DESIGNING MITIGATION ACTION STRATEGIES BASED ON RISK ANALYSIS OF IN-HOUSE MANUFACTURING SUPPLY CHAIN AT PT. SAFTA FERTI

Leni Herdiani[1], Zhenyu Cui[2], Amalia Ramadina[3], Nursaimatussaddiya[4],Eka Sihombing [5]
(Langlangbuana University, Engineering Faculty, Industrial Engineering) 1.3,
(University of new south wales-Australia)2
(High School of Economics Bina Karya)4
(Efarina University, Pematangsiantar)5
leni.herdiani@gmail.com

Abstract

The obstacles that occur as a result of supply chain risks in in-house manufacturing supply chain activities at PT Safta Ferti, make PT Safta Ferti unable to achieve optimal customer satisfaction, for PT Safta Ferti which is engaged in manufacturing services with production and repair activities of Mechanical Parts, especially Rotating Parts and other in-machine drive component products, customer satisfaction is the main goal which is one of the keys to business success. To minimize this, an analysis of the risks in the in-house manufacturing supply chain activities at PT Safta Ferti using the house of risk (HOR) method which consists of two phases, namely house of risk phase 1 (HOR1) and house of risk phase 2 (HOR2) with supply chain activity mapping using the supply chain operation reference (SCOR) model, based on the results of data processing with the HOR method, it is known that there are 63 risk events and 90 identified risk agents along the flow of in-house manufacturing supply chain activities at PT Safta Ferti with 22 risk agents. Safta Ferti with 22 priority risk agents selected in HOR1 on the basis of the use of the Pareto diagram principle with a ratio of 63:24 to take proactive action in HOR2 so that 28 draft mitigation action strategies (preventive action) are obtained along with the priority of their implementation related to 22 priority risk agents.

Keywords:Supply chain risk, customer satisfaction, House of Risk (HOR), supply chain operation reference (SCOR).

INTRODUCTION

Supply chain is defined as a network consisting of several companies (including suppliers, manufacturers, distributors and retailers) that work together and are involved either directly or indirectly in meeting customer demand, where the company performs the function of procuring materials, the process of transforming materials into semi-finished products and finished products, as well as the distribution of these finished products to end customers.

Safta Ferti is a company in the form of a limited liability company (PT) engaged in manufacturing services with the production and repair of Mechanical Parts, especially Rotating Parts and other engine drive component products. In running its business line, PT Safta Ferti uses a production system strategy in the form of engineer to order (ETO) which

requires PT Safta Ferti to be able to provide products and services that are of high quality, on time and in accordance with the customer desires in order to achieve optimal customer satisfaction because one of the keys to business success in the field of manufacturing services like this is customer satisfaction.

In carrying out its business activities so far, PT Safta Ferti tends to still not be able to achieve optimal customer satisfaction, this is because there are still many risks that arise in the company's supply chain flow that hampers the effectiveness and efficiency of the company's supply chain activities and result in decreased customer satisfaction and loss to the company and all stakeholders involved in the supply chain. Some examples of risks that often occur in PT Safta Ferti's supply chain activities are delays in project completion which result in late delivery of products to customers, defective products and returns and limitations in providing goods or products in accordance with customer desires.

As a company engaged in manufacturing services such as this, product suitability as well as timeliness of completion and the ability to provide goods and services in accordance with customer desires with good quality are the first key factors to achieve customer satisfaction. Therefore, it is necessary to study the risks in the supply chain activities of PT Safta Ferti in order to minimize the occurrence of risks that hinder the supply chain activities of PT Safta Ferti in order to create effectiveness, efficiency and risk minimization in the company's supply chain activities which are the scope of all functions involved in meeting consumer needs in an effort to increase customer satisfaction and minimize losses. According to Frosdick (1997) in Handayani (2016) risk is the probability of an event that causes losses during a certain period.

LITERATURE REVIEWS

Manufacturing Services

basically,manufacturing serviceshave the same characteristics as construction project activities, namely having the aim of producing a final product with certain conditions, not running or happening forever and activities are not carried out repeatedly or continuously, namely there is a starting and ending point.

