http://ejournal.seaninstitute.or.id/index.php/Ekonomi
Jurnal Ekonomi, Volume 12, No 03, 2023
ISSN: 2301-6280 (print) ISSN: 2721-9879 (online)

PROCESS RISK MANAGEMENT FOR BREAD PRODUCT DELIVERY OF MAKASSAR TO MANADO ROUTE AT PT. XYZ

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ARTICLEINFO

Keywords :
distribution,
fuzzy logic,
brainstorming,
house of risk,
risk management,
probability impact matrix

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ABSTRACT

Community service aims to increase the knowledge and understanding of citizens to reduce the risk of non-communicable diseasesers. This is due to success in product delivery will affect customer service and satisfaction which are an important part of the product marketing strategy. Therefore, risk identification in the process flow product delivery is an important thing to do in order to minimize the risks that occur which can hinder the success of product delivery. Risk identification in this study was carried out using a brainstorming approach, namely identifying every possible activity that may cause unwanted risks and involving several PT experts. X. The results from the brainstorming approach showed that there are 13 risk agents and 18 risk events. Then, a fuzzy logic approach was carried out to be able to determine an assessment of the occurrence of the risk agent and the severity of the risk event. Also, the House of Risk (HOR) approach was carried out to analyze the level of impact severity of risk and find out the sequence of risks that first get treatment and to map the probability impact matrix. From the results of this study, the researchers obtained five aspects that need to be improved, namely aspects of HR, Systems, Leadership, Relations and Environment. From these five aspects, 15 mitigation actions to help companies minimize any risks that occur were produced.

1. INTRODUCTION

Product delivery is an activity that includes the transfer of raw materials to the factory and the process of transferring finished products to customers (Kotler et al., 2001). Product delivery activities are very important activities because they allow producers to reach out-of-town consumers. It will be easier for consumers to get the desired product with product delivery activities (Putri et al., 2014). Product delivery is an important process for manufacturers because the success or failure of a company is judged by its ability to deliver the required product on time and because the behavior of a product depends on the product delivery process.

Company XYZ is a producer in the field of selling bakery products. Bread is one of the staple foods that has a carbohydrate value that is not much different from that of white rice; therefore, bread is included in the category of foods that have good carbohydrate values for the body. Thus, bread is a substitute for white rice and is a food that does not last long and is included in the category of perishable products. Perishable products are non-durable products that will have an effect on the product's selling value for a specific period of time; as a result, it is critical to monitor products, particularly in the product delivery process flow, which will travel three days.Control in the delivery and storage of products is needed, especially with the Makassar - Manado land shipping route, which has a distance of ± 1900 km.

The high demand for products and the high potential for returns on the Manado channel make PT.X have to think of a solution to be able to overcome every risk that occurs, starting from the risk of the process flow before it reaches the delivery department even to the delivery process itself, which has a high level of risk where risk is the level of uncertainty of an event that will result in a loss (Sinha et al., 2004). The risks that arise in every process activity, starting from receiving raw materials, production planning, production, storage warehouses, and even during the delivery process, are events that are detrimental and can hinder business processes in the company (Anggrahini et al., 2015).

From the diagram in Figure I, the high data on Manado returns throughout 2021 was all due to delays in the product delivery process, which caused the product's shelf life to be very short. This would affect the business quality of the company and will also affect the reputation of the company. product. As a result, identifying and analyzing the flow of the product delivery process was required to determine what obstacles were causing the delays. After the identification and analysis had been completed, corrective actions would be determined

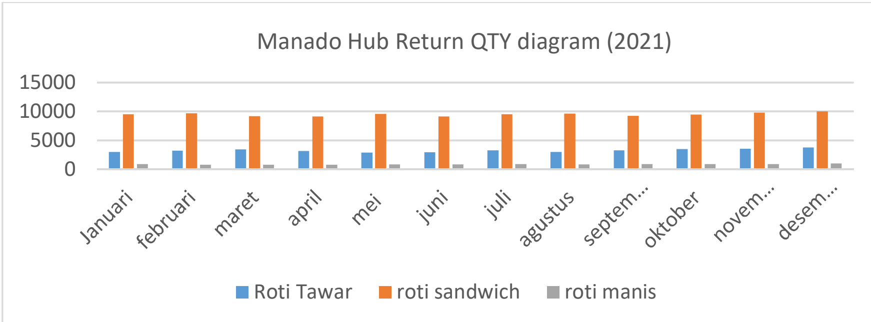

Figure I. Diagram of QTY Return of Manado Channel

The risk identification process will be done using the brainstorming method after each risk source is known. Then, it will be carried out using the fuzzy logic method to provide certainty for the occurrence and severity assessment. After the occurrence and severity values are known, the next process will be done with house of risk to determine the priority sources and analyze the design of risk mitigation strategies.

2. Literature review

In this literature review section, distribution, risk, risk management, fuzzy logic and house of risk would be explained.

