PAPER • OPEN ACCESS

Analysis of Supply Chain Risk Mitigation Strategies in the Bogor Compressor Company with the House of Risk Method

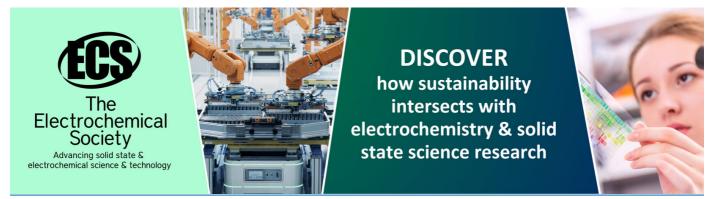To cite this article: Surya Perdana *et al* 2020 *IOP Conf. Ser.: Mater. Sci. Eng.* **852** 012094

View the article online for updates and enhancements.

Analysis of Supply Chain Risk Mitigation Strategies in the Bogor Compressor Company with the House of Risk Method

Surya Perdana*, Ridwan Usman, Nur Arifiya
Jurusan Teknik Industri, Fakultas Teknik dan Ilmu Komputer
Universitas Indraprasta PGRI

*suryaperdana.st.mm@gmail.com

Abstract. Compressor companies in the Bogor area, planning of purchasing raw materials and planning for production are based on direct orders from customers. Sometimes customers make sudden orders or increase the number of orders, so companies must change production schedules and order additional raw materials from suppliers. Not all suppliers can meet the sudden demand of the company. Compressor raw materials and other supporting raw materials often experience delays. This study aims to mitigate the causes of supply chain risk to eliminate and minimize company losses. The mapping of the company's supply chain activities is based on the SCOR. After risk identification, risk assessment is carried out to determine severity, occurence, and correlation. Furthermore, the ARP value calculation is performed to determine the ranking and risk prioritization. Determination of risk prioritization using the HOR method. Based on the Pareto table, the highest ARP value is above 80%, there are 2 causes of risk A1 and A2 that contribute as much as 86.55% of the total ARP supply, the causes of the risk are: A1: Sudden order addition and A2: Breakdown of internal and/or external communication. These two causes of risk are the priority for prevention by the company.

Keywords: Supply Chain, Compressor, SCOR.

1. Introduction

This research will discuss companies that produce compressors in Bogor. Planning for purchasing raw materials and planning of the production of this company is done based on direct orders from customers. There are times when customers place orders suddenly and or increase the number of orders from the initial order, so the company must change the production schedule that has been previously planned. This causes the company to immediately place an order for additional raw materials to the supplier to fulfill customer orders on time. But not all suppliers can meet the sudden demand of the company. In addition to these problems, control of compressor raw materials and other supporting raw materials also often experiences delays from suppliers, this needs attention. Because it can cause the production process to decline from the planned schedule and also have to change the delivery schedule to the customer. Based on the description above, this study aims to mitigate the causes of supply chain risk to eliminate and or minimize losses for the company.

The concept of supply chain considers customers as the "King" who must be given the best service and produce results. So that by applying concepts like this well, companies can compete in the global business era [1]. Implementation of the supply chain in the business world will help companies in terms of reducing raw material costs, inventory costs and distribution costs,

and encourage efficiency in terms of production time until the time of product delivery [2]. With a good supply chain performance, the performance of the company will be more focused and provide benefits, both for the company, suppliers, and consumers [3]. Companies must be able to connect supply chains at the level between management and between organizations collaboratively and related to the level of activity from raw material suppliers to the hands of customers [4]. In the supply chain, there are three flows, namely: the flow of goods, financial flow, and information flow [5]. The supply chain can also be defined as a network consisting of several companies (including suppliers, manufacturers, distributors, and retailers) that work together and are involved directly or indirectly in fulfilling customer requests. In supply chain activities there are opportunities for risk. So the need for risk management with the aim to minimize the level of risk and the impact of these risks [6]. Risk management can also be used to identify, mitigate and manage risks in the supply chain [7].

The first stage of risk management is to carry out a risk assessment by identifying the risks that may arise in the company. The aim is to identify the risks that will be addressed. The identification process involves risks that are controlled or not controlled by the company. This stage produces a list of risks obtained from the identification of sources of risk, what are the risks (what), where the risk arises or is found (where), how the risk arises in that place (how) and why the risk arises (why), where the risk has an impact on achieving the company's goals and objectives [8].

2. Method and materials

The identification of product development activities was applied to the marketing and product designing phases. The questionnaire was used as the instrument in this research. Determining and selecting the respondents, including the Company Director, Head of Marketing Division, Head of Production division, and Head of Research and Development division were asked to answer the questionnaire. Data were collected for 3 months, March-May 2019. The details of collecting and processing the data are explained as follows:

The second stage is collecting data which consists of mapping supply chain activities and identification of risks and causes of risk. Then supply chain activities related to raw materials needed to produce compressors are mapped in the SCOR (Supply Chain Operations Reference) model to classify supply chain activities. The next stage is the data processing stage, which includes a risk analysis that is determining the severity of the risk events and occurrence which is then mapped to the phase 1 house of risk (HOR) model.

