Risk Management Analysis in Supply Chain Activities of Bottled Water Companies Using the House of Risk Method

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Abstract. PT. XYZ is a bottled drinking water company, and its products are distributed to mini-markets and small and medium-sized enterprises. One crucial aspect for human survival is drinking water, and companies in the bottled water industry are required to provide products of the highest quality. To ensure the best quality products, preventive measures against risks in the company's supply chain are essential as they can impact the product's quality. This study aims to understand the flow of the company's supply chain, identify risks in the supply chain flow to determine the prioritized risk causes, and establish prioritized risk mitigation strategies to minimize potential risk occurrences at PT. XYZ. The research employs the House of Risk (HOR) method, divided into two phases: HOR Phase 1 and HOR Phase 2. In HOR Phase 1, risk identification is conducted, revealing 27 risk events and 20 risk causes. Mitigation strategies recommended for the highest-ranking risk causes involve using the HOR Phase 2 method. The results include 9 recommended mitigation actions that can be implemented within PT. XYZ.

Keywords: AMDK, House of Risk (HOR), Supply Chain Flow, Mitigation, Risk.

1. Introduction

Bottled drinking water (AMDK) is a product that is in great demand, thus a company is required to have a good image towards consumers by providing products of the best quality [1]. Good quality is an important factor in consumer selection to choose the product to use, therefore companies must be able to maintain the quality of the products offered so that they are free from risks that have the potential to arise in supply chain activities [2].

Risk management should be implemented properly in every business activity and AMDK companies also do not ignore the importance of implementing good and appropriate risk management, because it can have a big impact on the performance of every actor in the supply chain [3]. As with this AMDK company, by looking at supply chain activities, the supply chain at this AMDK company is seen starting from the procurement, production and distribution process which has a goal of meeting consumer needs to meet consumer satisfaction without causing shortages or excess stock which leads to profits for PT XYZ.

The supply chain flow at PT XYZ begins with product orders from consumers to PT XYZ which will be continued in the plan section. The plan section is divided into several components, namely receiving orders, planning the progress of production and planning delivery of finished products. Next, in the source section, the required bottle raw materials will be ordered by PT received by PT XYZ. The next process is the make section which contains production activities right up to the storage of the finished product. Next, in the delivery section, goods that have been stored in the finished product warehouse will be sent to the consumer, where if the consumer is satisfied, there is the possibility for the consumer to place an order again and if there is a defect in the product, the consumer can complain to the company and if the product If a defect is found, the product can be destroyed.

According to the head of production, there are several risks that occur, one of which is worker accidents during the production process and there is also the risk of the product experiencing contamination as well as defects or damage to the product which is usually caused by worker negligence or damage to the machine that occurs which causes damage to the product. Goods that experience contamination or damage will be rejected, where the reasonable limit applied by the company is only 1%. As the data shown below shows, from the 6 months of data obtained, the total number of rejected products exceeds the percentage limited by the company.

Table 1. The percentage of rejects on PT XYZ products

Period	Production Results (pcs)	Company Defect Standard(%)	Total Disability	Defect Percentage
April 2023	5323680	1%	75800	1,42%
March 2023	7005360	1%	96670	1,38%
February 2023	559 3392	1%	62950	1,13%
January 2023	6129600	1%	84950	1,39%
December 2022	6303840	1%	93380	1,48%
November 2022	6341280	1%	92560	1,46%

SCM itself has a definition as a concept that combines SCM with risk management [4] and added [5] that SCM is a systematic process for identifying, analyzing, and everything related to risk in a supply chain activity. company. SCM itself has the aim of achieving maximum supply chain activities and avoiding risks that could cause losses [3]. However, in implementing SCM, it does not always work well, every activity that the company carries out cannot be separated from risks that can affect the flow of goods. From the data presented in 2019 by CRMS (centre for risk management studies), Indonesia's level of ability in implementing risk management was only 76%, which means that Indonesia has become more mature in implementing it, but in implementing risk management it increases effectiveness and efficiency in the company's supply chain. only 33%, which means that there are still many companies that do not pay enough attention to risk management in supply chain activities.