Engineer To Order (ETO)

According to Martono (2019) in the engineer to order (ETO) production system strategy, products or services are uniquely designed based on specific requests from consumers. Once agreed, the design of the product or service between the producer and the consumer is made, then the delivery of raw materials from the supplier begins according to the company's request. The company does not store raw materials until they are needed, so the total time until the consumer receives the product or service starts from the agreement between the producer and the consumer, plus the time for product or service design, the time for the transformation process and the time for delivery to the consumer.

Supply Chain

Warella, SY et al (2021) define Supply Chain as a series of processes or networks of companies that work together to make and distribute products or services to end consumers. The supply chain includes all stages, both direct and indirect, in fulfilling consumer desires (Chopra & Meindl (2016) in Warella, SY et al (2021). Supply chain management is the activity of managing activities in order to obtain raw materials into semi -finished goods or work in process and finished goods and then the goods / products are sent through the distribution system (Haizer & Render, 2004 in Siagan, 2005).

According to Tumala and Schoenherr (2011) supply chain risk is a negative event that can affect supply chain operations. Usually, one source of risk can stimulate more than one risk event. For example, problems in a production system where suppliers can result in material shortages and reject last-minute upgrades due to lack of ability to supply (Pujawan and Geraldin, 2009).

risk

According to Frosdick (1997) in Handayani (2016) risk is the probability of an event causing losses over a certain period. Risk exists or arises because of uncertainty, where uncertainty is a condition, even if only partially, of insufficient information about understanding or knowledge related to an event, its impact and the possibility of occurrence (Leo J. Susilo, 2011).

Risk Management

Risk management is an effort to identify, analyze and control risks in every company activity with the aim of obtaining higher effectiveness and efficiency (Drmawi, 2016).

Supply chain risk management is a systematic process of identifying, analyzing, and dealing with risks in the supply chain (Khan and Zsidisin, 2012). In general, the process of risk management in the supply chain consists of risk identification, risk evaluation and risk mitigation where risk identification is fundamental in the risk management process (Hallikas and Veli-Matti, 2004 in Ulfah et. al, 2016). Where the focus of supply chain risk management is how to analyze and manage negative risks that may occur at one point in the supply chain network both large and small.

House Of Risk (HOR)

House of risk (HOR) is a model of supply chain risk management development from quality function deployment (QFD) and failure modes and effect analysis (FMEA) methods using the concept of House of quality (HOQ) to develop a framework for managing supply chain risks by Pujawan and Geraldin. The HOR model is based on the idea that proactive supply chain (SC) risk management should strive to focus on preventive measures, namely reducing the likelihood of risk agents occurring. Reducing the

occurrence of risk agents will usually prevent some risk events from happening. In such cases, it is necessary to identify risk events and risk-related agents. Usually, one risk agent can cause more than one risk event. for example, a problem in the production system with a supplier may result in a shortage of materials and reject an upgrade that is terminated due to lack of ability to supply and must switch to another procurement (Pujawan & Geraldin, 2009). In identifying potential failures, the HOR model uses 2 assessment criteria, namely:

1. Severity

The assessment of severity in business processes or supply chain activity flows is an assessment related to how likely the impact is to occur due to failure or disability in other words, the risk events or events that occur. The severity ranking value refers to Shahin (2004) where the ranking value for severity is between 1 and 10, where scale 1 shows no impact and scale 10 shows the impact of the hazard..

Table1 Severity Ranking Value

Number Of Severity Rating Description		
Ratings	impact	Description
1	None	no effect
2	Very Little	Very little effect on performance
3	Slight	Little effect on performance
4	Very Low	Very low effect on performance
5	Low	Low effect on performance
6	Medium	Moderate effect on performance
7	high	High effect on performance
8	Very High	Very high effect and inoperability
9	Seriously	Serious effect and failure preceded by a warning
10	Dangerous	Harmful effect and not preceded by a warning

Source: Shahin, (2004) International Journal of Quality & Reliability Management

2. *Occurrence*

The assessment of occurrence related to each risk event or event is carried out to determine how often thepossibilityof a cause of failure that results in the occurrence of risk events or events in the supply chain activities of an industry. The occurrence ranking value also refers to Shahin (2004) where the occurrence value is between 1 and 10, where a scale of 1 means that failure almost never occurs and a scale of 10 means that almost certain failures occur.

