720	354	696	1044	
Rank of Priority	**1**	**9**	**3**	**2**	**10**	**4**	**6**	**8**	**7**	**5**	

4. Conclusion

The conclusion of this study consists of two points, namely the risk identification and risk mitigation planning. Based on the result of risk event identification in automotive component companies there are six risk in plan activities, five risks in source, six risks in make, two risks in delivery and two risks in return. There are the most critical causes in the operator does not work correctly, sudden request product from customers, machine maintenance does not match the schedule, fluctuation in production capacity from supplier and poor quality supplier as the five most critical risk agent in company. Furthermore, the highest priority of mitigation improves review the current SOP and control the implementation, makes a punishment policy that does not do according to the SOP and maximize supervision to subordinate.

Operator do not work correctly have two possibilities, the first because operator do not understand the standard of work and secondly because of the morale of operator. For the second one is needed strict supervision from the supervisor and giving punishment for those who violate. The production manager should ensures that the standard operational (SOP) is easily understood by the operator, beside re-education is also needed and conduct and assessment before and after education to find out the result of knowledge. Other managers such as maintenance, quality control, maintenance and warehouse must update their SOP and ensure that workers can carry out the work correctly. Top

management must conduct periodically performance evaluations of workers in each department, this is to ensure improvement or improve company performance through improved performance human resources.

The monitoring and review of preventive action needs to be done by the company because the development and implementation of each stage of risk management needs to monitored to ensure the the creation of optimization of risk management.

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