From the results of interviews with the head of the factory at PT the company, these risks can cause the company to suffer losses, especially if production activities

are hampered due to damage to machines caused by a lack of checking the machines used, then there are products contaminated with dirt due to workers being less careful when checking the products produced, and worker accidents which are caused by several SOPs that are not implemented properly.

In an effort to improve or minimize the obstacles that exist at this time, accurate mitigation measures are needed, so in this study the researcher used the house of risk (HOR) method to identify what risks have the potential to arise and make improvements to reduce failure [6] and SCOR (supply chain operation reference) are used to measure and describe parts of the supply chain where SCOR has a certain level of flexibility that can be changed to increase efficiency in meeting consumer needs [7].

2. Research Methods

2.1 Data Sources
This data collection was carried out using the interview method and then questionnaires and literature studies were used to obtain valid data. The respondents taken in the questionnaire were stakeholders who had worked for approximately 5 years at PT XYZ in accordance with their respective fields of work.

2.2 Supply Chain Management
According to [8] supply chain management (SCM) is a reciprocal relationship between providers and consumers which has the aim of providing maximum value to consumers at low costs but providing comprehensive supply chain benefits. According to [9] supply chain management (SCM) has a main objective where supply chain management (SCM) can reduce time and costs in fulfilling needs, and SCM can also make deliveries according to predetermined times, and manage inventory properly. both between suppliers and consumers.

2.3 Supply Chain Risk Management
Supply chain risk management (SCRM) is an arrangement of activities consisting of identification, analysis, handling and control of risks in the supply chain [10] [11] adding that supply chain risk management (SCRM) is a process structured and collaborated in the supply chain used to achieve optimal conditions through strategy, human resources and other elements. According to [12] if a company does not manage risk well it will have a direct impact on the performance of the company which will later cause losses that the company must pay. Supply chain risk management (SCRM) is divided into several types according to [13] which include operational risk, financial risk, hazard risk and strategic risk.

2.4 Risk Management
Risk management can be interpreted as a policy that contains existing procedures within an organization, which are used to assist an organization in planning, evaluating, handling and monitoring a risk. , where in the future it is hoped that they will be able to minimize risks that could occur and are expected to be able to overcome risks that have the potential to arise [14].

2.5 Risk Assessment

Risk assessment is an assessment process that will later be useful for companies to identify any potential dangers that could arise [15]. The risk assessment stage according to [16] includes three activities, namely:

1) Identify risks
   Risk identification is a step in the process of grouping existing risks in the company
2) Risk Analysis
   This risk analysis is a measure of assessment of several possible risks that will arise, where the risk analysis will consider the source of the risk, severity, and the likelihood of a consequence arising. The following is the severity according to [17].

Table 2. Severity Criteria

Levels	Description	Description
1	No. Effect	No effects appeared on the product or activity
2	Very Slight	There is so little effect on the product or activity that it can be ignored
3	Slight	Little effect on the product or activity and of little concern
4	Minor	There is a minor effect on the product or activity
5	Moderate	There is a moderate effect on product or activity performance degradation
6	Significant	Product quality decreases but activities can still continue
7	Major	Decreased product quality and/or temporarily disrupted activities
8	Extreme	Decreased product quality and/or disrupted activities
9	Serious	Products are severely impacted and/or may halt activity
10	Hazardous	Products are very badly affected and/or cause cessation of activity and/or loss of customers

The next is determining the cause of the risk itself (Risk Agent) where the cause of this risk can be measured from the level of occurrence (Occurrence). The following are the occurrence criteria according to [17].

Table 3. Occurrence Criteria

Levels	Criteria	Description
1	Almost Never	The risk almost never occurs
2	Remote	Rare risk occurs within 1 month
3	Very Slight	Very less likely 1 time in 3 months
4	Slight	Slight possibility <5 times in 1 month
5	Low	Likely to happen once a month
6	Medium	Likely to occur >5 times in 1 month
7	Moderately High	Likely to happen once a week
8	High	Likely to occur >1 time in 1 week

Levels	Criteria	Description
9	Very High	Likely to occur >1 time every 3, 4 or 5 days
10	Almost Certain	Risks definitely occur, even appearing once a day

3) Risk Evaluation

After the two processes above have been carried out, the next process is to multiply the likelihood and severity values, where the results will later be used to determine the level of danger (Risk Level) by looking at the risk matrix table, according to [18] the results obtained from multiplying the likelihood and severity will be used to rank a potential source of a hazard which will later be used as a beacon to recommend what improvements should be made to an existing problem.