Table 2 Occurrence value ranking

Number Of Occurrence Rating Description		
Ratings	probability	Description
1	almost never	Failure is impossible
2	Very small (Thin)	Rare number of failures
3	Very little	Very few failures
4	A little	Few failures
5	small	Number of failures once

Number Of Occurrence Rating Description		
Ratings	probability	Description
6	Medium	Moderate number of failures
7	Moderately high	Moderately high number of failures
8	high	High number of failures
9	Very high	Very high number of failures
10	Almost certain	Almost certain failure

Source: Shahin, (2004) International Journal of Quality & Reliability Management

The HOR model stipulates that the calculation of the RPN value is derived from the probability of the risk agent and the severity of the risk event. Since one risk agent can induce more than one risk event, the HOR model specifies that it is necessary to calculate the aggregate risk potential of the risk agent. The HOR model places the probability of risk occurrence in relation to the risk agent while the severity in relation to the risk event. HOR considers the correlation relationship between risk events and risk causes. The value of the severity of the risk event, the probability of the risk cause and the level of correlation that has been obtained will be used to calculate the aggregate risk potential (ARP) value. Based on the ARP value, a decision will be made in selecting a number of risk causes that are given priority first for mitigation actions. (Utari, 2015).

If Oj is the probability of occurrence of risk agent j, Si is the severity of impact if risk event i occurs, and Rij is the correlation between risk agent j and risk event i (which is interpreted as how likely risk agent j will induce risk event i) then ARPj (Aggregate Risk Potential of risk agent j) can be calculated as follows:

$$ARPj = Oj \sum Si\ Rij$$

Where: ARPj = Aggregate Risk Potential of risk agent j.

Oj= Measurement of the probability of a risk agent occurring (Occurrence). Si = Risk impact level measurement (Severity).

Rij= Measurement of risk event correlation values.

HOR adapts the HOQ Model to determine which risk agents should be prioritized for preventive action. A ranking is assigned to each risk agent based on the magnitude of the ARPj Value for each risk agent j. Therefore, if there are many risk agents, companies can pre-select some of them that are considered to have a great potential to induce risk events. To this end, two deployment models are proposed, called HOR 1 and HOR 2 which are both based on the modified HOQ (House of quality) concept with HOR 1 or HOR phase 1 used to determine which risk agents should be prioritized for preventive actions and HOR 2 or HOR phase 2 to prioritize actions considering effective resources and costs.

In the HOQ model, the HOR links a set of requirements (what) and a set of responses (how) where each response can address one or more requirements. The degree of correlation is specifically classified as none and is assigned an equivalent value (0), low (1), medium (3), and high (9). Each need has a specific gap to fill and each response will

require some kind of resources and costs. By adopting the above procedure, HOR 1 was developed through the following steps:

1. Map the company's business processes or supply chain activities first, this mapping can be done with the SCOR model which consists of plan, source, make, deliver and return..
2. Identify risk events (Ei) for each business process or supply chain activity that has been mapped in the previous stage, the risks here are all events that may arise in supply chain activities that result in losses for the company.
3. Assessing the severity of the identified risk events, the severity of each risk event is placed in the right column of table 3, shown as Si.
4. Identify the risk agent (Aj) related to the identified risk event or events, the risk agent (Aj) is placed in the top row of the table.
5. Assessing the likelihood of occurrence of each risk agent, and associated event, the occurrence value is denoted as Oj and placed in the bottom row parallel to the Aj.
6. develop a relationship matrix,which is the relationship between each risk agent and each risk event denoted by Rij with relationship values referring to the quality function deployment method in the House of quality where the values consist of {0, 1, 3, 9} where 0 represents no correlation and 1, 3, and 9 represent, respectively, low, medium, and high correlation.
7. Calculate the aggregate risk potential of agent j (ARPj) determined as the result of the probability of occurrence of the event of risk agent j and the set of causal effects of each risk event caused by risk agent j as in the equation above and rank the risk agents based on the aggregate risk potential in descending order from the largest value to the lowest value.
8. Ranking the risk agents, in making the ranking order at this stage, a Pareto diagram can be used to facilitate the activities and analysis process for the next stage.

