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Identification and Evaluation of Logistics Operational Risk Using the FMEA Method at PT. XZY

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Abstract

The purpose of this study is to identify risks to operational factors in PT. XZY identifies and formulates existing handlers in PT. XZY related to risks to work operations. This study used the FMEA method. FMEA is a method used to perform analysis inductively, carried out repeatedly and systematically so that the process can be documented. Data was obtained using direct observation and interviews with logistics workers. Based on the results of problem identification and fmea calculation results, 19 operational risks were obtained in the logistics department of PT. XZY and varying RPN values, with the smallest value being 12 and the largest value being 729. Thus, it is concluded that the 3 highest risks in operations that can hinder work activities are limited product storage, improper placement of spare parts, and input errors in the system.

Keywords: *Risk Evaluation, FMEA Method, Logistics Operations.*

1. Introduction

One of the government's efforts in advancing the country's economy is the development of creative industries. Industry in Indonesia must continue to be developed both in terms of quality and other aspects, considering the large amount of competition in the industrial world. Improving the quality or product of an industry is certainly related to the creativity and innovation of human resources owned by a country [1]. The industrial products produced can also be useful for other industries. This quality improvement is closely related to the process that the industry goes through in producing the desired product effectively and efficiently [2].

The logistics process can be used as a view in optimizing production factors, namely to optimize cost, time, and quality [3]. In principle, the main activities at the company are logistics distribution activities and the provision of goods [4]. But sometimes there are still frequent failures in operational processes. Failures in logistics processes such as errors or defects in products can affect customer perception, thus referring to the consequences of such failures. This is because failures in the production process can damage the product or are referred to as defects. A risk is an effect of uncertainty on an objective, as defined by ISO [5] Therefore, it is necessary to approach using the FMEA method. According to Khalilurrahman, FMEA stands for (Failure Mode and Effect Analysis), which analyzes the root cause of problems caused by existing defects [6]. This FMEA is a measuring tool that is usually used to see what are the causes that are dangerous in the process of assessing the quality of a

product and service [7], as well as looking at the main factors that become problems in causing potential failures so that later solutions can be made [8]. The variables measured in this study are occurrence (frequency of occurrence), severity (impact), and detection [9]. To determine the FMEA, first look for the RPN value. The score assessment given can then be sorted by Risk Priority Number (RPN) to identify critical failure modes, related to the rating from the lowest assessment to the highest assessment [10]. Control within the company consists of five components, namely the control environment, risk assessment, control activities, information and communication, and activity monitoring [11].

In the process of going to an advanced company, the company must be able to run a good system. A good system is carried out to minimize the occurrence of risks because every company organization must have risks. According to AS/NZS Standard 4360:1995, risk is the chance of something happening that has an impact on the goal as measured in terms of consequences and probabilities. Companies that apply risk assessment will be more aware and ready to face the possibility of potential risks and can estimate the handling scenario [12] defines risk management in an organization as a risk management system faced by an organization comprehensively to increase corporate value. according to Vaughan in Rosih et al., [13], uncertainty is a state of mind filled with doubt. Therefore, risk management is carried out by the company to realize optimal business processes to provide benefits for the company and society.

Menururt Mcdermott and Beauregard one of the methods often used to identify the components that cause risk and prevent the problem from occurring is to use the FMEA method. This study used the Failure Mode and Effect Analysis (FMEA) method for risk analysis, in calculating the Ris Priority Number (RPN) and making a list of critical risks through a comparative calculation of the total RPN value divided by the number of risks. From the critical risk obtained from the RPN value, it is used as a Top Event in the root cause analysis of risk (Basic Event) using the Fault Tree Analysis (FTA) method. The last step is to make a risk response plan for each critical risk so that it is expected to be able to plan preventive measures before the risk occurs. The proposed risk response planning can be considered by the Department of Logistics in responding to risks.

Lintukangas, Kahkonen, & Ritala, investigate the ability of companies to mitigate different types of supply risks associated with the implementation of green supply management by companies. Sheu (2008) examines factors such as operational risks caused by power plants and reverse logistics processes for model formulation [14]. Ramanathan in Senthil et al., (2018) shows that logistics performance and customer loyalty are influenced by product risk characteristics and efficiency [15]. Subramanian, N., & Rahman, (2014) analyze complex issues and appropriate strategies for supply chains and proposes alignment models to reduce complexity using material flow and contractual relationship strategies [16]. Cucuzzella (2016) highlights approaches to addressing sustainability and creating relationships with risk management. The goal of this study is to identify risks to operational factors in PT. XZY identifies and formulates existing handlers in PT. XZY related to risks to work operations [17].