Distribution is an activity that facilitates the delivery of goods from producers to consumers so that consumers' needs for a product can be fulfilled (Tjiptono, 2015). Kotler and Keller (2011) defined distribution as an interdependent device starting from the process of providing raw materials to finished products that are ready for consumption by consumers. From the view of the experts, the researchers concluded that distribution is a process that involves producers and consumers.

Risk is a measure of probability that can impact the failure of a project (Hanggraeni, 2010). An activity from the product delivery process has the opportunity to cause risk; therefore, appropriate handling is needed to minimize the risk and impact (Hanafi, 2006).

Risk management is a risk management process that includes a process of identifying risks, an evaluation process, and finally a risk control process. Rizqiah (2017) explained that there are three principles by which risk management is part of a company's strategy and is embedded in the practices and culture of the company, as well as in business processes. and corporate organizations. According to BSI (2018), there are several main elements in the implementation of risk management, starting with consultation and communication, then setting the context, identifying and analyzing risks, evaluating risk sources, and making risk treatment decisions. After completion, risk management is still monitored and reviewed.

Fuzzy logic is a theory known as strict logic which is based on everything having a true or false value. The theory of fuzzy logic was first introduced by Prof. Lotti A. Zadeh in 1965, and the initial introduction of this concept started with the his paper in 1972 and was introduced the basis of fuzzy logic was the theory of fuzzy sets. Fuzzy logic is a way to map the input space into the output space (Sri and Hari, 2013). Kusumadewi (2003) stated that there are several advantages to using fuzzy logic:

1. Fuzzy logic is simple reasoning that has easy-to-understand mathematical concepts.
2. Fuzzy logic can be integrated with other methods in the sense that fuzzy logic is very flexible.
3. Fuzzy logic has a tolerance for inaccurate data.
4. Fuzzy logic is capable of modeling very complicated non-linear functions.
5. Fuzzy logic can directly apply expert experiences without going through the training process.
6. Fuzzy logic can be integrated with conventional control methods.
7. Fuzzy logic is based on natural language.

The HOR (House of Risk) method is a development method developed in 2009 by Pujawan and Geraldin. This method was a combined method of house of quality and Failure Mode and Effect Analysis (FMEA). The change in the HOQ (House of Quality) concept from the planning function of a product to the planning function of a risk mitigation scheme function. The term HOQ was changed to House of Risk

(Pujawan and Geraldin, 2009). In the assessment of the house of risk method, it is divided into two phases, namely:

1. Phase I HOR (House of Risk)
   1) Identifying the activities that occur in the product delivery process business flow, and then begin identifying risks in the business process flow.
   2) Assessing the impact (severity) of a risk event by determining the impact scale of each risk found. An assessment with a scale of 1-10 and a value of 10 represents an extreme impact (very dangerous) and a value of 1 represents no impact.
   3) Identifying risk agents and determining the chances of a risk occurring based on occurrence, the assessment is carried out on a scale of 1-10, where a value of 1 represents that the risk has never occurred and a value of 10 represents that the risk often occurs.
   4) Performing an assessment of the relationship between the risk agent and the risk event by weighting the value in the assessment of the correlation between the risk agent and the risk event, namely:

Table 1. The value of the correlation between risk agent and risk event

Rating	Correlation
0	Not related
1	Low correlation
3	Moderate correlation
9	High correlation

(Source: Pujawan and Geraldin, 2009)

   5) After each of the above steps is completed and the data is available, then the aggregate risk potential (ARP) calculation is performed.
   6) Risk agent ranking is then carried out to find out which one is prioritized in determining the risk mitigation strategy.

2. Phase II HOR (House of Risk)
   1) Choosing a number of risk agents to carry out risk mitigation measures, the process of selecting a risk agent can be seen from the largest ARP value.
   2) Identification in determining risk mitigation strategies that are considered effective in dealing with and preventing the occurrence of risk agents.
   3) Determining the magnitude of the correlation value in the risk mitigation strategy and risk agent, the correlation assessment can be seen in Table 1.
   4) Calculating each total value on risk prevention measures using the formula, namely: Tech = Σ j ARPj Ejk
   5) The level of difficulty in the application of each preventive action can be assessed which is denoted by the symbol Dk.
   6) The total value of the ratio at the application level can be calculated using the formula: ETDk = TEk/Dk.
   7) Performing priority ranking on each predetermined preventive action.

Toppel et al., (2019) revealed ways to reduce risk by transferring risk. Dadsena et al., (2019) paid attention to resources during the analysis process as an important thing to do. It is important to make a comprehensive decision-making process for being able to realize a low-cost risk mitigation strategy because every available mitigation measure is based on controlling the source of risk (Zhan et al., 2019).

3. METHOD

This research was conducted at PT. X. located in the Makassar industrial area, Daya, Biringkanaya District, Makassar, South Sulawesi. The object of this research is the risk of the process flow of the distribution and delivery of PT. X route Makassar – Manado.