Table 3. HOR model 1

Business Processes	**Risk Event (Ei)**	**Risk Agents (Aj)**							***Severity* Of Risk Event I (Si)**
		A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	
Plan	E1	R11	R12	R13					S1
	E2								S2
Source	E3	R21	R22						S3
	E4								S4
Make	E5	R31							S5
	E6								S6
Deliver	E7								S7
	E8								S8
Return	E9								S9
Occurrence of Agent j		O1	O2	O3	O4	O5	O6	O7	
Aggregate Risk Potential j		ARP1	ARP2	ARP3	ARP4	ARP5	ARP6	ARP7	
Priority Rank of Agent j		P1	P2	P3	P4	P5	P6	P7	

Tabel. I Model HOR 1

Source: Pujawan & Geraldin, (2009) Business Process Management Journal

Description:

(Ei) = E1, E2, E3,..En = risk event

(Aj) =A1, A2, A3,,,An = risk agent

(Rij) = R11, R12,..Rnn = Correlation value between risk agent and risk event

(Si) = S1, S2, S3,..Sn = The severity value of the risk event

(Oj) = O1, O2, O3,..On = The occurrence value of the risk agent

(ARPj) = ARP1, ARP2, ARP3…ARPn = Aggregate risk potential agent value of risk agents

(Pj) = P1, P2, P3 = Risk agent rating based on ARPj value

HOR2 is used to determine which actions or activities should be carried out first, effectively considering differences such as the involvement of resources and the degree of difficulty in implementation. Companies should ideally choose a set of actions that are not too difficult to carry out but can effectively reduce the likelihood of a risk agent occurring. The following are the stages of HOR phase 2, namely:

1. Select a number of risk agents with a high priority rating, to facilitate this selection process, a pareto diagram can be used to facilitate the ARPj analysis process, the risk agents included in the high priority will be input to the discussion in HOR phase 2 which is placed on the left side (what) of HOR2 as depicted in Table 4, in placing the corresponding ARPj value in the right column..
2. Identify actions deemed relevant to prevent the risk agent. Note that one risk agent can be addressed by more than one action and one action can simultaneously reduce the probability of occurrence of more than one risk agent. In HOR 2 these actions are placed in the top row as "How".
3. Determine the relationship between each countermeasure and each risk agent, Ejk. The values {0, 1, 3, 9} whose respective values indicate no, low, medium and high correlation between action k and agent j, respectively. This relationship (Ejk) can be considered as the degree of effectiveness of action k in reducing the probability of occurrence of risk agent j.
4. Calculate the total effectiveness of each action with the following formula :

$$TEk = \sum_j ARPj\ Ejk$$

Where: TEk = Total Effectiveness

ARPj = Aggregate Risk Potential from risk j

Ejk = Correlation value between preventive measures and each risk agent

5. Assess the degree of difficulty in performing each action, Dk, and place the values successively below the total effectiveness score. The degree of difficulty, indicated by a scale (such as a Likert or other scale) should reflect the funds and other resources required in performing the action. In this study the degree of difficulty value scale is shown in table 3.

Table2 Difficulty degree rating scale

Weight	Information
3	easy to implement

4	somewhat easy to implement
5	difficult to implement

6. Calculate the total effectiveness of the implementation of mitigation measures (Effectiveness to difficulty of ratio) with the following formula:

$$ETDk = \frac{TEk}{Dk}$$

ETDk = effectiveness to difficulty of ratio.

TEk = Total effectiveness.