2.6 House Of Risk

The definition of house of risk (HOR) according to [19] is a method used in research that has a focus on preventive actions aimed at finding and determining activities that cause the risk, where the risk becomes a priority which will later be risk mitigation measures are taken.

In its implementation, house of risk (HOR) has two stages, namely HOR 1 and HOR 2, where HOR 1 is used to identify which risk agents should be prioritized for preventive action [20], while HOR 2 is used in determining action. priorities that are considered effective and of course remain within cost and resource estimates that are said to be reasonable [21].

2.7 Supply Chain Operation References (SCOR)

SCOR is a model that can be used in supply chains in several categories, some of these categories such as describing, designing an activity in the supply chain in a business activity within the company and SCOR also focuses more on manufacturing supply chain operations [22]. In the supply chain management process in SCOR there are several processes to achieve goals, according to [23] there are five main processes in the supply chain as follows.

1) Plan

Plan is a depiction of any activity that aims to develop a plan. Plan consists of collecting requirements and information on existing resources and balancing to determine the ability to fulfill demand from existing inventory

2) Source

This process is a description of a delivery order where the description is in the form of scheduling the delivery, receipt and storage of goods

3) Make

This process is a depiction of the core activities of the production system in a company that will produce output from the company

4) Deliver

Deliver is a depiction of the activity of distributing goods produced by the company which aims to meet the demand of consumers who have been determined

5) Return

This process is a description of the activity of returning goods that usually occur damage or defects in the company's products

3. Result And Discussion

3.1 Data Collection

Data collection in this research used interview methods, questionnaires and literature studies. The respondents taken for this research were stakeholders who had worked for approximately 5 years at PT XYZ in accordance with their respective fields of work. Where the respondents who helped in filling out this research questionnaire were as follows.

Table 4. Respondents

No.	Position	Length of Service
1	Head of the factory	> 5 years
2	KA. SUB. BAG. Production	> 5 years
3	KA.SUB.BAG.ADM Marketing/Warehouse	> 5 years
4	Head marketing	> 5 years
5	KA.SUB.BAG.ADM.Marketing	> 5 years

The data collected is data that will be used in the next stage, where the data is supply chain activity mapping data using the Supply Chain Operation Reference (SCOR) which includes Plan, Source, Make, Deliver and Return. The following are supply chain activities at PT XYZ.

Table 5. Supply Chain Activity Process

Major Processes	Sub - Processes
Plan	Packaging type planning.
	Planning the running of a production.
	Finished product delivery planning.
Source	Procurement of packaging that will later be used.
	Selection of Supplier for packaging.
Make	Production activities
	Finished product inspection
	Finished product packaging
Deliver	Delivery of goods to consumers.
Return	Consumers can complain to the company if there is damage.
	Consumers can destroy defective products.

1) Identify Risk Events

The first stage that will be carried out is to identify risks and potential risks based on data collection carried out by interviews and also literature studies as support. At this stage, an assessment of risk events will be carried out based on sevirity (level of severity) with an assessment on a scale from 1-10 which can be seen in Table VI. The following are the results obtained from the results of the risk event assessment questionnaire.

