

Risk Analysis and Mitigation in Supply Chain with House of Risk (HOR) Approach in Bag Manufacturing Industry at XYZ Ltd.

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Abstract

XYZ Ltd. is a company engaged in the bag-making manufacturing industry. The products produced include various types of bags such as backpacks, messengers, triangles, body bags, waist bags, and wheeled suitcases. The problems currently faced by XYZ Ltd. in its business processes, namely requests that are not the same as forecasts, delays in raw materials sent by suppliers, damage to raw materials during storage in warehouses due to the absence of routine checks, machine breakdowns that affect production process delays, and returns of finished products from consumers due to defect at the time of delivery. This causes the company to lose in terms of time and cost. This study uses the House Of Risk method. The House Of Risk method is a modification of the Failure Modes and Effects of Analysis (FMEA) method and the Quality Function Deployment (QFD) method. The purpose of this study is to identify potential risks that may arise in the supply chain at XYZ Ltd, find out the causes of these risks, and design effective risk mitigation strategies for the company. In the House Of Risk (HOR) stage 1, namely the risk identification stage, there are 33 risk events and 42 risk agents. Then after being analyzed using a Pareto diagram, 13 dominant risk causes were found based on the Aggregate Risk Potential (ARP) value. In the House Of Risk (HOR) phase 2, 14 mitigation actions (preventive actions) are proposed to overcome the probability of the emergence of risk agents in the supply chain of XYZ Ltd.

Keywords

Supply Chain Management, Risk Mitigation, House of Risk, Bag Manufacturing Industry.

1. Introduction

Business processes starting from providing quality products and fast delivery are the company's success in this globalization era. Companies are required to be able to meet dynamic market demands to survive (Pulansari et al., 2021). Basically, every company needs goods and services to support all activities within the company. To obtain these goods and services, the company carries out procurement activities. In carrying out its business processes, the procurement department will face various types of risks and causes of risks that may arise in their business processes and cause impacts that disrupt the smooth running of the business processes of procurement activities (Hendayani et al., 2021). The types of risks and the causes of these risks can come from within the company or from outside the company (Saifuddin et al., 2021). XYZ Ltd. is a company engaged in the bag-making manufacturing industry. The products produced include various types of bags such as backpacks, messengers, triangles, body bags, waist bags, and wheeled suitcases. Located in the city of Surabaya, East Java and was established in 1990.

XYZ Ltd. carries out supply chain activities starting from the procurement of materials, the production process to the distribution of products to distributors and finally products to consumers. Supply chain activities are inseparable from disturbing uncertainty. The problems currently faced by XYZ Ltd. in its business processes, namely requests that are not in accordance with forecasts, delays in raw materials sent by suppliers, damage to raw materials during storage in warehouses due to the absence of routine checks, machine breakdowns that affect production process delays, and

returns of finished products from consumers due to defect at the time of delivery. This causes the company to lose in terms of time and cost (Nugraha et al., 2020).

Research on the house of risk include Ulfah et al. (2016) who used the house of risk method to analyze risk management improvements in refined sugar supply chains and Kristanto et al. (2014) in mitigating risks in the leather raw material supply chain. Therefore, it is necessary to identify the risks that may occur in the supply chain of XYZ Ltd. uses the House of Risk (HOR) method. The House of Risk method is a modification of the Failure Modes and Effects of Analysis (FMEA) method and the Quality Function Deployment (QFD) method which in this model uses the House of Quality (HOQ) (Puji et al., 2019), to prioritize which risk sources are first selected to take the most effective action, to reduce the potential risk from risk sources (Aini et al., 2019). In the HOR approach, the calculation in the form of Aggregate Risk Potential (ARP) is obtained from the probability of the source of risk (occurrence) and the impact of damage (severity) (Ratnasari et al., 2018). The ARP value is used to determine the priority risk agent for which preventive action will be taken.

This research is expected to identify potential risks that may arise in the company's supply chain. Knowing the causes of these risks and being able to design effective risk mitigation strategies (Ramadhani and Baihaqi, 2018). The house of risk method will be recommended PT XYZ Ltd., especially in the Procurement Division to solve problems regarding the relationship between risk events, the relationship between risk causes, the relationship between risk and risk causes and risk mitigation actions that will be carried out (Nalhadi et al., 2019).