Data Processing Techniques

The following are some of the steps carried out in this research, namely:

1. Mapping the activities of each department starting from the product order flow to the product delivery process.
2. Carrying out risk identification actions by direct observation of the object of research and brainstorming with experts from PT. X to be able to know the risk agent and risk event .

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Jurnal Ekonomi, Volume 12, No 03, 2023
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3. Assessing the probability of occurrence after the risk agent and risk event had been successfully identified and severity was carried out using the fuzzy logic method.
4. In this continuation, prioritization of risk sources was carried out by looking for the highest correlation between the source that causes the risk to occur and the risk events generated by the HOR Phase I method, so that the results obtained could be continued in the next process, namely HOR Phase II.
5. At the HOR Phase II stage, a mitigation/handling design was carried out so that it could be applied in every activity starting from receiving orders to the process of sending finished products.

Conceptual framework

The framework of this study is seen in Figure 2:

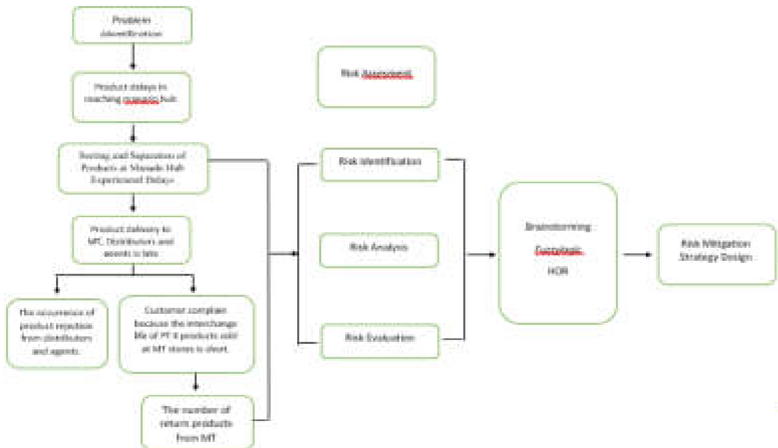

Figure 2. Conceptual Framework

4. RESULT AND DISCUSSION

This section provides the explanation of the data collection, data analysis and discussion.

Activity Mapping

PT. X applies the concept of full-based mode ordering system, in which the production process and supply of goods are carried out based on actual customer requests. The point at which sales receive consumer demand through distributors, agents, and modern trade and use it as the basis for conducting the production process. The product process flow can be seen in Figure 3.

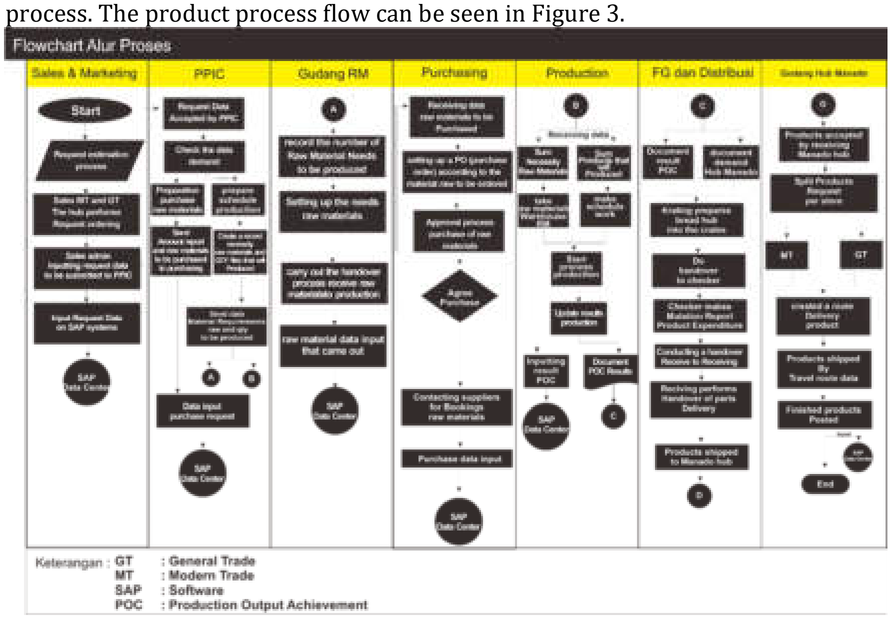

Figure 3. Flow Chart of the Process

Activity mapping was carried out using a brainstorming approach, by asking each department about the process flow of activities that occur before arriving at the distribution department. The activity mapping based on brainstorming results can be seen in Table 2.