HOR Phase 1

HOR was used as the measuring method in this research. HOR phase 1 was a severity assessment of the risk event and the risk agent occurrence assessment, and the correlation between the risk event and the risk agent. The assessment was conducted by the questionnaire were used as the Aggregate Risk Potential (ARP) value, which further is used to determine the priority of risk agents as a basis for mitigation initiatives. The formula for ARP value is provided in equation (1), below:

$$ARP_j = O_j \cdot \sum S_i \cdot R_{ij}$$

Description :

ARP_j = aggregate risk potential on risk agent 'j', j = 1,2,3,..n

Oj   = occurrence of risk agent 'j', j = 1,2,3,…n
Si   = severity of a risk, i = 1,2,3,..n
Rij   = correlation level between 'i' risk and 'j' risk, ij = 1,2,3,…n
K   = respondent 'k', k = 1,2,3,..n

3. Results and discussion

Making compressor machines based on orders from the customer, so there is no stock of goods in the company. After receiving the request, the next step is to plan raw material requirements and plan production according to the customer's order. From the planning of raw material requirements, the purchasing department will order raw materials to suppliers by sending proposals to suppliers. Then the purchase order is issued and sent to the supplier. Furthermore, the supplier will send the raw materials ordered to the company in accordance with the estimated time of arrival. The incoming raw materials will be inspected in advance to find out whether the raw materials are in accordance with specifications. If the raw material does not meet the specifications, then the raw material will be returned to the supplier to be replaced with new raw materials that meet the specifications or sorted by the supplier to see and choose which raw materials are still acceptable. While the raw materials received will be put into a warehouse awaiting processing. This raw material will be brought to the production floor for the compressor production process. After the production is complete, a quality check is carried out. After checking, then sent it to the customer. But often, orders from customers are sudden and increase in quantity, resulting in delays in production that can cause delays in delivery. This is related to the process of ordering raw materials to the supplier that cannot be done suddenly and the supplier cannot provide the raw materials faster than the agreed time.

At the Risk Identification and Risk Causes stage, the activities of the company based on SCOR elements are elaborated, and the mapping process is carried out by interviewing respondents. The description of these activities is based on Plan, Source, Make, Deliver and Return. The details can be in Table 1 and Table 2.

Table 1. Company Activities Based on SCOR

Plan	Forecasting from the marketing team on order quantities
	Order directly from the customer
	Determination of procurement of raw materials
	Production planning
	Planning checking of finished products
	Delivery planning
Source	Communication with suppliers
	Contract with supplier
	Receiving raw materials from suppliers
Make	Implementation of production activities
	Quality inspection of finished products
	Finished product packaging
Deliver	Selection of transportation services
	Shipment to customer
Return	Return of raw materials to the supplier

After identifying the risks that occur in the company's supply chain, the causes of the emergence of risks that affect the occurrence of risks are identified. Identifications for the causes of risk are not grouped according to SCOR but look at all identified risks. This is because one cause of risk can be a cause of risk for other risks even though different processes.

Table 2. Risk Assessment

Process	Code	Risk Event	Severity
Plan	E1	Error forecasting order quantity	5
	E2	A sudden change in production plans	5
	E3	Error calculation of raw material requirements	2
	E4	Forecasting accuracy level below 60%	3
	E5	Error in time required during the production process	5
Source	E6	Change in confirmation of the Estimated Time Arrival Port (ETA Port) from the supplier	3
	E7	Error in raw materials sent by the supplier	3
	E8	The change in time comes raw material	5
	E9	Media purchase does not work correctly	2
	E10	Poor supplier communication	3
	E11	Contract of agreement that is violated by the supplier	3
Make	E12	Material is lacking	5
	E13	Available inventory cannot be used	3
	E14	Late in production execution	4
	E15	Additional production due to new contracts/orders	5
Deliver	E16	Error sending product to customer	2
	E17	Late delivery to the customer	5
	E18	Return of raw materials to the supplier	3
Return	E19	*Supplier sent the wrong item*	5
	E20	Late in the process of returning to suppliers	5
	E21	*Suppliers will not accept returned goods*	5

Severity, Occurrence and Correlation Stages Identification is an assessment of the severity of the identified risk events, an assessment of the occurrence of the causes of identified risks and an assessment of the level of correlation between events risk and causes of risk. The measurement of risk events and causes of risk is to determine the scale of severity (severity) of the results of identification of risk events and to determine the scale of occurrence (probability of occurrence) of the causes of risk. Severity, occurrence and correlation levels are conducted based on a risk assessment questionnaire, the same is done to carry out this measurement with the distribution of questionnaires [6]. The risk assessment questionnaire is assessed by company representatives who have the authority and know the entire supply chain activities, namely the supply chain manager. In this study, the main focus is on the causes of risk because the causes of risk are the triggering factors for risk. Thus it can reduce the incidence of risk events. The results obtained are 7 causes of risk in which one cause of risk can cause one or more risk events.

