

Risk Mitigation Analysis Of Delays In The Procurement Of Personal Protective Equipment (PPE) Using The House Of Risk (HOR) Method

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ABSTRACT

PT XYZ is a company engaged in shipping that provides sea transportation services such as ship rental and ship management. In carrying out its business operations, PT XYZ needs to procure Personal Protective Equipment (PPE), which in its business operations has a lot of urgency in activities and order lead times that change every time, causing delays in PPE delivery by suppliers. Based on these problems, the purpose of this study is to apply the House Of Risk (HOR) technique to analyze risk agents or risk causes related to the risks caused, as well as identify and measure the impact of risks related to procurement operations on Personal Protective Equipment (PPE). In this study, 20 risk events and 20 risk agents were identified. The results of data processing from HOR phase 1 of ARP obtained 3 dominant risk agents from a total of 20 risk agents using a pareto diagram with the concept of 80:20. In HOR phase 2, 6 handling strategies were obtained. Using the Pareto 60:40 principle, the main mitigation strategy is determined by obtaining 4 strategies that can be implemented from 6 prioritized mitigation strategies based on their effectiveness.

Keywords: Procurement, Delay, Risk Mitigation, House of Risk

Introduction

Procurement processes ensure that the required goods or services are obtained at the right time and place, in the right quantity and quality, and at the right cost. [1] Given the significant impact procurement has on a business's ability to continue its operations, effective risk management is also required in the procurement process. [2] Risk management can reduce the potential harmful impact of these risks. [3] The company's performance will be greatly deteriorated if there is no systematic risk management.

Through the application of risk analysis, risk assessment, and mitigation plans, risk management is a management effort to control hazards in business operational activities. [4] PT XYZ is a company engaged in shipping that provides sea transportation services such as ship chartering and ship management. Human resources are critical to the company's ability to provide marine transportation services and are an important milestone in ship operations. Therefore, it is the company's responsibility to ensure the safety of crew members during work, and all companies in Indonesia are required to provide Personal Protective Equipment (PPE) to all employees. The Minister of Manpower and Transmigration of the Republic of Indonesia issued the Personal Protective Equipment (PPE) Regulation Number 8 Year 2010 to regulate this matter.

As a result, in running its business PT XYZ really needs to procure goods which in its business operations there is a lot of urgency and order leadtime that changes every time based on when the crew is scheduled to leave. One of the risk events that has occurred is the late delivery of goods. There is a delay in the delivery of Personal Protective Equipment (PPE) on Tugboat 56 and Tugboat 58 from the supplier. Where from the order date until the goods are received long enough to miss the crew's scheduled departure to the ship. Tugboat 56 in July experienced a delay of 1 day, in August experienced a delay of 5 days, and in October experienced a delay of 4 days, as well as Tugboat 58 in August experienced a delay of 8 days, and in October experienced a delay of 4 days.

This occurs due to a lack of coordination between the units involved, waiting for approval in the purchase of goods which is quite long and the procurement team that does not check the inventory of goods in the warehouse which makes sudden orders without an estimate of the right time. As a result, Tugboat 56 and Tugboat 58 experienced uncontrolled out of stock goods. Due to the absence of accurate stock in and stock out records and the absence of goods available in the warehouse, the procurement team always experiences a shortage of stock which makes the procurement cycle worse. Because of this, the crew of Tugboat 56 and Tugboat 58 boarded without Personal Protective Equipment (PPE) and used PPE that was no longer suitable for use which would trigger work accidents and complaints from the Health Safety Environment (HSE).

Based on these problems, to determine the risk and source of the problem, risk analysis and identification must be carried out by considering these problems. The purpose of this study is to use the House of Risk (HOR) technique to identify risk variables or risk causes related to hazards arising from the application of the method. [5] Therefore, procurement risk management is needed to reduce the losses caused by these risks. Companies can adopt the HOR approach, which includes creating targeted actions to mitigate risks arising from risk agents, as a proactive measure to reduce risks.