Table 2. Activity mapping based on the brainstorming results

Sub Section	Activity
Admin sales	1. Creating order data
	2. Sending order data
PPIC & RM	1. Creating MRP data to be able to start production
	2. Calculating the capacity and bill of materials
	3. Purchasing raw materials
	4. Preparing raw materials
	5. Calculating raw material stock
Production	1. Handing over of raw materials from Warehouse RM
	2. Carrying out the production process
	3. Product Checking Process
	4. Product handover to warehouse based on documents (POC)
Finish Good	1. Preparing products into containers (crates)
	2. Making product expenditure mutation reports
	3. Creating handover documents
Distribution	1. Taking products from FG
	2. Packaging the products
	3. Sending the products to the Manado Hub Warehouse
Manado Warehouse Hub	1. Receiving products from Makassar
	2. Segregating products based on store orders
	3. Packaging the products
	4. Sending to shop

After the activity mapping has been identified, the next step was to determine the risk agent and risk event starting from the product activity process until the product reached the Manado hub through the interview process.

Table 3. The Risk agents

Code	Risk Agent
A1	Bad connection
A2	Problems with the program
A3	Human Error
A4	The difference between forecast and actual demand
A5	Natural disasters
A6	Congestion
A7	Machine trouble
A8	Lack of work supervision
A9	Declining product quality
A10	Preventive maintenance is less than optimal
A11	Product diversity
A12	Vehicle circulation is not going well
A13	Error in product delivery

In Table 3, there are thirteen risk agents in the process of sending perishable products for the Makassar - Manado route which were obtained through the interview process.

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Table 4. The Risk events

Code	Risk event	Units (Sections)
E1	Sales delays in increasing demand data	Booking
E2	Product order data cannot be sent	Booking
E3	Product demand does not meet the minimum production	PPIC
E4	Delaying in the arrival of raw materials at the factory	PPIC

E5	Rejecting the raw materials (not according to standard)	PPIC
E6	Error in calculating the stock of raw materials	PPIC
E7	Production downtime occurs	Production
E8	Not achieving production targets	Production
E9	Number of rejected products	Production
E10	Error entering label on machine (price/ED)	Production
E11	Error using of raw materials	Production
E12	Product non-conformity	Finishing Goods
E13	Product setting error	Finishing Goods
E14	Fifo flow error on the product	Finishing Goods
E15	OTD time discrepancy (on time delivery)	Distribution
E16	Product rejected	Distribution
E17	High returns	Distribution
E18	Vehicle damage	Distribution

In Table 4, it can be seen from the results of the interviews that there were 18 risk events that occurred in the process of shipping perishable products for the Makassar to Manado route.

After obtaining risk event and risk agent data, the next step was to return to the interview process to obtain data on the design of indicators that cause risk agents and the impact generated by risk events, which would be continued in processing the fuzzy logic.

There are 13 designs resulting from indicators that cause risk agents, here are 2 examples of indicator designs that cause risk agents, namely:

1. Human error indicators that cause human error are:
   1) Workloading
   2) working pressure
   3) Working environment
2. Forecast data and actual data have different indicators that cause these risks, namely:
   1) Lack of information about trend developments.
   2) Coordination of sales and shop owners is not well established.
   3) Coordination of methods and flow of information are not going well.

There are 18 designs resulting from the impact of a risk event , here are 2 examples of the resulting impact designs, namely:

1. Production downtime impacts resulting from production downtime are:
   1) There are additional costs.
   2) Competitors can seize the market.
   3) It can lower the company's image.
2. The number of impact reject products resulting from this risk are:
   1) It does not fulfill the product in the market.
   2) It might lower the company's image.
   3) There is a financial loss.

Fuzzy logic

Fuzzy processing was carried out with the Matlab R2020 software. It was carried out by determining the input and output variables that could be obtained from the indicators that cause risk agents and the impact resulting from risk events. In the fuzzy rules, this time, there is solely one example that was made to simplify and speed up the fuzzy process:

Fuzzy set

The initial step was carried out by determining the input variables and output variables as well as the fuzzy sets which can be seen in Table 5.

Table 5. Fuzzy Risk Agent set

Function	Variable Name	Fuzzy set	Speaker universe	description	Unit Domains

Inputs	Workload	Highly Impactless Not impactful Neutral Impactful Very Impactful	(0-5)	This is what causes the output.	[-0.5 0 1 1.5] [1 1.5 2 2.5] [2 2.5 3 3.5] [3 3.5 4 4.5] [4 4.5 5 5.5]
	Work pressure	Highly Impactless Not impactful Neutral Impactful Very Impactful	(0-5)	This is what causes the output.	[-0.5 0 1 1.5] [1 1.5 2 2.5] [2 2.5 3 3.5] [3 3.5 4 4.5] [4 4.5 5 5.5]
	Work environment	Highly Impactless Not impactful Neutral Impactful Very Impactful	(0-5)	This is what causes the output.	[-0.5 0 1 1.5] [1 1.5 2 2.5] [2 2.5 3 3.5] [3 3.5 4 4.5] [4 4.5 5 5.5]
Output	Human error	Never A little Fair Very high Almost certainly	(0-10)	This is what causes the output.	[-0,5,0,2,3] [2,5.3,5.4,5] [4. 4,5. 6,5] [6,2. 7,7. 8,2] [7,5.8,5.10.10,5]

Furthermore, the membership function, or commonly known as membership degrees, which have a value interval of 0-1, is one way that can be used to obtain membership values by determining curve points (membership functions). Thus, Figures 4, 5, and 6 show the images of the curves for each input variable. Figure 4 shows the workload input variable curve, Figure 5 displays the working pressure curve, and Figure 6 provides the work environment curve.