The mapping that has been carried out is continued by searching for the ARP value to see the correlation between risk events and the causes of risk so that the highest risk causes that have

the highest risk can be obtained. Risk assessment is carried out through the calculation of Risk Priority Number (RPN) based on three factors, namely the likelihood of an occurrence, the severity of the impact arising (severity), and detection (detection).

Calculation of the Aggregate Risk Potential (ARP) value, where there are 3 (three) risk assessment factors, namely the severity of the risk event, the probability level of the cause of the risk, and the correlation value between the risk event and the cause of the risk. As for the details, it can also be seen in table 3 below.

This ranking value can be seen in Table 3, were from the ARP ranking results obtained 25 causes of risk where the causes of risk that have an ARP value are only 20 risk events. 5 ARP values that will not be reviewed again because they are zero.

Table 3. Ranking of ARP values

Risk event	Code (Aj)	ARPj	Pj
Sudden addition of orders	A1	825	1
Breakdown of internal and/or external communication	A2	256	2
Changes in sales plans	A6	125	3
Natural disasters	A5	16	4
The QA/QC process is not followed/followed up	A4	12	5
Breakdown on IT systems	A3	8	6
The choice of air and land transportation equipment is not standard and has many delays	A7	7	7

Based on ARP ranking results with 7 causes of risk, identification of prevention will be defined in advance from the causes of risk and the correlation of both to obtain a risk mitigation strategy. Mitigation actions are actions taken by companies in overcoming and reducing the impact produced by risk events and reducing the probability of the cause of risk. The ARP values that have been obtained, ranked from the first to the seventh sequence, are seen in the Pareto analysis table as follows.

Table 4. Pareto analysis of ARP assessment on HOR 1

Risk event	Code (Aj)	ARPj	Pj	Cumm. Count.	Cumm %
Sudden addition of orders	A1	825	1	825	66.053
Breakdown of internal and/or external communication	A2	256	2	1081	86.550
Changes in sales plans	A6	125	3	1206	96.557
Natural disasters	A5	16	4	1222	97.838
The QA/QC process is not followed/followed up	A4	12	5	1234	98.799
Breakdown on IT systems	A3	8	6	1242	99.440
The choice of air and land transportation equipment is not standard and has many delays	A7	7	7	1249	100

Seen from the Pareto table, ARP values that have been ranked and taking the highest ARP values that reach above 80% are 2 (two) causes of risk A1 and A2 that contribute as much as 86.55% of the total ARP supply, the causes of these risks are:

A1: Sudden addition of orders
A2: Breakdown of internal and/or external communication

Thus these two causes of risk are the priority for precautions that need to be taken by the company to maximize effective business.

4. Conclusion
Based on the results of research at the compressor company can be known several things, including:
 a. The use of the House of Risk method is proven as the right solution for designing mitigation strategies for the causes of risk.
 b. The main risk causes based on the results of this study produce 2 causes of risk that must be considered, including:
      A1: Sudden addition of orders
      A2: Breakdown of internal and/or external communication

5. References
[1]   Hayati, E. N., Fitriyah, M. W. 2015. Application of E-Supply Chain Management in Industry (Case Study at PT Maitland-Smith Indonesia). *DINAMIKA TEKNIK*, Vol. 9, No. 2, pp. 19-33.
[2]   Leppe, E. P., Karuntu, M. 2019. Analysis Of Home-Based Industrial Tofu Supply Chain Management In Bahu Manado. *Jurnal EMBA*, Vol. 7, No. 1, pp. 201–210.
[3]   Miradji, M. A. 2014. Analysis of Supply Chain Management at PT Monier in Sidoarjo. *BALANCED*, Vol. 10, No.19, pp. 63-82.
[4]   Prasetya, A. D., Retnoningsih, D., Koestiono, D. 2019. Performance of (Supply Chain Management) Potato Chips in Small Industry Batu City. *HABITAT*, Vol. 30, No. 2, pp. 44-53.
[5]   Munawir, H. dan Krismiyanto. 2016. Risk Analysis and Risk Mitigation Strategy for Cow Milk Supply Chain (Case Study in Singosari Village, Boyolali). *Simposium Nasional Teknologi Terapan (SNTT) 4*.
[6]   Kristanto, B. R. and Hariastuti, N. L. P. 2014. Application of House of Risk (HOR) Model for Mitigating Risks in the Supply Chain of Raw Skins. *JITI*, Vol. 13, No. 2, pp. 149-157.
[7]   Purwaditya, A. K., Widodo, K. H. and Ainuri, M. 2018. Risk Mitigation in the Upper Scombridae Fish Supply Chain at the Tegal Beach Fishing Port, Central Jawa. *J. Sosek KP*, Vol. 13, No. 2, pp. 219-227.
[8]   Adi, W. and Bakhtiar, A. 2017. Risk Mitigation Strategies in the Supply Chain UD. Wayang Semarang With House Of Risk Model. *Industrial Engineering Online Journal*, Vol. 6, No. 4, pp. 1-9.