Table 6. Identify Risk Events

Major Processes	Sub - Processes	Risk Event	Reference	Code	Severity
Plans	Packaging type planning	The goods ordered do not match the specifications.	Interview	E1	6
		Orders arrived late.	Interview	E2	5
		There is damage to the order that arrived.	Wardani, 2022 [28]	E3	8
	Planning the running of a production.	Errors in designing a production process.	Interview	E4	5
		Sudden changes in production planning.	Interview	E5	5
		errors in designing delivery of finished products to consumers.	Interview	E6	5
	Finished product delivery planning.	Quantity errors in sending finished products to consumers.	Interview	E7	4
		Error in scheduling delivery from factory.	Interview	E8	8
Source	Procurement of packaging that will later be used.	Delays in carrying out the procurement process	Interview	E9	8
		Error in determining the order arrival date	Interview	E10	4
		The quality of the product ordered is not suitable	Interview	E11	6
		The quantity of product ordered is not appropriate	Interview	E12	6
	Selection of Supplier for packaging.	Supplier's inability to meet demand	Wardani, 2022 [28]	E13	3
		Termination of contract with supplier	Interview	E14	7
Make	Production activities	Worker accidents during the production process.	Wardani, 2022 [28]	E15	4
		There is a defect in the product	Interview	E16	6
		The product is contaminated	Interview	E17	9
	Finished product inspection	Lack of thoroughness during the inspection process	Interview	E18	6
	Finished product packaging	Damage to packaging	Interview	E19	4
Deliver		Delays in delivery	Interview	E20	4

Major Processes	Sub - Processes	Risk Event	Reference	Code	Severity
Return	Delivery of finished products to consumers.	Product damage during the distribution process	Interview	E21	7
		Inconsistency in the number of products sent	Interview	E22	7
		Delivery address error	Interview	E23	4
	Consumers can complain and return it to the company if there is damage.	Reduced customer trust	Interview	E24	8
		Decreased company image in the eyes of customers	Interview	E25	8
		Cover shipping costs	Interview	E26	5
	Consumers can destroy defective products.	Compensation costs for the destruction of the defective product	Interview	E27	5

In Table VI above, it is known that there are 27 risk events identified at PT XYZ which are found in 5 major processes. The assessment carried out in Table VI was obtained with a single value because it was carried out using a questionnaire for each supply chain flow with 1 respondent in each major process.

2) Identify the Causes of Risk

The next stage after identifying the risk event and assessing the severity of the risk event is to identify the cause of the risk itself, which will then be given an assessment of the probability of the risk event (occurrence) of the cause of the risk. At this stage an assessment will be carried out according to the assessment scale which can be seen in table III. The following are the results of a questionnaire for assessing the causes of these risk events.

Table 7. Identify the Causes of Risk

Risk Agent	Reference	Risk Agent Code	Occurance
Human error (not careful, not concerned, wrong input, etc.)	Interview	A1	8
Incompetent workers	Interview	A2	6
Unexpected market demand	Interview	A3	4
Miscommunication between workers	Interview	A4	8
Error in data input	Interview	A5	6
Lack of thorough planning	Interview	A6	6
Errors in determining production time estimates	Interview	A7	6
Lack of testing and verification	Interview	A8	4
Limited production capacity	Interview	A9	4
Non-conformity to specifications and delivery delays	Interview	A10	4
Lack of training and awareness of workers	Interview	A11	8

Risk Agent	Reference	Risk Agent Code	Occurance
Damage to machines used during the production process	Interview	A12	4
Errors in production, packaging and storage	Interview	A13	8
Lack of helpful tools and Technology	Interview	A14	6
Lack of supervision on cardboard packaging	Interview	A15	8
Lack of coordination and communication	Interview	A16	8
Rough and careless handling	Interview	A17	6
Error in order processing	Interview	A18	4
Incomplete consumer address information	Interview	A19	2
The finished product is damaged	Interview	A20	10

In the table above, it is known that there are 20 identified risk causes that have the possibility of risk events occurring.

3) Correlation Assessment

This stage is a useful stage for determining a relationship between 27 risk events and 20 risk causes that have previously been identified. The rating scale that will be given later for assessing this correlation is 1, 3, and 9. The number 1 means that there is a weak relationship, the number 3 means that there is a moderate relationship, and the number 9 means that there is a strong relationship.The following are the results of a questionnaire from assessing the correlation between risk events and the causes of the risk.

3.2 Data processing and analysis

This data processing stage is carried out using the House of Risk (HOR) method, this method contains two phases, namely HOR phase 1 and HOR phase 2. HOR phase 1 is intended to determine the cause of risk which is a priority and then mitigation measures will be taken. in HOR phase 2.