Based on the results of interviews for the risk agent of human error, the impact that causes the risk to have a value can be seen in Table 6.

Table 6. The risk impact values

Risk Agent	Cause Indicator	Assess the impact of risk based on the results of the interviews
Human error	Workload	5
	Work Pressure	5
	Work environment	4

Table 6 shows the value of the risk impact based on the results of the interviews that have been conducted by the researchers. From the values obtained, a set category will be determined based on the value of the risk impact which can be described based on the membership function which is described in the form of intervals based on the form of the set, namely:

Highly impactless set (*Sangat Tidak Berdampak* or STB):

$$\begin{cases} 1, & x \leq 1 \\ 1,5 - x, & 1 \leq x \leq 1,5 \end{cases}$$

Not impactful set (*Tidak Berdampak* or TB):

$$\begin{cases} x - 1, & 1 \leq x \leq 1,5 \\ 1, & 1,5 \leq x \leq 2 \\ 2,5 - x, & 2 \leq x \leq 2,5 \end{cases}$$

Neutral Set (Neutral or N) :

$$\begin{cases} x - 2, & 2 \leq x \leq 2,5 \\ 1, & 2,5 \leq x \leq 3 \\ 3,5 - x, & 3 \leq x \leq 3,5 \end{cases}$$

Impactful set (*Berdampak* or B):

$$\begin{cases} x - 3, & 3 \leq x \leq 3,5 \\ 1, & 3,5 \leq x \leq 4 \\ 4,5 - x, & 4 \leq x \leq 4,5 \end{cases}$$

Very Impactful set (*Sangat Berdampak* or SB):

$$\begin{cases} x-4, & 4 \leq x \leq 4{,}5 \\ 1, & x \geq 4{,}5 \end{cases}$$

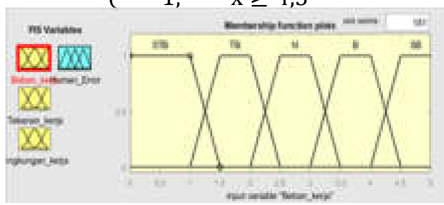

Figure 4. Fuzzy Set of Workload Variable Values

Based on the value of the risk impact from the results of interviews with the workload variable which has a value of 5, it can be concluded from the form of the set interval it has an interval value of 1 with the conclusion that the set is "very impactful" with the interval shape (1, $x \geq 4{,}5$)and in Figure 4 it can be seen that the curve is in the SB category.

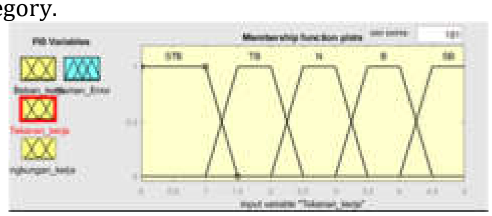

Figure 5. Variable Input Working Pressure

Figure 5 shows the work pressure curve and the work pressure variable from the interview results has a risk impact value of 5. Thus, it can be described from the membership function in the form of intervals (1, $x \geq 4{,}5$) which can be concluded to have an interval value of 1. So, from the interval value 1 it can be concluded that work pressure is included in the set "very impactful."

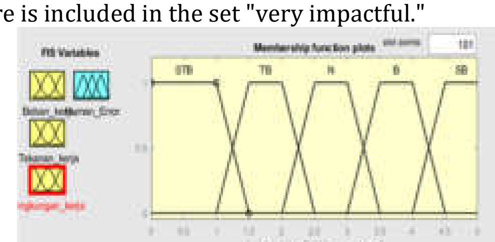

Figure 6. Work Environment Variable Input

Furthermore, the work environment variable from the results of the interview has a risk impact value of 4, so it can be described from the membership function in the form of an interval 1, $3{,}5 \leq x \leq 4$, where the form of the interval describes the value of interval 1 if it has a value of more than equal to 3.5 and more or less equal to 4, which means it can be categorized into the impactful set from that from the results of the risk impact interview, which has an impact value of 4 from the form of the interval means it has an interval value of 1, and seen from the membership function curve. Based on the interval value 1, it is true that the work environment is included in the impact set category.