Dk= Degree of difficulty.

7. determine the priority ranking for each action (Rk) where Rank 1 is given to the action with the highest ETDk value.

Table 4. HOR model 2

To Be Treated Risk (A_j)	*Preventive Action* (PA_k)					Aggregate Risk Potentials
	PA1	PA2	PA3	PA4	PA5	(ARPj)
A1	E11					ARP1
A2						ARP2
A3						ARP3
A4						ARP4
A5						ARP5
A6						ARP6
A7						ARP7
A8						ARP8
A9						ARP9
Total Effectiveness of action k	TE1	TE2	TE3	TE4	TE5	
Degree of difficulty Performing action k	D1	D2	D3	D4	D5	
Effectiveness to difficulty Ratio	ETD1	ETD2	ETD3	ETD4	ETD5	
Rank of Priority	R1	R2	R3	R4	R5	

Tabel II
Model HOR 2

Source: Pujawan & Geraldin, (2009) Business Process Management Journal

Description:

(Ei) = E11 = risk event

(Aj) = A1, A2, A3…An = risk agent

(TEk) = TE1, TE2, TE3…Ten = Total effectiveness of each action

(Dk) = D1, D2, D3…Dn = Degree of difficulty in implementing the action

(ETDk) = ETD1. ETD2, ETD3…ETDn = Effectiveness to difficulty ratio

(Rk) = R1, R2, R3…Rn = Rank (ranking of each action in order of highest ETD value.)

Supply Chain Operation Reference (SCOR)

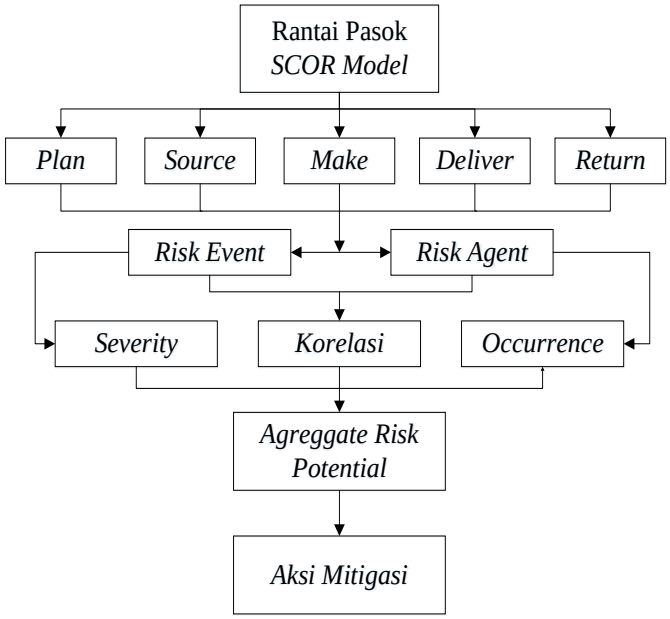
According to Darojat (2017) Supply chain operation reference (SCOR) is a reference model of the supply chain that is able to map the parts of the supply chain which aims to measure the performance of the supply chain itself. SCOR is used as a standard in describing processes, performance matrices, implementation and use of supply chain technology. (Sholeh, 2020).

Pareto Diagrams

A Pareto diagram is a bar chart that shows problems in the order of their occurrence. Each problem is represented by one bar chart. The most prevalent problem will be the highest bar chart, while the least prevalent problem will be represented by the lowest bar chart. (Tisnowati et.al., 2008). Pareto diagrams are used to compare different categories of events arranged according to their size, from the largest on the left to the smallest on the right. This arrangement helps us to prioritize the importance of the categories of events or causes of events studied to determine the main problem of the process (Nasution, 2004).

METHODS

The research method used is descriptive qualitative, descriptive research is research that aims to explain or describe a situation, event, object whether people or everything related to variables both with numbers and words.



Figures1 Research Design

The data processing method used in the implementation of the research is the House of Risk (HOR) method, which is a method for managing supply chain risks using the House of Quality (HOQ) concept with supply chain activity mapping using the SCOR Model.