1) House of Risk Data Processing Phase 1

This stage is carried out to calculate the ARP value and then carry out a risk evaluation.

a. ARP Value Calculation

This ARP calculation aims to determine the priority of the causes of risk which will later be used to become the main focus in resolution. This ARP value is obtained from the correlation between risk events and risk causes. The following is the ARP value that has been calculated and then entered into the phase 1 HOR risk matrix table which aims to make ranking easier

Table 8. HOR Phase 1

Risk Event	Risk Agent					
	A1	A2	A3	A4	A5	Severity
E1	9	3		1	3	6
E2	1	1		3	3	5

Risk Event	Risk Agent					Severity
	A1	**A2**	**A3**	**A4**	**A5**	
E3	1	3				8
E4	3	3		3	3	5
E5		1	9	3	3	5
E6	1	1		3	3	5
E7	3	1		3	3	4
E8	3	1		3		8
E9	1	3	9	3	3	8
E10	3	3	3	3		4
E11						6
E12	3	1	3	3	1	6
E13			9			3
E14		1				7
E15	3	1		1		4
E16						6
E17	3					9
E18	9	3				6
E19	3					4
E20	1			3		4
E21	3					7
E22	9			3		7
E23	9				3	4
E24						8
E25						8
E26						5
E27						5
Occurrence	8	6	4	8	6	
ARP	3120	930	696	1544	792	
Rank	1	3	5	2	4	

Based on the overall calculations, the highest ARP value was found to be A1, namely Human error (not careful, not concerned, etc.), while the smallest ARP value was A19, namely incomplete consumer address information

b. Risk Evaluation

After carrying out the ARP calculation, a risk evaluation will then be carried out. The following is a priority grouping of risk agents to determine the order of risk agents based on the ARP value which can be seen below.

<div align="center">**Table 9.** Risk Cause Pareto Calculation</div>

Code	Rank	ARP	Percentage	Cumulative
A1	1	3120	0,1487131	15%
A16	2	2912	0,1387989	29%
A20	3	2340	0,1115348	40%
A4	4	1544	0,0735939	47%
A17	5	1404	0,0669209	54%
A13	6	1384	0,0659676	61%
A6	7	1140	0,0543375	66%
A2	8	930	0,0443279	70%
A18	9	900	0,042898	75%
A5	10	792	0,0377502	78%
A3	11	696	0,0331745	82%
A11	12	680	0,0324118	85%
A8	13	672	0,0320305	88%
A12	14	564	0,0268827	91%
A7	15	528	0,0251668	93%
A15	16	432	0,020591	96%
A14	17	396	0,0188751	97%
A10	18	348	0,0165872	99%
A9	19	108	0,0051478	100%
A19	20	90	0,0042898	100%

According to [24] Pareto uses the 80/20 concept or the 80 20 rule, this rule explains that from 80% of events the effects arise due to 20% of the causes, whereas according to [25] the Pareto 80/20 principle says 20% of problems have an impact of 80%, of which 20% are important problems. Based on the calculation results above, it can be seen that this risk is considered important.
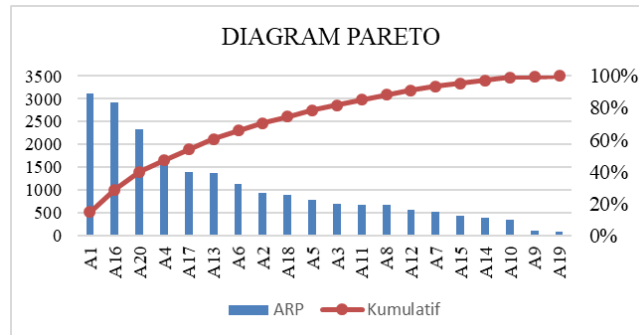
Figure 1. Pareto diagram

Based on the Pareto diagram above, it can be seen that the priorities for taking action according to the highest ARP ranking are risk causes A1, A16, A20, A4, A17, A13, A6, A2, A18, and A5. Below is a summary of the causes of risk based on their rank.