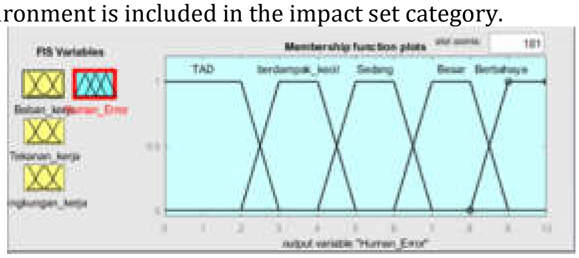

Figure 7. Human Error Output Variable

Figure 7 shows the output variable of the human error aspect based on the results of the defuzzification affirmation process which can be seen in Figure 8. The output of the input value of each

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Jurnal Ekonomi, Volume 12, No 03, 2023
ISSN: 2301-6280 (print) ISSN: 2721-9879 (online)

variable produced a value of 9 where the value of 9 is the occurrence value for human error based on that value then from the results of the membership function with intervals1, $x \geq 9$ with an interval value of 1 means human error is indeed included in the dangerous set category.

After the membership function has been formed and the set categories have been determined, the fuzzy rules were carried out. The number of fuzzy logic rules was obtained from the number of input variables in the fuzzy logic which would be multiplied by the fuzzy set categories, where each input has 5 fuzzy set categories, and if multiplied by each input variable and the categories would form 125 rules along with 1 example of fuzzy logic rules.

If (workload is very impactful) and (work pressure is very impactful) and (work environment is impactful) then (human error is dangerous).

Affirmation (deffuzification)

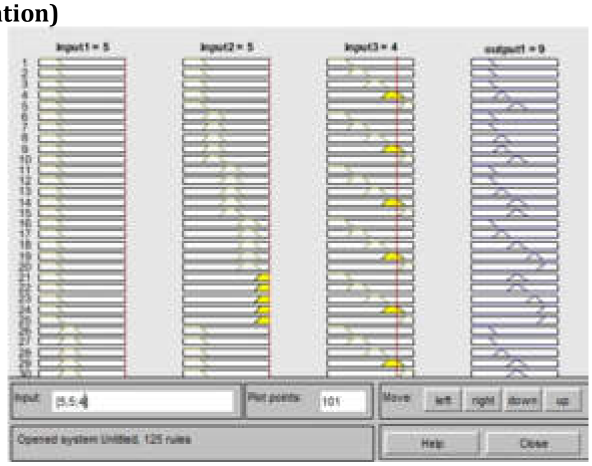

Figure 8. Affirmation (deffuzification)

After the fuzzy rules have been defined, fuzzy logic was then confirmed using the help of the Matlab R2020 software, which can be seen in Figure 8. From this assertion, the occurrence and severity values were determined .Figure 8. Defuzzification

Figure 8 shows the value of affirmation (defuzzification). This value is the value of affirmation of the category which later became the occurrence value for the risk agent and severity for the risk event. The purpose of the assessment using the fuzy method was merely affirmation of category seen from the results of human error defuzzification with a value of 9. Thus, it can be concluded that human error is included in the dangerous risk category.

After the final process of the fuzzy logic process in this study, namely the process of confirming the output value which would become the occurrence value for the risk agent and severity for the risk event. The results of each of these processes can be seen in Table 7 and Table 8.

House of Risk

Based on the results of data collection and the process of fuzzy stages that have been carried out, the results obtained are risk event risk events in the form of severity values, and what causes these risks to occur risk agents in the form of occurrence values, cause the product delivery process to be hampered in each product delivery process activity.

House of Risk Phase I

Based on the results of the fuzzy logic method, the occurrence and severity values were obtained which can be seen in the Table 7 for occurrence and 8 for severity.

Table 7. The Results of measuring the risk agent (occurrence)

Code	Risk Agent	Occurrence
A1	Bad connection	5.33
A2	Problems with the program	7.25
A3	Human Error	9.0
A4	The difference between forecast and actual demand	7.25

A5	Natural disasters	5.23
A6	Congestion	7.25
A7	Machine trouble	7.25
A8	Lack of work supervision	7.25
A9	Declining product quality	5.33
A10	Preventive maintenance is less than optimal	7.25
A11	Product diversity	5.33
A12	Vehicle circulation is not going well	7.25
A13	Error in product delivery	9.0

Table 7 is the result of measurement of risk agents determined through a fuzzy logic process where fuzzy logic helps in confirming the occurrence value of risk agents which can be seen in Table 7.

Table 8. The results of measuring risk events (Severity)

Code	Risk Event	Units (Sections)	Severity
E1	Sales delays in increasing demand data	Booking	9
E2	Product order data cannot be sent	Booking	9
E3	Product demand does not meet the minimum production	PPIC	7.25
E4	Delaying in the arrival of raw materials at the factory	PPIC	9
E5	Rejecting the raw materials (not according to standard)	PPIC	7.25
E6	Error in calculating the stock of raw materials	PPIC	7.25
E7	Production downtime occurs	Production	9
E8	Not achieving production targets	Production	7.25
E9	Number of rejected products	Production	7.25
E10	Error entering label on machine (price/ED)	Production	7.25
E11	Error using of raw materials	Production	7.25
E12	Product non-conformity	Finish Good	9
E13	Product setting error	Finish Good	7.25
E14	Fifo flow error on the product	Finish Good	7.25
E15	OTD time discrepancy (on time delivery)	Distribution	7.25
E16	Product rejected	Distribution	7.25
E17	High returns	Distribution	7.25
E18	Vehicle damage	Distribution	9

After the occurrence and severity values were revealed, the potential aggregate risk calculation was carried out and became the final stage in the HOR phase I process in the aggregate risk potential calculation. The aggregate risk potential value was obtained by multiplying the impact of risk severity with the probability of the risk occurring and the correlation between the risk agent and the risk event.