2. Literature Review

2.1 Supply Chain

The supply chain is a network of companies that work together to achieve the same goal, namely delivering a product to the final consumer (Pujawan, 2017). Supply Chain Management (SCM) is a method or approach to manage the flow of products, information, and money in an integrated manner involving several parties, from upstream to downstream consisting of suppliers, manufacturers, distributors, wholesalers, retailers, and end customers. (Pujawan, 2017).

2.2 SCOR (Supply Chain Operation Reference)

According to Salazar, Caro, and Cavaroz (2012) in Magdalena and Vannie (2019), the Supply Chain Operation Reference (SCOR) is structured into five different processes, namely plan, source, make, deliver, and return from suppliers to consumers. The implementation of the Supply Chain Operation Reference (SCOR) model effectively contributes to efficient logistics in supply chain operations (Wahyuni et al., 2020).

2.3. House of Risk (HOR)

Introduced by Pujawan and Geraldine (2009) HOR is a renewable method in analyzing risk. The application uses the principle of Failure Mode and Error Analysis (FMEA) to measure risk quantitatively combined with the House of Quality (HOQ) model to prioritize risk agents that must be prioritized first and then choose the most effective actions to reduce the potential risks caused. by risk agents. According to Magdalena and Vannie (2019), the House of Risk (HOR) has 2 stages. HOR stage 1 to determine the priority level of risk agents that must be given as a preventive measure (Astuti et al., 2019). HOR stage 2 is a priority in taking actions that are considered effective (Sanny et al., 2020).

2.4 Failure Mode and Effect Analysis (FMEA)

According Tejaningrum and Rustyani (2019) Failure Mode and Effect Analysis (FMEA) is a tool to identify the root cause of the failure of a product or non-fulfillment of product specifications. In relation to the use of Failure Mode and Effect Analysis (FMEA), will be familiar with terms related to potential failure modes, effects, and detection.

3. Methods

In conducting research, it is necessary to carry out problem solving steps. The steps for solving the problem in this study are as follows and can be seen in Figure 1:

1. Variable identification explains the variables studied.
2. Data collection is used for research materials which include primary data and secondary data.
3. Risk analysis (House of Risk stage 1), namely determining the value of the questionnaire on severity, occurrence, correlation, then calculating ARP, and evaluating risk based on the Pareto diagram.
4. Risk handling (House of Risk stage 2), namely determining priority risk agents based on Pareto diagrams, determining mitigation strategies, determining the correlation of mitigation strategies with risk agents, calculating TEk values, weighting Dk values, calculating ETDk values, and ranking priority (Rk) .
5. Analysis and discussion, namely attaching the results obtained from data processing and then a detailed description of the results obtained.