Table 10. Recapitulation of Priority Causes Based on Ranking

ARP	Code	Rank	Risk Agent
3120	A1	1	Human error (not careful, not concerned, wrong input, etc.)
2912	A16	2	Lack of coordination and communication
2340	A20	3	The finished product is damaged
1544	A4	4	Miscomm between workers
1404	A17	5	Rough and careless handling
1384	A13	6	Errors in production, packaging and storage
1140	A6	7	Lack of proper planning
930	A2	8	Incompetent workers
900	A18	9	Error in order processing
792	A5	10	Error in data input

After knowing the risk causes that are priorities in the HOR phase 1 stage, the next thing that will be carried out is the HOR phase 2 stage, where the HOR phase 2 stage is the stage that will be carried out to determine the most appropriate and effective risk mitigation actions based on the priorities of the risk causes that have previously been determined. known, to reduce the occurrence of risks that may occur.

2) House of Risk Data Processing Phase 2

The next stage is the HOR phase 2 stage. HOR phase 2 is intended to determine the most effective risk mitigation actions to reduce the possibility of risks occurring that will have an impact on the company. HOR phase 2 has several stages, namely designing a mitigation strategy, assessing the correlation between the causes of risk and recommendations for risk mitigation actions, calculating Total Effectiveness (TEk) and

Degree of Difficulty (Dk), and calculating the Effectiveness of Difficulty ratio (ETDk) which aims to to find out priority mitigation actions.

a. Degree of Difficulty

Degree of Difficulty (Dk) is an assessment of the level of difficulty if this action is implemented in the company in the future. The following are the results of the questionnaire by the respondents.

Table 11. Recommended Mitigation Action

Code	Preventive Action	Degree of Difficult
PA1	Provide regular training to workers and provide warnings to workers	3
PA2	Improve coordination and communication between parties so that accurate information is conveyed	4
PA4	Supervise the loading process and also provide counseling to comply with existing regulations	3
PA3	During the distribution process, goods can be arranged correctly and the goods can be handled correctly	4
PA9	Carrying out checks and conducting training for workers	3
PA6	Improving cooperation with suppliers	4
PA7	Carrying out training to improve the abilities of the workers themselves	3
PA5	Implementing industrial technical requirements	4
PA8	Double check the product you want to send	3

The table above is a recommendation for risk mitigation strategies which are useful for reducing risk causes based on priority risk causes. According to the questionnaire results, it was found that PA4, PA9, PA7, and PA8 got a score of 3, which means it is easy to implement and PA2, PA3, PA6, and PA5 got a score of 5, which means it has a moderate level of difficulty for implementation in the company later.

b. Calculation of Total Effectiveness (TEk) Value

At this third stage, the Total Effectiveness (TEk) value will be calculated which is obtained from the correlation between the recommended mitigation strategy and the ARP value for the priority risk causes. Below is an example of calculation for TEk in the phase 2 HOR matrix using the following formula.

$$TEk = \Sigma ARPj \times Ejk \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(1)$$

Example:

(A20, PA3)

$TE_3 = 2340 \times 9$

$TE_3 = 21060$

c. Calculation of Effectiveness to Difficulty Ratio (ETDK) Value

The next stage, after knowing the value of TEk, is to calculate the ETDk value. This calculation is carried out to determine the effectiveness and difficulty ratio in

implementing the recommended mitigation strategies. Below is an example for calculating the ETDk value in the phase 2 HOR matrix using the following formula.

$$ETDk = \frac{TEk}{DEk} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(2)$$

Example:
(A20, PA3)
$$ETD_3 = \frac{21060}{4}$$
$$ETD_3 = 5265$$

After calculating the HOR phase 2, this mitigation strategy will then be ranked to find out which is the priority based on the value from highest to lowest ETDk. To make it easier to sort the rankings from highest to lowest, they can be entered into the phase 2 HOR matrix table as below.

Table 12. Phase 2 HOR Matrix

Risk Agent	Mitigation Action									ARP
	PA1	**PA2**	**PA3**	**PA4**	**PA5**	**PA6**	**PA7**	**PA8**	**PA9**	**ARP**
A1	9									3120
A16		9								2912
A20			9	3						2340
A4		9					3			1544
A17	3			9						1404
A13	9				9				3	1384
A6	1					9				1140
A2	3						9			930
A18	3			3				9		900
A5	3								9	792
TEk	53754	40104	21060	22356	12456	10260	13002	8100	11280	
Dk	3	4	4	3	4	4	3	3	3	
ETDK	17918	10026	5265	7452	3114	2565	4334	2700	3760	
Rank	1	2	4	3	7	9	5	8	6	

From the table above, it can be seen that there is a correlation between the causes of risk and recommended risk mitigation strategies, where the correlation with the highest ranking is between PA1 and A1, A17, A13, A6, A2, A18, and A5. Below is the calculation of the phase 2 HOR matrix based on the highest ranking to the lowest.