RESULTS AND DISCUSSION

Supply Chain Flow

The supply chain flow in PT Safta Ferti's in-house manufacturing consists of 3 main components consisting of suppliers as a source of material, PT Safta Ferti as a transformant that transforms raw materials or materials into finished or semi-finished goods in accordance with customer wishes starting from making designs, manufacturing and finishing products and finally customers as orderers, recipients and users of the products they order. While the flow of the supply chain consists of 2 flows, namely suppliers to manufacturing and manufacturing to customers.

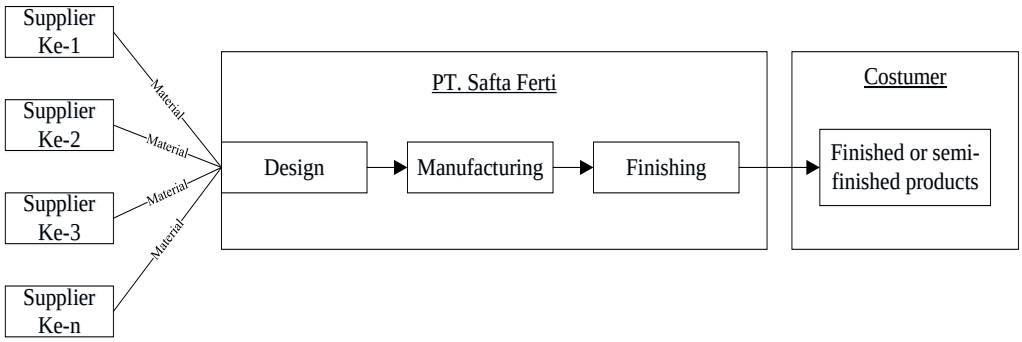


Figure 2 Supply chain flow In-house manufacture in PT. Safta Ferti

House Of Risk (HOR)

1. House Of Ris*k*Phase 1 (HOR 1)

House of risk phase 1 (HOR 1) is the first stage in data processing in research with output in the form of aggregate potential of a risk agent which will later become input in the second stage or phase,namelyhouse of risk phase 2 (HOR 2). To calculate the aggregate potential of an identified risk agent. In HOR 1 Mapping Supply Chain Activities with the SCOR Model focuses on five core processes starting from plan (planning) which consists of all activities related to planning the fulfillment of procurement, production and delivery needs in in-house manufacturing activities at PT. Safta Ferti, source which includes the procurement of goods or services to fulfill production requests in accordance with the wishes ofconsumersor customers, make which is the process of transforming raw materials or components into products in accordance with the wishes of consumers or customers, Deliver which is the process of delivering products to consumers or customers and Return which includes all activities of returning and receiving returns/ replacements of products or raw materials caused by various reasons that can be accepted and have been agreed upon by each related party.

Table 5 Supply Chain Activity Mapping

SCOR Model	Activity	ActivityCode
plan	RFQ fulfillment planning from customers	K1
	Material requirements planning	K2
	Production Planning	K3
	Material Procurement Planning	K4

SCOR Model	Activity	ActivityCode
	Cost Budget Planning for the Project to be carried out	K5
	Delivery Planning	K6
Source	Down Payment Acceptance	K7
	Material Receipts	K8
	Customer PO Payment Repayment	K9
make	Implementation of Production Activities	K10
	Quality Checking of Finished Products	K11
	Packaging of Finished Products	K12
	Finished Product Storage	K13
deliver	Delivery of Finished Products to Customers	K14
return	Material Return to Supplier	K15
	Material Replacement by Supplier	K16
	Product Return by Customer	K17
	Product Replacement to Customer	K18

Risk events see table 6

Table 6 Risk Events

SCOR Process	Activity	Risk Events	code	Severity
plan	K1	RFQ beyond the company's capabilities	E1	1
		Incorrect description in the RFQ	E2	9
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
return	K18	Delays in returning products to customers	E62	9
		Additional Cost Expenditure	E63	5