Table 9. House of Risk Phase I

Risk Events	Risk Agent													Seve rity
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	
E1	9	9	3					3						9
E2	9	9	3					3						9
E3				9										7,25
E4			1	9	3	9		3			3	3		9
E5			1	9	3	9		3			3	3		7,25
E6			9	3				3						7,25
E7			3				9							9
E8			3											5,33
E9	9	9	3	3										7,25
E10			3				9	9	9	9				7,25
E11			9				9	9	9	9				7,25
E12			3					3			3			9
E13			3					1			9			7,25
E14			9					3			3			7,25
E15	9	3					9	3		3		9	9	7,25

E16								9	9	9	3			7,25
E17								9	3	3			9	7,25
E18												9		9
Occurence	5,33	7,25	9	7,25	5,23	7,25	7,25	7,25	5,33	7,25	5,33	7,25	9	
ARP	1559	1805,35	3612,1	1848,84	254,963	1060.3	2006,44	3358.56	1159,28	1734.56	983,385	1413.75	1174.5	
priority	7	5	1	4	13	11	3	2	10	6	12	8	9	

After the aggregate potential value was known, the next step was to make a pareto diagram that presents the risk agent ranking to find out the 5 highest risk values that would be prioritized in risk mitigation.

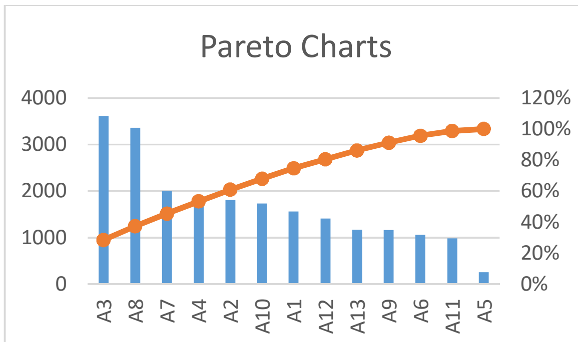

Figure 9. Phase I Pareto HoR Diagram

From the pareto diagram in Figure 9, thirteen risk sources were sorted based on the highest to lowest graph and the company requested 5 main risk sources only to be prioritized for risk mitigation measures, namely: A3 Human Error, A8 lack of work supervision, A7 Machine trouble, A4 difference between forecast vs actual demand, A2 problems with the program or application used.

House of risk Phase II

After knowing the risk source that has the highest ARP value and has the top priority in the risk mitigation process, before designing a preventive action, a risk map and action table were carried out.

Table 10. Risk Assessment Matrix

Likelihood level	Severity level				
	Very low	Low	Fair	High	Very high
Very high				A3	
High		A2	A4	A8, A7	
Fair					
Low					
Very low					

Table 11. Action table

Color	Risk	Action
(red)	Very high	Take direct action: 1. Increase the comfort of the work environment. 2. Increase resources. 3. Improve leadership character. 4. Improve standard operating procedures.
(orange)	Alert/high	Immediate corrective action is required: 1. Consider upgrading and adding resources. 2. Consider improving system operational procedures. 3. Plans to deal with threats.
(yellow)	Fair	Corrective actions taken in a timely manner: 1. Do monitors.

		2. Usually the system is considered good enough so no more system repairs are carried out.
	Low	The low category is usually considered acceptable risk, therefore: 1. No more repairs needed. 2. Control will not be too tight. 3. Carry out work as usual.

Based on the risk assessment matrix table in Table 10, three risk sources are in the red category. This shows that there are three risks that are in the critical category and must be immediately acted on, and there is one risk that is in orange which indicates that one source of risk is included in the warning category and as soon as possible must be repaired immediately and one risk is in the yellow category must be repaired in a timely manner, starting from monitoring the field and correcting any problems encountered in the field so as not to cause harm and not poses a fatal risk.

After knowing the risk sources and categories of each risk through a risk map, this is what is done to form the basis for designing a risk mitigation strategy. At this stage, interviews were conducted with the head of distribution to design mitigation and overcome each existing risk source. Table 12 is the design of a risk mitigation strategy after conducting an interview session with the distribution head which is a strategy for carrying out risk prevention.