Research Methods

This research uses quantitative research methodology. applying quantitative methodology with a positive foundation to analyze certain populations or groups. [6] The purpose of quantitative data analysis, which is statistical in nature, is to describe and evaluate prejudice. The stages passed in the data processing process in this study are described by the conceptual framework in Figure 1 as follows:

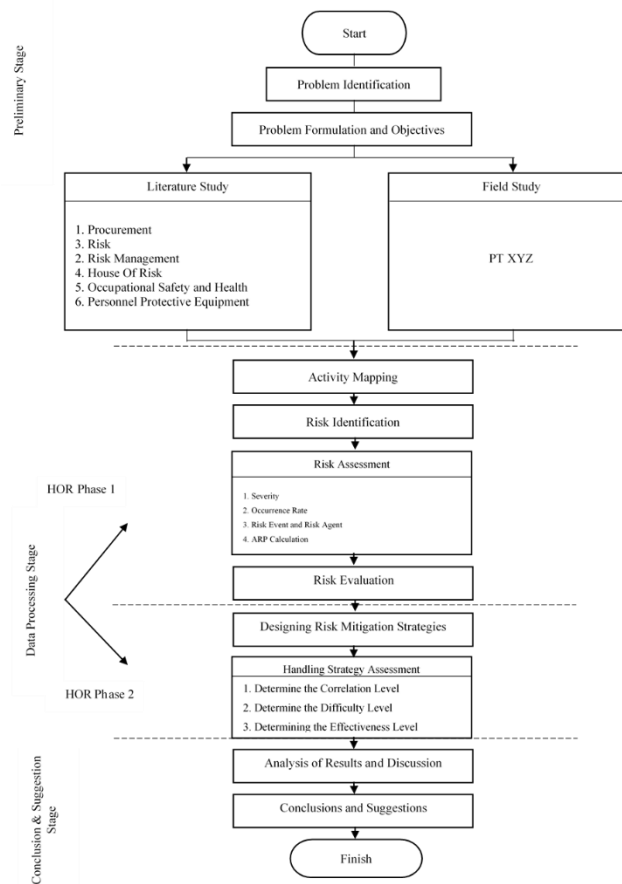


Figure 1. Conceptual Framework

A six-month study period from January to June, academic year 2023-2024 was used for this research. This research was conducted at the shipping company PT XYZ which provides sea transportation services. Risks related to the procurement of personal protective equipment (PPE) at PT XYZ are the focus of this research. Several research methods were used in this study to analyze the data, including the following:

Risk Identification

This risk identification stage was carried out at PT XYZ. The purpose of this stage is to determine the strategy for handling procurement delays that will be corrected. The causes of delays that are controlled by the company and those that are not controlled by the company need to be considered in the identification procedure. At the identification stage, the researcher asked questions about problems in procurement activities to PT XYZ informants.

Mapping Procurement Activities

Procurement activities carried out by the company were identified through observations and interviews, then at this stage mapped using the House of Risk (HOR) approach. Weighting is done by distributing questionnaires containing information about risk events and severity values, as well as risk agents and event values, after field data collection.

HOR (House Of Risk) Method Phase 1

At this stage, if field data has been collected by observation, interviews and problem solving that has been carried out on PT XYZ employees in the procurement of goods. At this stage, the value of the risk event relationship with the risk agent is given. If the scoring has been done, then the next step is to determine the Aggregate Risk Potential (ARP) value for taking the right risk source handling technique and prioritizing. There is a phase 1 HOR model technique to help decide which level of risk should be emphasized. Here are the techniques of the HOR phase 1 model:

Table 1 House of risk method phase 1

Business Processes	Risk Event (E _i)	Risk Agents (A _j)							Severity of Risk event i (S _i)
		A ₁	A ₂	A ₃	A ₄	A ₅	A ₆	A ₇	
Plan	E ₁								S ₁
Source	E ₂								S ₂
	E ₃								S ₃
Make	E ₄								S ₄
	E ₅								S ₅
Deliver	E ₆								S ₆
	E ₇								S ₇
Return	E ₇								S ₇
Occurance of Agents j	E ₈	O1	O2	O3	O4	O5	O6	O7	S ₈
Aggregate Risk Potential j	E ₉	AR	AR	AR	AR	ARP	ARP	ARP	S ₉
Priority rank of agent j		P1	P2	P3	P4	5	6	7	

Calculate the Aggregate Risk Potential (ARP_j) value to identify risk agents that need to be addressed. Next, apply effective mitigation techniques.