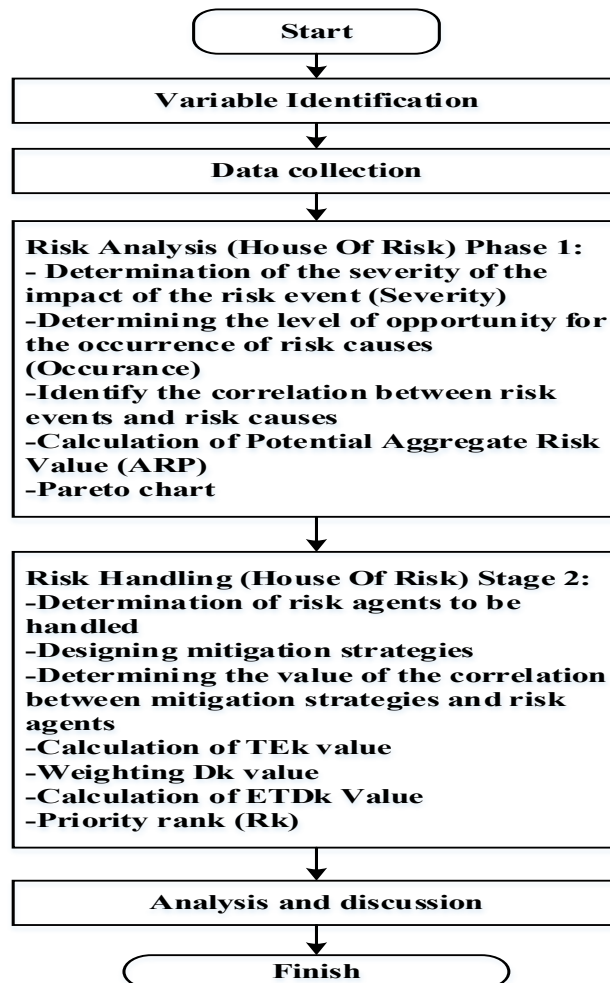


Figure 1. Research Methodology

4. Data Collection

The data collected in this study were data from interviews and brainstorming covering activities in the supply chain which were then distributed to fields related to supply chain activities. The results of data collection are as follows.

1. Business Processes in the Company's Supply Chain

Business processes in the company's supply chain are carried out using the SCOR approach, which is as follows.

a. Plan

It is a process that balances demand and supply to determine the best course of action to meet procurement, production, and delivery needs. Plan includes the process of estimating distribution requirements, planning and controlling inventory, production planning, material planning, and capacity planning.

b. Source

That is the process of procuring goods and services to meet demand. The processes involved include scheduling deliveries from suppliers, receiving, checking, and authorizing payments for goods shipped by suppliers, selecting suppliers, and evaluating supplier performance.

c. Make

That is the process of transforming raw materials or components into products that customers want. The process includes production scheduling, carrying out production activities and conducting quality testing, managing semi-finished goods (work in process), maintaining production facilities, and others.

d. Deliver

Deliver is a process to fulfill demand for goods and services. The processes involved include handling orders from customers, selecting a delivery service company, handling finished product warehousing activities, and sending invoices to customers.

e. Return

Return is the process of returning or accepting product returns for various reasons. The activities involved include identifying product conditions, requesting authorization to return defects, scheduling returns, and making returns.

2. Production System

The production system is a series of activities carried out to process raw materials into finished products that have added value. The stages of the process of making a backpack are as follows.

- a. Raw material preparation
- b. Design design
- c. Pattern making
- d. Cutting and tuning
- e. Installation of accessories and brands
- f. Sewing and assembly
- g. Process quality control

5. Results and Discussion

5.1 Mapping of Business Activities Based on SCOR

At this stage, supply chain activities will be grouped based on SCOR. At level 1 (major process) it is further elaborated into level 2 (sub process) which is further elaborated into level 3 (detail activity), namely detailed activities. (Table 1)

Table 1. Mapping of XYZ Ltd. Supply Chain Business Activities by SCOR

Level 1	Level 2	Level 3
Major Process	Sub Process	Detail Activity
Plan	Forecasting	Planning the quantity of demand and supply
	Capacity planning	Planning raw material warehouse capacity
	Financial planning	Aligning supply chain with financial planning
	Production planning	Planning the production process
Source	Procurement process	Supplier sends raw materials to the company
		Receive raw materials from suppliers
		Checking raw materials from suppliers
	Limited human resources	
Supplier	Evaluating supplier performance	
Make	Machine maintenance and repair	Check and make sure the sewing machine is ready to use
		Sewing machine repair
	Backpack product	Production control process
		Checking the bag of the production process
Deliver	Backpack delivery	Checking delivery
	Finished product warehousing	Arrange products in finished warehouse
Return	Return of rejected products	Returning bag products
		Handling products returned from consumers

Source: Company Data

5.2 Identification of Risk Events in Supply Chain Activities

After describing the supply chain activities based on the SCOR model, then risk identification is carried out (Paillin et al., 2021). The risk in question is supply chain activity that causes the company to lose money and time. The following are risk events at XYZ Ltd. (Table 2)