Table 12. Aspects and mitigation measures

Aspect	**Mitigation Measures**
HR	Provide training for workers on a regular basis
	Provide training and motivation in work
	Provide training for the Engineering team so that preventive maintenance can be maximized
	Provide training to be able to read trends in the market
	Provide good problem solving training
System	Improve standard operating procedures
	Improve the work culture of discipline and timeliness
	Create a regular machine maintenance schedule
	Manage schedule and machine capacity
	Manage production cut off properly
	Improve company support for employees
Leadership	Every shift leader must always provide motivation, direction and enthusiasm before working
	Provide direction and training for shift leaders about leadership
Relations	Maintain good communication with our business partners, both supermarkets, distributors and agents so that it is easy to get information about trend developments in the field
Environment	Provide a comfortable work environment

Based on the determination of aspects and mitigation measures in Table 12, the next step was to determine the level of difficulty in its application, which can be seen in Table 13. The level of difficulty and application of preventive action can be influenced by several factors, including the time period required for its implementation and the costs to be incurred issued. This is the basis for the distribution head to determine the level of difficulty in its application.

Table 13. Risk agents and preventive actions along with the level of difficulty in implementing them

	Risk Agent		**Preventive Action**	**Level of difficulty**
A3	Human error	PA1	Provide a comfortable work environment	2
		PA2	Provide training for workers on a regular basis	3
		PA3	Each Shift leader must always provide motivation, direction and enthusiasm before working	2
		PA4	Provide direction and training for shift leaders about leadership	3
A8	Lack of work supervision	PA5	Improve standard operating procedures	2
		PA6	Improving the work culture of discipline and timeliness	2

		PA7	Provide training and motivation in work	3
A7	Machine Trouble	PA8	Create a machine maintenance schedule	3
		PA9	Manage schedule and machine capacity	3
		PA10	Provide training to the Engineering team so that preventive maintenance can be maximized	3
		PA11	Manage production Cut Off properly	2
A4	The difference between forecast and actual demand	PA12	Provide training to be able to read trends in the market	3
		PA13	Establish good communication with supermarkets, distributors and agents, in order to obtain information about development trends in the market	3
A2	Problems with the program	PA14	Improve company support for sales	2
		PA15	Provide good problem solving training	3

Effectiveness to difficult ratio was then calculated to see the level of effectiveness of each implementation strategy that would be carried out. This can be seen in Table 14 concerning the House of Risk in Phase II.

Table 14. House of risk in phase II

Risk Agent	Preventive Action PA 1	PA 2	PA 3	PA 4	PA 5	PA6	PA 7	PA 8	PA 9	PA 10	PA 11	PA 12	PA 13	PA 14	PA 15	ARP
A3	9	9	3	9	3		9									3611
A8	1				9	9	9								1	3358.6
A7								9	9	9	9					2006,44
A4												9	9			1848,8
A2														9	3	1805,3
TECH	35858	32499	10833	32499	41060	30227,4	62726	18058	18058	18058	18058	16639	16639	16248	8775	
DK	2	3	2	3	2	2	3	3	3	3	2	3	3	2	3	
ETD	17929	10833	5416,5	10833	20530	15113,7	20909	6019,3	6019,3	6019,3	9029	5546.4	5546	8124	2925	

Table 14 concerning the house of risk phase II presents data on the ETD value (effectiveness to difficulty ratio) shows the priority of preventive actions that must be carried out by PT. X to be able to reduce the impact of risk agents. Meanwhile, Table 15 shows the results of ranking/ prioritizing risk mitigation that must be carried out. From the results of Table 14 house of risk phase II, the sequence of priority risk mitigation actions can be seen in Table 15.

Table 15. Priority sequence of Risk Mitigation actions

Handling Order	Code	Preventive actions	ETD
1	PA7	Provide training and motivation in work	20909
2	PA5	Improve standard operating procedures	17929
3	PA1	Provide a comfortable work environment	15113,7
4	PA6	Improve the work culture of discipline and timeliness	10833
5	PA2	Provide regular training for workers	10833
6	PA4	Provide direction and shift leader training on leadership	10833
7	PA11	Manage production cut off properly	9029
8	PA14	Increase company support for employees	8124
9	PA8	Create a machine maintenance schedule	6019,3
10	PA9	Manage schedule and machine capacity	6019,3

11	PA10	Provide training for the Engineering team so that preventive maintenance can be maximized	6019,3
12	PA12	Provide training to be able to read current trend developments	5546.7
13	PA13	Establish good communication with supermarkets, distributors and agents, in order to obtain information about development trends in the market	5546
14	PA3	Each Shift leader must always provide motivation, direction and enthusiasm before working	5416
15	PA15	Provide good problem solving training	2925

Table 15 above presents the order of risk mitigation priorities starting from handling strategies to providing motivational training in work to providing problem solving training.

5. CONCLUSIONS

The results of this study indicated that in the product delivery process PT. X route Makassar - Manado revealed several causes causing delays in the product delivery process with risk sources, namely: human error, lack of work supervision, machine trouble, differences in forecast and actual and problems with the applications used. From each of these risk sources, there are five aspects that must be improved in order to minimize the occurrence of risk sources, namely: HR, Systems, Leadership, Relations and Environment. From these five aspects, 15 risk mitigation actions were produced.

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