Risk Evaluation

The risk evaluation stage is to choose which risk agent will be handled first in the risk evaluation technique. Grouping risk agents using pareto diagrams is the next technique after providing ARP values. At this point the risk is evaluated using a scale that can impact a number of additional risk agents. With the rules of pareto diagrams, the 80:20 concept states that 20% of causes affect 80% of events.

House Of Risk (HOR) Method Phase 2

After identifying risk agents in the phase 1 House of Risk (HOR) process, the next step is the phase 2 House of Risk (HOR) process. This stage is to address current risks and predict future risks that may result in losses. [5] In HOR phase 2, specifically by developing strategies to mitigate risks and assessing correlations and relationships. Priority risk agents are selected using pareto diagram analysis. The prioritized risk sources that have been selected will be entered into the Phase 2 House of Risk. Following in table 2 is the HOR phase 2 model:

Table 2 House of risk phase 2

To be treated risk agent (A _j)	Preventive Action (PA _k)					Aggregate Risk Potentials (ARP _j)
	PA ₁	PA ₂	PA ₃	PA ₄	PA ₅	
A ₁	E ₁₁					ARP1
A ₂						ARP2
A ₃						ARP3
A ₄						ARP4
Total effectiveness of action k	TE ₁	TE ₂	TE ₃	TE ₄	TE ₅	
Degree of difficulty performing action k	D ₁	D ₂	D ₃	D ₄	D ₅	
Effectiveness to difficulty ratio	ETD ₁	ETD ₂	ETD ₃	ETD ₄	ETD ₅	
Rank of priority	R ₁	R ₂	R ₃	R ₄	R ₅	

Results

Risk Identification

In this procedure, the risk identification process begins with observations and interviews with informants. After that, the impact of risk events and risk agents are communicated through questionnaires given to informants. Twenty risk events were identified from five current procurement activities based on informant interviews, and there are twenty potential risk sources that can cause risk events at PT XYZ. Evaluation of severity and frequency of occurrence was conducted after identification of risk events and risk agents.

Risk Assessment

The initial stage in finding the risk severity value is the first step in determining the potential impact. The severity assessment that has been carried out can be seen in table 3 below:

Table 3 Severity assessment

Process	Activity	Risk Event	Code	(Severity) S _i
Plan	Demand Planning and Scheduling	Miscalculation on item request	E1	6
		Change of specification request from crewing	E2	4
		Poor coordination between department units	E3	6
		Schedule change request from crewing	E4	4
		Out of stock in the warehouse	E5	7
Source	Procurement Process	Lack of funds for purchasing goods	E6	5
		Error in cost estimation	E7	4
		Delay in payment	E8	6
		Errors in checking the quality of goods with the bid price	E9	5
Make	Goods Purchasing Process	Delay in making PO	E10	5
		Delay in PO approval from the leadership	E11	7
		Wrong information on item specifications in the PO	E12	6
Deliver	Goods Receipt	Lack of coordination with suppliers	E13	5
		Delay in receiving goods from suppliers	E14	7
		Insufficient quantity of goods from suppliers	E15	6
		Wrong company address on delivery order	E16	5
		The company's supplier is late in providing invoices	E17	7
Return	Return of Goods	Item specifications are not as desired	E18	7
		There was a complaint from the leadership	E19	6
		There is no return policy if the goods are not suitable	E20	4

The likelihood of a risk occurring is indicated by the numerical value of this occurrence rate. This potential value has been adjusted to reflect the real circumstances faced by PT XYZ during the procurement process. The following are the results of the occurrence assessment which can be seen in table 4 below:

Table 4 Occurance assessment

Code	Risk Agent	Occurance
A1	The level of demand for goods changes	5
A2	Lack of work supervision by leaders	4
A3	No recording of stock items	6
A4	Lack of human resources	6
A5	Old suppliers in providing price quotes	3
A6	Purchase order data information errors	4
A7	Error in supplier selection	2
A8	Long duration of price quotation	2
A9	Work procedure errors	4
A10	Sudden requests to suppliers	7
A11	Administrative completion that takes a long time	8
A12	Over budget compared to the initial plan	6
A13	Incomplete documents	5
A14	Inaccurate budget estimation	4
A15	Poor company track record in supplier payments	3
A16	Lack of OHS supervision	4
A17	Lack of awareness of OHS	4
A18	Lack of coordination with HSE regarding the specifications of goods according to the rules	4
A19	Tenaga kerja lalai (<i>Human Error</i>)	5
A20	Kurangnya prosedur kerja yang sesuai dengan SOP	4

After determining the risk event, risk agent, severity, and event value, the next data processing procedure is carried out, specifically the calculation process of the House of Risk stage 1 and its correlation value.

House of Risk Phase 1

This phase is dedicated to identifying risks and allocating resources, starting with the highest priority. To determine the priority value by using the correlation value, severity and occurrence. Interviews with informants at PT XYZ generate the value of the relationship. To show the relationship value of each risk with the risk agent, there are four scales, namely 0, 1, 3, and 9.

Specifically in the House of Risk phase 1, the aggregate risk potential (ARP) is calculated based on the correlation value to determine which risk priorities will be addressed or mitigated. The following formula is used to determine the aggregate risk potential (ARP) value:

$$ARP_j = O_j \sum S_i . R_{ij} \dots\dots\dots (1)$$

Description:

- ARP_j : Aggregate Risk Potential
- O_j : Occurrence Level of Risk
- S_i : Severity Level of Risk
- R_{ij} : Correlation value

This HOR phase 1 table contains calculations regarding ARP, which is the final stage for identifying risks. In addition, the risk agent rating value will be used to determine which strategy to implement to mitigate the risk. The following in table 5 is the phase 1 house of risk table:

Table 5 House of risk phase 1

Risk Event	Risk Agent																				Severity of Risk
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	
E1	9	0	9	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	3	0	6
E2	9	0	0	0	0	9	0	0	0	1	0	1	0	0	0	0	3	0	0	0	4
E3	1	3	3	0	9	3	0	0	3	1	1	0	0	0	0	0	3	9	0	3	6
E4	3	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	9	4
E5	1	9	9	0	0	0	0	0	0	9	0	0	0	0	0	0	0	3	9	0	7
E6	1	0	0	0	0	0	0	0	0	3	9	0	0	0	0	0	0	0	0	0	5
E7	1	3	0	0	0	0	0	0	1	0	3	3	0	9	0	0	0	0	0	0	4
E8	0	9	0	0	0	0	0	0	1	0	0	0	0	0	9	0	0	0	0	0	6
E9	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	9	0	0	9	5	
E10	1	3	3	3	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	5
E11	0	9	0	3	0	0	0	9	9	0	0	0	0	0	0	0	0	0	0	0	7
E12	0	3	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	3	0	6
E13	0	0	0	3	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	3	5
E14	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	3	7
E15	0	9	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3	6
E16	0	0	0	0	0	0	0	0	0	9	0	3	0	0	0	0	0	0	0	1	5
E17	0	0	0	0	0	0	0	0	0	3	0	1	0	9	0	0	0	0	0	0	7
E18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	3	0	0	0	7
E19	0	0	9	0	0	0	0	0	0	0	0	0	0	0	9	3	3	0	0	0	6
E20	0	3	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	9	4	
Occ of Agent	8	4	6	6	3	4	2	2	4	8	8	6	5	4	3	4	4	4	5	4	
ARPi	6	9	10	3	2	4	1	1	4	10	79	36	18	16	35	46	37	45	55	77	1003
Ranking	6	9	1	1	1	1	2	1	8	2	4	12	18	19	14	9	11	10	7	5	

Risk agent A3 for not recording product stock has the highest aggregate risk potential (ARP) value, as shown in Table 5 House of Risk phase 1 above. However, risk agent A7 for supplier selection errors has the Risk assessment is conducted after receiving the scores of the key risk agents.