Table 13. Recapitulation of Mitigation Action Recommendation Ranking

Code	Preventive Action	Rank	TEk	Degree of Difficult	ETD
PA1	Provide regular training to workers and provide warnings to workers	1	53754	3	17918
PA2	Improve coordination and communication between parties so that accurate information is conveyed	2	40104	4	10026
PA4	Supervise the loading process and also provide counseling to comply with existing regulations	3	22356	3	7452
PA3	During the distribution process, goods can be arranged correctly and the goods can be handled correctly	4	21060	4	5265
PA7	Carrying out training to improve the abilities of the workers themselves	5	13002	3	4334
PA9	Check carefully	6	11280	3	3760
PA5	Implementing industrial technical requirements	7	12456	4	3114
PA8	Double check the product you want to send	8	8100	3	2700
PA6	Improving cooperation with suppliers	9	10260	4	2565

Based on the table above, it can be seen that the highest order of recommended risk mitigation strategies is risk mitigation strategy PA1 with the mitigation strategy being to provide routine training to workers and provide warnings to workers.

3) Analysis

By using the HOR method, which contains 2 phases, 9 recommendations for priority risk mitigation strategies were obtained which aim to reduce or minimize the causes of risk. The following are 9 recommendations for risk mitigation strategies.

a. PA1 Mitigation Strategy

This PA1 mitigation strategy is a mitigation strategy with the 1st ranking, where this mitigation strategy is useful for overcoming the causes of risks from A1, A17, A13, A6, A2, A18, and A5. The PA1 risk mitigation strategy is to provide regular training to workers and also provide warnings to workers.

This mitigation strategy has a score of 3, which means it has a low level of difficulty to implement, which means it is easy to implement in the company. When implementing mitigation strategies by providing routine training to workers and also providing warnings to workers, it is hoped that it will be able to minimize several errors that arise in the future. When these errors can be minimized, the company's activity processes are expected to run smoothly

b. PA2 Mitigation Strategy

This PA2 mitigation strategy is a mitigation strategy with the 2nd ranking, where this mitigation strategy is useful for overcoming the causes of risks from A16 and A4. This PA2 mitigation strategy is to improve coordination and communication between parties so that appropriate and accurate information is conveyed.

This mitigation strategy has a value of 4, which means its implementation is not too difficult and not too easy to do. The use of the mitigation strategy provided is to help companies increase the productivity of their employees' performance

c. PA3 Mitigation Strategy

This PA3 mitigation strategy is a mitigation strategy with the 4th ranking, where this mitigation strategy is useful for overcoming the causes of risk from A20. The PA3 mitigation strategy itself is arranging goods appropriately and providing correct handling during the distribution process.

This mitigation strategy has a value of 4, which means that its implementation is not too difficult and not too easy for the company to implement. The benefit of implementing this mitigation strategy is minimizing damage to goods during the process of sending goods to consumers.

d. PA4 Mitigation Strategy

The PA4 mitigation strategy is the 3rd ranked mitigation strategy, where this PA4 mitigation strategy has a value of 3 and is easy to implement in companies. The PA4 mitigation strategy is useful for overcoming the causes of risk A20, namely finished products that are damaged which causes customer confidence to decrease, A17, namely rough and careless handling which results in product damage during the distribution process, and A18, namely errors in order processing which results in quantity discrepancies. products are sent to consumers, where the PA4 mitigation strategy is to carry out supervision during the loading process and also provide counseling to comply with existing regulations to ensure activities run according to plan. Carrying out supervision during the loading and unloading process aims to reduce the possibility of errors that may be made by staff and for errors that occur, strict action will be taken as a consequence [26].