Table 2. Risk Event

Major Process	Sub Process	Detail Activity	Ei	Risk Event
Plan	Forecasting	Planning the quantity of demand and supply	E1	Demand does not match the forecast
			E2	Gap between recorded and available stock
	Capacity planning	Planning raw material warehouse capacity	E3	Capacity planning that is not as planned
			E4	Damage to raw materials because there is no regular warehouse check
Financial planning	Aligning supply chain with financial planning	E5	Incompatibility between the supply chain and financial planning	
Production planning	Planning the production process	E6	Sudden changes in the production process	
Source	Procurement process	Supplier sends raw materials to the company	E7	Delay in raw materials from suppliers
			E8	Raw material error received
	Supplier	Checking raw materials from suppliers	E9	Raw materials received are not inspected in detail by employees
			E10	Changes in the quality of raw materials
		Limited human resources	E11	Lack of expertise and low human resources
		Evaluating supplier performance	E12	It's hard to find a suitable local supplier
E13	Not evaluating supplier performance			
Make	Machine maintenance and repair	Check and make sure the sewing machine is ready to use	E14	Less precise and thorough for the process of checking the production machine
			Sewing machine repair	E15
	Backpack product	Production control process	E16	Damage to the zipper
			E17	Error in marking for seam folds
			E18	Error in marking for zipper installation
			E19	Error in cutting the pattern on the fabric
			E20	Untidy fabric setting
			E21	Mistakes in sewing according to the pattern
			E22	There was a work accident
	E23	Production schedule delay		
	Checking the bag of the production process	E24	Decrease in product quality during production	
Storing finished products in warehouse	E25	Pile of finished products collapsing in storage warehouse		
Deliver	Backpack delivery	Checking delivery	E26	Only able to send a minimum number of products
			E27	A natural disaster occurred during shipping
			E28	Product damage during transit
			E29	Product delivery error to user
E30	Product delivery delays to users			
Return	Return of rejected products	Returning bag products	E31	Late product return
			E32	Returns not accepted
		Handling products returned from consumers	E33	Delay in handling product returns

Source: Company Data

5.3 Identification of Risk Agents in Supply Chain Activities

After knowing the risks that arise in the process of supply chain activities, at this stage a list of risk causes is determined which is the basis for the occurrence of risk events (Parinduri et al., 2019). The following are the causes of risk at XYZ Ltd. (Table 3)

Table 3. Risk Agent

Ei	Risk Event	Ai	Risk Agent
E1	Demand does not match the forecast Gap between recorded and available stock	A1	Delay in information obtained from consumers
		A2	Incorrect forecast calculation
E2	Capacity planning that is not as planned	A3	Workers error in recording data
E3	Damage to raw materials because there is no regular warehouse check	A4	Workers do not check between planning and warehouse stock
E4	Incompatibility between the supply chain and financial planning	A5	There is no SOP for routine checks from the company
E5	Sudden changes in the production process	A6	Unstable raw material prices from suppliers
E6	Delay in raw materials from suppliers Raw material error received	A7	Power outage resulting in production delays
		A8	Urgent request
E7	Raw materials received are not inspected in detail by employees Changes in the quality of raw materials	A9	Disruption during the delivery process
		A10	Difficult administrative process
E8	Lack of expertise and low human resources It's hard to find a suitable local supplier	A11	Lack of checking from the supplier
		A12	There was a miscommunication with the supplier
E9	Not evaluating supplier performance	A13	Hurry in checking process
E10	Less precise and thorough for the process of checking the production machine Maintenance takes a long time	A14	There is an increase in the price of raw materials
		A15	Raw materials are hard to find during certain seasons
E11	Damage to the zipper Error in marking for seam folds	A16	Limited human resources
		A17	No job training
E12	Error in marking for zipper installation Error in cutting the pattern on the fabric	A18	Low quality as expected
		A19	The price is relatively expensive
E13	Untidy fabric setting Mistakes in sewing according to the pattern	A20	Dependence on one supplier
		A21	There is no SOP for evaluating supplier performance
E14	There was a work accident	A22	Time pressed checks
E15	Production schedule delay	A23	Machine damage is very serious
E16	Decrease in product quality during production	A24	Unorganized zipper storage in warehouse
E17	Pile of finished products collapsing in storage warehouse	A25	Careless workers
E18	Only able to send a minimum number of products	A26	Lack of focus at work
E19	A natural disaster occurred during shipping	A27	Not checking the pattern
E20	Product damage during transit	A28	A set knife that is not sharp
E21	Product delivery error to user	A29	Worker fatigue
E22	Product delivery delays to users	A30	Not using safety equipment
E23	Late product return	A31	There is a machine breakdown
E24	Returns not accepted	A32	Damaged raw materials due to the production process
E25	Delay in handling product returns	A33	Workers do not follow the arrangement in the warehouse according to the SOP
E26	Demand does not match the forecast	A34	Limited means of shipping transportation