Risk Evaluation

Next, choose which risk agent will be handled first at this risk evaluation stage. The priority of risk agents can be ascertained by sorting the processed ARP values from highest to lowest. Priority is given to the risk agent with the highest value and vice versa. Table 6 displays the risk agent priority level values as follows:

Table 6 Risk agent priority level

Risk Agent Code	ARP	Cumulative ARP	% ARP	Cumulative % ARP
A3	1098	1098	11%	11%
A10	1016	2114	10%	21%
A2	972	3086	10%	31%
A11	792	3878	8%	39%
A20	776	4654	8%	46%
A1	645	5299	6%	53%
A19	555	5854	6%	58%
A9	484	6338	5%	63%
A16	468	6806	5%	68%
A18	456	7262	5%	72%
A6	372	7634	4%	76%
A17	366	8000	4%	80%
A12	432	8432	4%	84%
A15	351	8783	3%	88%
A4	336	9119	3%	91%
A5	207	9326	2%	93%
A8	198	9524	2%	95%
A13	185	9709	2%	97%
A14	164	9873	2%	98%
A7	162	10035	2%	100%

Using a pareto diagram is the next step in the risk evaluation process. In the Pareto diagram, the data classification will be arranged from left to right, highest to lowest. The 80:20 Pareto diagram principle states that by increasing 20% of the dominant risk sources, 80% of the remaining risk sources must be reduced. Pareto diagrams are useful for identifying problems that need to be given top priority. Below is a Pareto diagram showing the most important risk agents:

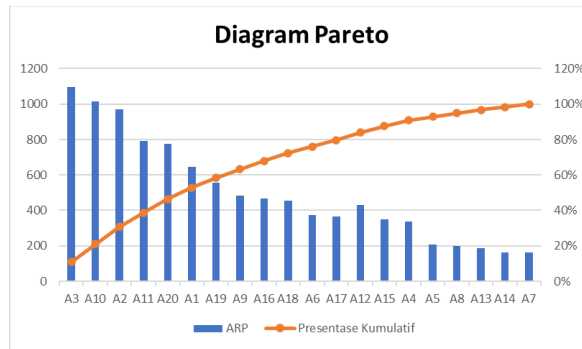


Figure 2. ARP Pareto Diagram

The diagram above identifies key risk factors that can offer management techniques. The pareto diagram above identifies three major risk agents which are A3, A10, and A2. These risk agents can be addressed by creating a risk management strategy that takes them into consideration. The total value of the dominant hazard potential of the three risk agents is presented in table 7 below:

Table 7 Dominant risk agent

Ranking ARP	Code	Risk Agent	ARP	Oj	Si
1	A3	No stock records	1098	6	6
2	A10	Sudden requests to suppliers	1016	8	5
3	A2	Lack of work supervision by leaders	972	4	4

Calculation of risk mitigation techniques through the House of Risk phase 2 can then be done after all current risk agents are known.

House of Risk Phase 2

The second stage of HOR includes a number of actions, including developing a management plan to mitigate risks, conveying correlation levels, comparing existing risk management techniques, outlining overall effectiveness scores and difficulty levels, and calculating effectiveness-difficulty ratios to set priorities.

Handling Strategy Design

In stage 3 the dominating risk agents for which coping strategies will be developed are shown in the pareto diagram above. 6 action solutions were generated based on the 3 risk agents. The following in table 8 are the handling strategies that can be recommended for implementation:

Table 8 Handling strategy design

Risk Agent	Handling Strategy	Code
A3	Creation of stock-taking records	PA1
	Improving warehouse inventory management system	PA2
A10	Make a plan for estimating the time of purchase to suppliers	PA3
	Expanding the network area with suppliers	PA4
A2	Conducting routine audits	PA5
	Creating work training and work discipline	PA6

It can be obtained from the above table 6 treatment plans that aim to completely eliminate or significantly reduce the likelihood of the selected risk agent materializing.