While the risk agent as in table 7

Table 7 Risk Agent

SCOR Process	Risk Events	Risk Agent	code	Probability Occurrence
plan	E1	Company resources are not able to fulfill the RFQ from the Customer	A1	2

SCOR Process	Risk Events	Risk Agent	code	Probability Occurrence
		The company cannot meet the deadline given by the customer to complete the project	A2	10
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
…	…	…	…	…
return	E63	Purchase of additional materials	A89	6
		Shipping transportation costs	A90	2

Matrix house of risk phase 1 see figure 3

Risk Event (Ei)	Risk Agent (Aj)										*Severity* of Risk Event i (Si)
	A1	A2	A3	A4	…	…	A87	A88	A89	A90	
E1	9	9									1
E2			9	9							9
…											…
…											…
…											…
E62											9
E63									9	9	9
Occurrence of Agent j (Oj)	2	10	7	9	…	…	7	2	2	8	
Aggregate Risk Potensial j (ARPj)	18	90	567	7344	…	…	9	9	270	90	
Priority Rank of Agent j	53	46	29	1	2	44	45	48	51	16	

Figures1 House of Risk Matrix Phase 1 (HOR 1)

Priority Risk Agent Pareto Chart see figure 3

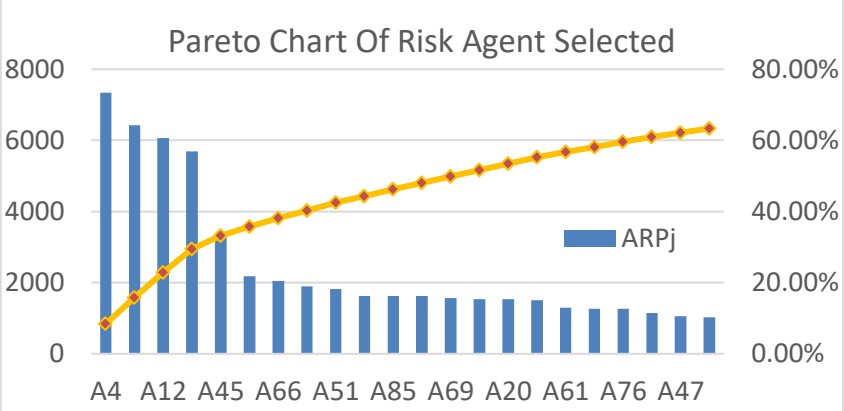


Figure 3 Priority Risk Agent Pareto Chart

usingtheprinciple of Pareto diagrams, with a value ratio of 63:24, which means 63% of problems can be resolved by dealing with 24% of risk agents, resulting in 22 selected risk agents based on the highest aggregate risk potential value that is prioritized for proactive actions to be followed up in House Of Risk phase 2 (HOR 2).

Table 8 Mitigation Action Plan

Risk Agent	code
Workers are not careful	A4
Workers are in a hurry	A5
Workers are less competent	A12
Workers are not focused when working because the work environment is not comfortable	A11
QC supplier Less thorough	A45
There is no structured method or guide in preparing the production schedule	A15
Workload is too heavy (Overload)	A66
Congestion during the material delivery process	A41
Limited labor	A51
Production schedules are made based on assumptions of facts in the field and deadlines given by the Customer	A18
Late product completion	A85
Uncertainty over material arrival time	A50
Poor storage management	A69
Lack of maintenance	A19
Maintenance is not well scheduled	A20
Supplier's inability to provide materials	A26
Poor layout of production facilities	A61
Insufficient amount of material received from suppliers	A72
Error in ordering the amount of material	A76

Risk Agent	code
Lack of skilled labour	A10
Packaging is not safe	A47
Damage during the shipping process	A46

4.2 House Of Risk Phase 2 (HOR 2)

House of risk phase 2 (HOR 2) is the second stage in the house of risk method which aims to follow up on the results of data processing that has beenobtainedin HOR 1, HOR 2 focuses on designing proactive actions or mitigation actions related to risk agents that are aggregate priorities in HOR 1 and deciding which actions or mitigation actions are prioritized to be implemented first looking at the level of ease of implementation of each draft mitigation the action strategy that has been designed, the purpose of designing the mitigation actions themselves is so that risk agents and risk events can be avoided and the percentage of the possibility of a detrimental risk can be reduced. In the House of risk model, ideally, companies should choose a set of actions that are not too difficult to implement but can effectively reduce the likelihood of risk agents occurring.