E27	Gap between recorded and available stock	A35	External factors
E28	Capacity planning that is not as planned	A36	Means of transportation delivery is not safe
E29	Damage to raw materials because there is no regular warehouse check	A37	Lack of coordination by the delivery party
E30	Incompatibility between the supply chain and financial planning	A38	Natural disasters
E31	Sudden changes in the production process	A39	Has exceeded the time limit set by the company
E32	Delay in raw materials from suppliers	A40	Product returns do not meet specifications
E33	Raw material error received	A41	Delivery distance factor from company to consumer
		A42	Barriers to communication between companies and consumers

Source: Company Data

5.4 Questionnaire Preparation and Questionnaire Distribution

The preparation of the questionnaire was carried out to obtain the severity and level of occurrence. The questionnaire is divided into three types, namely the value of severity, the value of the level of occurrence, and the value of the correlation between risk events and risk agents (correlation). Meanwhile, questionnaires were distributed to company officials who really understand the state of the company and the company's business processes in the supply chain. Assessment of the severity and occurrence questionnaire is carried out by the head of the production field, the head of the PPIC field, and the head of the warehouse field. Meanwhile, specifically for the correlation questionnaire, only the general manager assessed it.

5.5 Data Processing

In processing the data, the results obtained from the respondents from high-ranking companies are used to assess risk events to the causes of risk (risk agents) through the questionnaire provided. Then after obtaining the value from the questionnaire, the severity of the impact of the risk event (severity), the level of occurrence of the opportunity for the occurrence of the risk cause (occurrence), and the correlation value between the risk event and the risk agent (correlation). The results of the questionnaire will then be the basis of the risk analysis processes and risk management in the House Of Risk (HOR) method, which will be applied to the House of Risk analysis phase 1.

5.6 Risk Analysis (House of Risk Phase 1)

At this stage, it is to obtain risk events and causes of risk. The risk events and causes of these risks cause the company to lose in terms of time and costs so that it has an impact on business activities in the company (Kurniawan et al., 2021).

1. Determination of the Severity of the Impact of Risk Events (Severity)

At this stage, the value of the impact (severity) of each identified risk event is determined by distributing questionnaires to departments and parties related to the company's supply chain activities. The scale used is a value of 1-10.

2. Determination of the Level of Occurrence of the Impact of the Cause of Risk

At this stage, the value of the occurrence of each risk agent (risk agent) that has been identified is determined by distributing questionnaires to departments and parties related to the company's supply chain activities. The scale used is a value of 1-10.

3. Identification of Correlation between Risk Events and Risk Causes (Correlation)

At this stage, the correlation between risk causes and risk events is assessed (correlation). If a risk agent causes an event to occur, it can be said to be correlated. In assessing the correlation between risk events and risk causes, we use a description of values of 9 for strong correlation, 3 for moderately correlated, and 1 for weakly correlated.

4. Calculation of Aggregate Risk Potential (ARP)

Aggregate Risk Potential (ARP) is used to rank the causes of emerging risks. An example of the calculation is as follows.

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

$$ARP_1 = A_1 \times ((E_1 \times 9) + (E_2 \times 1) + (E_3 \times 1))$$

$$ARP_1 = 7 \times ((8 \times 9) + (4 \times 1) + (2 \times 1))$$

$$ARP_1 = 546$$

5. Pareto Charts

In the risk ranking stage, several risk agents with the highest occurrence rate will be selected based on the concept of Pareto analysis. According to Magdalena and Vannie (2019), in accordance with the principle of the Pareto Charts, which is 80%: 20%, the priority problem to be solved is the problem with a percentage of up to 80%.