Correlation of Handling Strategies with Risk Agents

Agents and coping strategies are now linked on four different scales of 0, 1, 3 and 9. These ratings indicate whether the risk agent and risk event have a strong, weak or moderate relationship. Based on the

findings of the informant interviews, table 9 displays the level of relationship between the coping strategy approach and the risk agent:

Table 9 Correlation of handling strategies with risk agents

Risk Agent	Handling Strategy					
	PA1	PA2	PA3	PA4	PA5	PA6
A3	9	9	1	0	9	3
A10	9	3	9	9	0	9
A2	3	1	1	0	9	9

Calculation of Total Effectiveness (TEk)

After obtaining the design of the handling strategy, the aim is to ensure the level of efficacy of the handling strategy in accordance with the potential relationship with the risk agent. The calculation of total effectiveness uses the formula below:

$$TEk = \sum \text{ARP}_j E_{jk} \dots\dots\dots (2)$$

- Tek : Total Effectiveness
- ARPj : Aggregate Risk Potential
- Ejk : Correlation Value

Here is an example of calculating Total Effectiveness (TEk):

$$\begin{aligned}
 TE1 &= \Sigma [(C4*I4)+(C5*I5)+(C6*I6)] \\
 &= \Sigma [(9*1098)+(9*1016)+(3*972)] \\
 &= 21942 \\
 TE2 &= \Sigma [(D4*I4)+(D5*I5)+(D6*I6)] \\
 &= \Sigma [(9*1098)+(3*1016)+(1* 972)] \\
 &= 13902 \\
 TE &= 3 \Sigma [(E4*I4)+(E5*I5)+(E6*I6)] \\
 &= \Sigma [(1*1098)+(9*1016)+(1* 972)] \\
 &= 11214 \\
 TE4 &= \Sigma [(F4*I4)+(F5*I5)+(F6*I6)] \\
 &= \Sigma [(0*1098)+(9*1016)+(0* 972)] \\
 &= 9144 \\
 TE5 &= \Sigma [(G4*I4)+(G5*I5)+(G6*I6)] \\
 &= \Sigma [(9*1098)+(0*1016)+(9* 972)] \\
 &= 18630 \\
 TE6 &= \Sigma [(H4*I4)+(H5*I5)+(H6*I6)] \\
 &= \Sigma [(3*1098)+(9*1016)+(9* 972)] \\
 &= 21186
 \end{aligned}$$

Degree of Difficulty (Dk) assessment

The Degree of Difficulty (Dk), often referred to as the level of difficulty, is a matrix that states the level of difficulty in implementing each preventive measure. The numbers 3, 4, 5 represent low, medium, and high difficulty respectively. This third scale is used to calculate the degree of difficulty. The measurement of the level of difficulty in implementing mitigation efforts (Dk) to reduce the emergence of risk agents is presented in table 10 below:

Table 10 Difficulty level of handling strategy

Code	Handling Strategy	D _k
PA1	Creation of stock-taking records	3
PA2	Improving warehouse inventory management system	4
PA3	Make a plan for estimating the time of purchase to suppliers	3
PA4	Expanding the network area with suppliers	4
PA5	Conducting routine audits	4
PA6	Creating work training and work discipline	3

Effectiveness to Difficulty Ratio Calculation (ETD_k)

In determining the Effectiveness to Difficulty (ETD_k) of each handling strategy, the following formula is generated:

$$ETD_k = TE_k/D_k \dots\dots\dots (3)$$

Description:

ETD_k = Effectiveness to Difficulty of Ratio

Tech = Total effectiveness

D_k = Degree of Difficulty

The following is an example of a complete calculation of Effectiveness to Difficulty (ETD_k):

ETD₁ = C7/C8 = 21942/3 = 7314
 ETD₂ = D7/D8 = 13902/4 = 3476
 ETD₃ = E7/E8 = 11214/3 = 3738
 ETD₄ = F7/F8 = 9144/4 = 2286
 ETD₅ = G7/G8 = 18630/4 = 4658
 ETD₆ = G7/G8 = 211186/3 = 7062