To be treated risk agent (Aj)	*Preventive Action* (PA_k)										Aggregate Risk Potentials (ARPj)
	PA1	PA2	…	…	…	…	…	…	PA27	PA28	
A4	9	3									7344
A5	9	9									6426
A12											6066
A11											5697
…											…
…											…
A76									9		1260
A10											1152
A47											1062
A46											1024
Total Effectiveness of action k (TEk)	123930	79866	…	…	…	…	…	…	11340	14580	
Degree of difficulty performing action k (Dk)	3	3	…	…	…	…	…	…	3	3	
Effectiveness to difficulty ratio (ETD)	41310	26622	…	…	…	…	…	…	3780	4860	
Rank of Priority	1	4	…	…	…	…	…	…	22	19	

Figure 4 House Of Risk Matrix Phase 2 (HOR 2)

Mitigation Action Design Priority Ranking see table 9

Table 9 Mitigation Action Design Priority Ranking

Mitigation Actions	code	ETD	Rank of Priority
Evaluate the performance of each worker	PA1	41310	1
Make strong contract agreements with suppliers	PA18	28776	2
Emphasize to workers to implement the SOP properly and correctly in every work activity	PA5	28458	3
Conduct regular supervision of the performance of each worker	PA2	26622	4

Mitigation Actions	code	ETD	Rank of Priority
Organizing skill training and work discipline	PA6	20351	5
Keeping the work environment clean and comfortable	PA8	17091	6
Provide education regarding the importance of accuracy in work	PA4	16524	7
Rearrange the layout of the work environment ergonomically	PA7	15410	8
Placing workers in accordance with their fields	PA11	13649	9
Make a production scheduling design based on a scheduling method	PA12	12211	10
Make a calculation of material receipt time	PA20	10530	11
Replace damaged work facilities	PA9	10255	12
Adding facilities that can provide comfort for workers while working	PA10	10255	12
Conduct regular monitoring of supplier performance	PA19	8316	13
Purchase/order materials 1 or 2 days earlier	PA21	7898	14
Improve and maintain good communication with suppliers	PA26	7560	15
Make a structured SOP design	PA3	7344	16
Choose safe packaging materials	PA22	6258	17
Doing double packing	PA23	6258	17
Not forcing machines/equipment to work beyond capacity	PA24	6120	18
Consistent in implementing the schedule	PA28	4860	19
Perform routine maintenance on machinery and equipment	PA13	4617	20
Performing routine checks (controlling) on machinery and equipment	PA14	4617	20
Make a plan for alternative supplier selection	PA16	4536	21
Evaluate supplier performance	PA17	4536	21
Checking the BOM before ordering	PA27	3780	22
Make a maintenance schedule based on a method	PA15	3463	23
Provide dedicated space for material storage, and finished products	PA25	2822	24

CLOSING

Conclusion

Based on the HOR method in the in-house manufacturing supply chain activities of PT SaftaFerti, there are 90 Risk Agents that have been identified in HOR1 and obtained 22 priority risk agents that can trigger 44 risk events in PT Safta Ferti's in-house manufacturing activities. Based on the 22 priority risk agents in HOR1, 28 draft mitigation action strategies were obtained in HOR2 related to priority risk agents and based on the highest effectiveness to difficulty ratio ETD value of each mitigation action obtained in HOR 2, it is known that PA1 or the 1st preventive action, namely conducting performance evaluations of each worker, is the first priority mitigation action to be implemented and PA25 or the 25th preventive action to provide a special room for material storage, and

finished products, which is the mitigation action with the lowest priority, which is ranked 24th among the 28 existing mitigation actions.

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