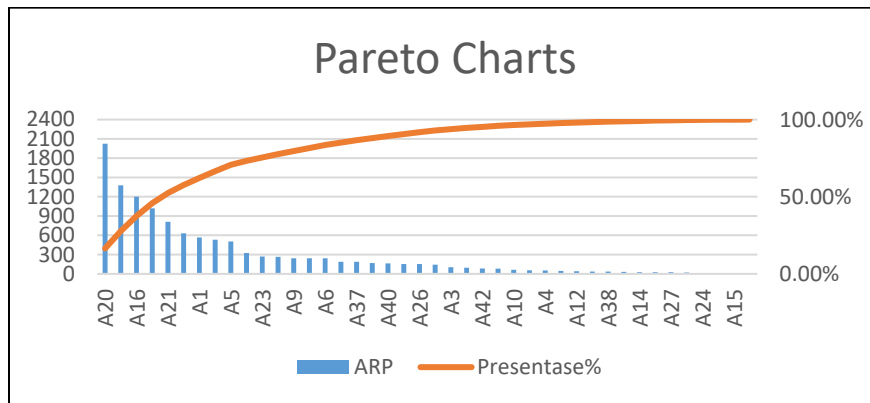


Figure 2. Pareto Charts

From the results of the Pareto Charts Figure 2 above, it can be concluded that 13 risk agents are the cause of the dominating risk of 79.60% and 29 risk agents are the causes of risk that contribute 20.40% of the total Aggregate Risk Potential (ARP). So that risk agents are prioritized for mitigation based on the Pareto Charts concept, namely 13 risk agents. The following is a breakdown of the 13 dominating risk agents. (Table 4)

Table 4. Dominant Risk Agent

Rank	Code	Risk Agent	ARP
1	A20	Dependence on one supplier	2025
2	A34	Limited means of shipping transportation	1377
3	A16	Limited human resources	1200
4	A29	Worker fatigue	1020
5	A21	There is no SOP for evaluating supplier performance	810
6	A17	No job training	630
7	A1	Delay in information obtained from consumers	567
8	A31	There is a machine breakdown	532
9	A5	There is no SOP for routine checks from the company	504
10	A22	Time pressed checks	324
11	A23	Machine damage is very serious	270
12	A8	Urgent request	265
13	A9	Disruption during the delivery process	243

Source: Data Processed

5.7 Risk Management (House of Risk Phase 2)

At this stage, a mitigation strategy will be designed to prevent risk agents from appearing in the company's supply chain. The output of HOR 1, which is the risk agent that dominates 80% based on the Pareto diagram, will be the input for HOR 2. The design of the mitigation strategy that will be chosen will also consider the total effectiveness and level of difficulty if the strategy is implemented.

1. Determination of the Risk Agent to be Handled

The output of HOR 1 is the risk agent that dominates 80% in the Pareto diagram concept of the Aggregate Risk Potential (ARP) calculation.

2. Mitigation Strategy Design

The design of the mitigation strategy is given to each risk agent who has the highest ARP value based on the Pareto concept. Within each risk agent can be mitigated by one or more mitigation actions.

3. Determination of Correlation Value between Mitigation Strategy and Risk Agent

At this stage, the determination of the correlation value between the mitigation strategy and the risk agent. E_{jk} is the correlation value between mitigation strategies and risk agents. The Likert scale used to determine the correlation value is the same as the Likert scale in the correlation value between risk events and risk agents. (Table 5)

Table 5. Correlation Value Between Mitigation Strategies and Risk Agent

Risk Agent		Mitigation Strategy		(E_{jk})
A20	Dependence on one supplier	PA 1	Looking for more than one supplier from within the country	9
A34	Limited means of shipping transportation Limited human resources	PA 2	Add transportation	3
		PA 3	Using a third party delivery service	1
A16	Worker fatigue	PA 4	Employing outsourcing	9
A29	There is no SOP for evaluating supplier performance No job training	PA 5	Giving rest hours to workers	9
		PA 6	Providing an even workload to workers	1
A21	Delay in information obtained from consumers	PA 7	Make an annual supplier performance evaluation SOP	9
A17	There is a machine breakdown	PA 8	Conducting job training for workers	3
A1	There is no SOP for routine checks from the company Time pressed checks	PA 9	Provide customer service hotline	3
		PA 10	Create a company website	3
A31	Machine damage is very serious Urgent request	PA 11	Checking before the production process	3
		PA 12	Make SOPs for routine machine checks	9
A5	Disruption during the delivery process	PA 13	Make SOPs for routine warehouse checks	9
A22	Dependence on one supplier	PA 12	Make SOPs for routine machine checks	9
A23	Limited means of shipping transportation	PA 11	Checking before the production process	3
A8	Limited human resources	PA 1	Looking for more than one supplier from within the country	9
A9	Worker fatigue	PA 14	Make delivery SOPs to be well organized	3