House Of Risk Matrix phase 2

In House Of Risk phase 2, all calculations obtained will be included in table 11 below as the final step of HOR phase 2. The HOR phase 2 table below combines a number of different variables to determine the order of priority, including data on handling strategies, data on dominant risk agents, aggregate risk potential calculated from dominant risk agents, data on the level of difficulty, and data on the calculation of total effectiveness and effectiveness against difficulty, starting from formulating measures to minimize risks. The following is HOR phase 2 table 11:

Table 11 House of risk phase 2

Risk Agent	Handling Strategy						ARP
	PA1	PA2	PA3	PA4	PA5	PA6	
A3	9	9	1	0	9	3	1098
A10	9	3	9	9	0	9	1016
A2	3	1	1	0	9	9	972
TE_k	21942	13902	11214	9144	18630	21186	
D_k	3	4	3	4	4	3	
ETD_k	7314	3476	3738	2286	4658	7062	
Rangking	1	5	4	6	3	2	

Table 11 House of Risk phase 2 above can be used to generate a list of mitigation strategies based on the highest ETD_k value. The priority ranking table of each handling approach based on the calculation of the house of risk phase 2 is presented in table 12 below:

Table 12 Prioritization of handling strategies

Code	Handling Strategy	Priority
PA1	Creation of stock-taking records	1
PA6	Creating work training and work discipline	2
PA5	Conduct routine audits	3
PA3	Make a plan for estimating the time of purchase to suppliers	4
PA2	Improve warehouse inventory management system	5
PA4	Expanding the network area with suppliers	6

Discussion

Risk Event and Risk Agent Analysis

In an effort to identify the risk of events occurring at PT XYZ, it was obtained through observations and interviews with informants. Selection of informants is carried out based on the requirements that have been met. The selection of informants can amount to 3 to 7 people so that the resulting research decision process is acceptable. [7] Informants who have met the criteria and are willing to be used as respondents, namely there are 4 informants who are directly related to the procurement process activities at PT XYZ.

In this study, 20 risk events can be identified, which are divided into 5 potentials, namely the planning and scheduling process, the process of procuring and purchasing goods, receiving goods and returning goods to be identified. There are currently 20 risk agents that need to be found. Each risk agent has the ability to trigger one or more risk events.

House Of Risk (HOR) analysis phase 1

To decide which dominant risk agents will be addressed by which treatment approach at this time, the House of Risk phase 1 is used. Prioritized risk agents are determined by applying the aggregate risk potential (ARP) calculation, which considers the weighted value of the severity, occurrence, and correlation of each risk agent. [8] Of the 20 risk agents, 3 were identified as dominant risk agents based on the ARP data processing results.

In this study using pareto diagrams and with the concept of 80:20, this study aims to minimize 80% of other risk agents by overcoming 20% of the dominant risk agents. [9] The approach of addressing 31% of risk agents is assumed to minimize the remaining 69% of risk agents, based on the findings of figure 2 of the pareto risk agent diagram. The following are the dominant risk agents obtained:

No stock record

The Aggregate Risk Potential (ARP) assessment for no stock recording has a high ARP value of 1,098. The absence of stock recording at PT XYZ is caused by a messy work area, warehousing SOPs that are still not running well, the absence of an accurate stock in stock out recording system.

Unexpected requests to suppliers

The Aggregate Risk Potential (ARP) assessment for sudden requests to suppliers has the second highest ARP value of 1.016. Sudden requests to suppliers are due to the urgency of ship departures and also errors in estimating the time for the purchase of goods, as well as a lack of good coordination with suppliers.

Lack of work supervision by leaders

The Aggregate Risk Potential (ARP) assessment for the lack of work supervision by the leadership has the third highest ARP value of 972. Where the lack of work supervision by the leadership is the lack of evaluation of employee work per department or as a whole, a job audit system that has not been routinely carried out in the company.

House Of Risk (HOR) Analysis Phase 2

Appropriate countermeasures should be provided when dominant risk agents have been identified to reduce the risk. The House of Risk phase 2 method is used to derive these risk reduction strategies. HOR phase 2 is a mitigation approach that uses correlation and difficulty to rank risk agents to assess how effective a treatment is. [5] The strategies are ranked from highest to lowest ETDk value. This mitigation strategy was obtained from interviews with informants at PT XYZ. Where from the results of the interview obtained 6 handling strategies that are suitable and can be applied at PT XYZ.