e. PA5 Mitigation Strategy

The PA5 mitigation strategy is a mitigation strategy that is ranked 7th, where the PA5 mitigation strategy is worth 4, which means its implementation is not too easy and not too easy to apply to companies. This PA5 mitigation strategy is useful for overcoming the causes of risk A13 of errors in production, packaging , and storage of goods which results in product contamination. The PA5 risk mitigation strategy is to implement industrial technical requirements. The application of these industrial technical requirements is useful for ensuring that the products produced are in accordance with established quality standards, can ensure the safety of products that are safe for use by the public and if these industrial technical requirements are implemented, it is hoped that they will be able to reduce the risk of product defects and possible quality problems. could tarnish the company's reputation

f. PA6 Mitigation Strategy

The PA6 mitigation strategy is a mitigation strategy with a ranking of 9th, where the PA6 mitigation strategy has a value of 4, which means its implementation is not too complete and not too easy to implement in companies. The PA6 mitigation strategy is useful for overcoming the causes of A6 risks, namely the lack of careful planning where

causing delays in the procurement process. The PA6 risk mitigation strategy is to increase cooperation with suppliers

g. PA7 Mitigation Strategy

The PA7 mitigation strategy is a mitigation strategy with the 5th ranking, where the PA7 mitigation strategy is conducting training to improve the abilities of the workers themselves. This PA7 mitigation strategy also has a value of 3, which means its implementation within the company is easy to do. This PA7 mitigation strategy is used to overcome the causes of risks A4 and A2.

This recommendation for mitigation action is supported by research conducted by [27] which states that this training can help companies achieve quality human resources.

h. PA8 Mitigation Strategy

The PA8 mitigation strategy is to double check the products that want to be sent to consumers, where the PA8 mitigation strategy is ranked 8th and has a value of 3, which means it is easy to implement for companies. This PA8 mitigation strategy is used to overcome the cause of risk A18, namely errors in order processing which result in delays in the process of sending goods to consumers. Just like in PA9, checking is important, especially double-checking products that want to be distributed to consumers because it functions to avoid errors that could occur, helps to ensure that the products you want to send are of quality that meets the standards that have been set.

i. PA9 Mitigation Strategy

The PA9 mitigation strategy is to carry out more thorough checks. This mitigation strategy is ranked 6th. This PA9 mitigation strategy has a value of 3, which means it is easy to apply to companies, where this mitigation action is useful for overcoming the causes of risk from A13, namely errors in the production, packaging and product storage processes which result in products experiencing contamination and A5, namely errors in data input. which causes quantity errors in sending finished products to consumers and errors in scheduling deliveries.

4. Conclusions And Suggestions

Based on risk identification using the HOR phase 1 method which is grouped into 5, namely plan, source, make, deliver and return, it was identified that there were 27 risk events and 20 risk causes. After carrying out the ARP calculation process, there are 10 priority risk causes, namely A1 (human error), A16 (lack of coordination and communication), A20 (finished products that experience damage), A4 (miscommunication between workers), A17 (rough and careless handling. careful), A13 (errors in the production, packaging and storage processes), A6 (lack of careful planning), A2 (incompetent workers), A18 (errors in order processing), and A5 (errors in data input).

The recommended mitigation action for the risk cause with the highest ranking is using the HOR phase 2 method, where the results obtained are 9 recommendations for mitigation actions that can be implemented in PT companies. XYZ. These mitigation actions are, PA1 (providing routine training to workers and giving warnings to workers), PA2 (improving coordination and communication between parties so that accurate information is conveyed), PA3 (during the distribution process, goods can be arranged correctly and handling of goods correct), PA4 (Carry out supervision during the loading process and also provide counseling to comply with existing regulations),

PA5 (Carry out industrial technical requirements), PA6 (Increase cooperation with suppliers), PA7 (Carry out training to improve the capabilities of the worker himself), PA8 (Rechecking the product to be sent), and PA9 (Checking carefully).

Suggestions that the author can give to PT. XYZ is a company that needs to improve risk management in its supply chain activities. Companies can also use this method to consider planning the 9 mitigation actions explained in the previous analysis section. Furthermore, it is hoped that future researchers can develop this research method by adding things that are missing and developing the method used with other similar methods to handle risks so that more accurate and valid results can be obtained.

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