Source: Data Processed

4. Calculation of Total Effectiveness of Action (TE_k)

The TE_k value is obtained from the value between the Aggregate Risk Potential (ARP) of each correlated risk agent and then multiplied by the correlation value. The following is an example of calculating the Total Effectiveness of Action (TE_k).

$$TE_k (\text{Total Effectiveness of Action}) = \sum ARP_j E_{jk}$$

$$TE_{PA1} = (ARP_{20} \times 9) + (ARP_8 \times 9)$$

$$TE_{PA1} = (2170 \times 9) + (576 \times 9)$$

$$TE_{PA1} = 24714$$

5. Weighting Difficulty of Performing Action (D_k)

After calculating the TE_k value, the Difficulty of Performing Action (D_k) value is then weighted. This D_k value states the difficulty level of implementing each mitigation action. On a scale of 3 indicates that the mitigation action is easy to implement, a scale of 4 indicates that the mitigation action is moderate to implement, and a scale of 5 indicates that the mitigation action is difficult to implement.

6. Calculation of Effectiveness to Difficulty of Ratio (ETD $_k$) Value

This ETD $_k$ value states the ratio between the effectiveness of the mitigation action and the difficulty level of each mitigation action. The ETD $_k$ value is obtained from the TE_k value divided by the D_k value. The following are examples of ETD $_k$ calculations and results for all 14 mitigation strategies.

$$ETD_k (\text{Effectiveness to Difficulty Ratio of Action}) = TE_k / D_k$$

$$ETD_1 = TE_1 / D_{k1}$$

$$ETD_1 = 24714 / 4$$

$$ETD_1 = 6179$$

7. Priority Rank (Rk)

The ranking is done based on the ratio level of the level of effectiveness and the level of difficulty to determine the priority of the largest ETD_k value. The following is a recap of the evaluation results of other mitigation strategies. (Table 6)

Table 6. Recap of Mitigation Action Evaluation Results

PAj	Mitigation Strategy	TEk	Dk	ETDk	Rk
PA1	Looking for more than one supplier from within the country	24714	4	4617	1
PA4	Employing outsourcing	13851	3	3600	2
PA5	Giving rest hours to workers	10800	3	2814	3
PA7	Make SOPs for an annual supplier performance evaluation	8442	3	2430	4
PA12	Make SOPs for routine machine checks	7290	3	4617	5
PA13	Make SOPs for routine warehouse checks	7128	3	2376	6
PA11	Checking before the production process	6696	3	2232	7
PA2	Add transportation	6075	5	1215	8
PA10	Create a company website	2568	3	856	9
PA8	Conducting job training for workers	2664	4	666	10
PA9	Provide customer service hotline	2568	4	642	11
PA3	Using a third-party delivery service	2025	5	405	12
PA6	Providing an even workload to workers	1200	4	300	13
PA14	Make delivery SOPs to be well organized	567	4	142	14

Source: Data Processed

In this chapter, data processing has been carried out starting from HOR stage 1 to HOR stage 2. The results obtained from HOR data processing stage 1 are that there are 33 risk events caused by 42 risk causes. The results obtained from the HOR data processing stage 2 are 14 mitigation actions. The following is an explanation of 14 mitigation actions in the company's supply chain activities.

6. Conclusion

Based on the results of research that has been carried out at XYZ Ltd., the following conclusions are obtained. In the House of Risk (HOR) stage 1, there are various kinds of risks that occur in the company, namely as many as 33 risk events. From some of these risk events, there were 42 causes of risk (risk agents). So that from 42 risk agents, there are 13 most dominant risk agents based on the Pareto diagram from the calculation of the Aggregate Risk Potential (ARP) value.

In the House of Risk (HOR) stage 2, 14 mitigation actions have been ranked. Some of the mitigation actions that have the biggest impact on the company are looking for more than one supplier from within the country (PA1), using outsourced workers (PA4), giving rest hours to workers (PA5), and making SOPs for an annual supplier performance evaluation (PA7).

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