In HOR phase 2, a pareto diagram is used to pinpoint the important mitigation techniques. To achieve this, the 60:40 pareto principle which states that 40% of mitigation methods should result in 60% of successful mitigation strategies is applied. This was done after the prioritized order of the recommended mitigation strategies was obtained. The following is a pareto diagram of the recommended mitigation strategies:

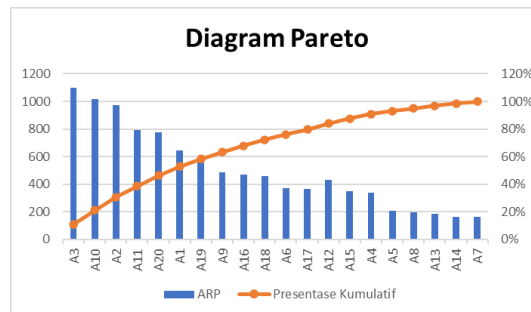


Figure 3. Pareto Diagram Of Proposed Mitigation

Based on the figure above, the success of the mitigation strategy in its implementation is taken into account in the previously proposed mitigation pareto diagram. This results in a list of 4 key mitigation solutions out of 6 mitigation priorities that can be implemented. The 4 main mitigation techniques that can be implemented by PT XYZ are as follows:

The first strategy with an ETDk value of 7,314 is the creation of a stock-taking record. To avoid stock shortages in the warehouse, to know the stock available in the warehouse and know the recording for stock in and stock out of goods. The action that can be taken for the above strategy is to create a stock-taking record with a database. Database recording can be made using Microsoft Excel software. This will make it easier for PT XYZ to check outgoing or incoming goods.

The second strategy with an ETDk value of 7.062 is to create job training and work discipline, to avoid errors in the work process, work training should be held per department or procedures for discipline towards work and work responsibilities. Aiming to improve the quality of human resources and in order to minimize errors in work procedures.

The third strategy with an ETDk value of 4.657 is to conduct regular audits, either an evaluation per department or an overall routine audit for regular checks in order to find out the point of error of work that is not in accordance with the work process which will result in evaluation material for the future.

The last strategy, with an ETDk value of 3.738, is to make a plan for estimating the time of purchase to suppliers, where for the sake of running well the operation of the ship should provide an estimate of the time of purchase of goods with the departure of the ship so that there are no delays, and make agreements between suppliers and companies to improve coordination with suppliers. Where the agreement can contain the quality of goods, the maximum time to provide goods, the maximum time to deliver goods and return goods.

Conclusion

Based on the research conducted, the conclusions that can be drawn from the calculations, data processing analysis, and discussions that have been carried out are as follows:

There are 20 potential risks identified in the procurement process at PT XYZ which are divided into 5 potential risks at the demand planning and scheduling stage, 4 potential risks in the procurement process, 4 potential risks in the process of purchasing goods, 4 potential risks in the process of receiving goods, and 3 potential in the process of returning goods. Then there were 20 risk agents identified that could possibly be the source of the risk event. 3 risk agents were identified as being in the priority category at the House of Risk phase 1 stage, allowing appropriate action to be taken. The prioritized risk agents are no stock records (A3), sudden requests to suppliers (A10), lack of work supervision by leaders (A2).

In the House of Risk phase 2, the stage is to be able to design a handling or mitigation strategy that aims to reduce or minimize the occurrence of risk agents. Based on the 3 risk agents that are prioritized, it can be proposed to (PA1) Make stock-taking records, (PA2) Improve the warehouse inventory management system, (PA3) Make an estimated purchase time plan to suppliers, (PA4) Expand the network area with suppliers, (PA5) Conduct routine audits, (PA6) Make work training and work discipline. And after calculating the ETD value and the Pareto diagram of the 60:40 concept, 4 mitigation strategies with the highest effectiveness value

were obtained, namely (PA1) Making stock-taking records, (PA6) Making work training and work discipline, (PA5) Conducting routine audits, (PA3) Making a purchase time estimation plan to suppliers.

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