2. Research Method

This study used the FMEA method. FMEA is a method used to perform analysis inductively, carried out repeatedly and systematically so that the process can be documented [18]. The document will be used as a basis for identifying failures or errors during the production process. In general, the FMEA method is used to analyze or identify various critical components regarding reliability and availability [19].

The FMEA (*Failure Mode and Effect Analysis*) method was used in this study to calculate the value of *Severity* (S), *Occurrence* (O), and *Detection* (D) to get RPN (*Risk Priority Number*). A good supply chain management system between business actors will make product products quality, minimize operational costs, reduce the production process, and limit things that do not have an important impact on the production process [20].

Data was obtained using direct observation and interviews with logistics workers. Data collection is used to identify the causes of operational risks that have the potential to hinder

work activities and the possible impacts of these risks. Furthermore, several potential failures were obtained that occurred during operations in the logistics department. These results relate to the impacts of the failure, the possibility that the failure was caused by what, and how to control the failure so that it does not happen again in the future.

Researchers also make questionnaire data related to the assessment of each logistic operational risk that will be filled out by logistics workers. From the results of filling out the questionnaire, the SOD value was obtained for each logistics operational risk. In more detail, the process of using the FMEA method is as follows (Seful Imam and Dessy Merry Nilasari Pakpahan, 2020) [21]:

1. Severity

   Severity is the first step of assessment to calculate the magnitude of the impact or event that affects the outcome and process. And the third step

2. Occurence
   Occurance is a possible chance of failure of the results and *processes*.

3. Detection
   Detection is an assessment of control performance to be able to provide information related to errors in the performance of a process.

4. RPN (Risk Priority Number)

   RPN *is defined* as a product obtained from his calculation by multiplying the degree of damage, prosecution, and detection in a process. RPN is used to obtain information about the priorities of thwartedness. The results of RPN are used to create a ranking order for failures in a potential product. With this, then the RPN formula is as follows (Qingyun Zhu, et al, 2020) [22]:

   RPN= Severity x occurrence x detection.

3. Findings

The results of this study were carried out by searching for information through interviews with logistics workers. The purpose of the interview is to find out the conditions and circumstances in the logistics department in carrying out work operations. So that the results of data on risky activities that have the potential to interfere with logistics operations were found. The determination of failure factors is carried out by comparison of various related literature. After obtaining various forms of failure, including internal, external, process, and human failures. These things are also related to risk indicators during logistic operations. The risk indicators included in logistics operations are as follows.

Table 1. Mode and effects of internal operational failures.

Failure Mode	***Failure Effect***	***Failure Cause***	***Current Control Prevention***
Logistics Facility Processing			
Limited storage	The accumulation of goods, both expenses, and inventory.	Because the warehouse space with dimensions is not too wide.	Arrangement neatly and orderly to maximize storage space.
Use of Logistics Technology			
Data input errors in the system	Fatal impact of data errors from parties	Inaccuracy in entering data consisting of many numbers.	Special time and special workers for data input to reduce the risk of errors.

Data is not saved or lost	No data record can be utilized for the next moment.	The occurrence of an error in the device used.	Routine maintenance on devices used by employees.
Delivery Report data is hampered by network	Communication errors occur from the logistics division to other divisions.	The network is disconnected or there is an interruption that results in information not being conveyed.	Selection of the network with the best quality to reduce the risk of signal interference.
Inventory Management			
Incompatibility of the amount of stock of inventory with the number of goods issued	Unable to determine the purchase of goods and unable to meet user requests	Error in the number of goods retrieved without writing data on the bin card.	In each item pick-up, it is always included to write the number of items on the bin card.
Stacking of goods Inventory in the warehouse	Running out of storage space for goods in the warehouse.	Purchase of goods that are not adjusted to the needs and stocks in the warehouse.	Inspection (checking) on the *Bin Card* regarding the amount of stock available in the warehouse.
Stock void *inventory*	Unable to meet user needs.	Delays in the process of purchasing goods.	Conduct planning and forecasting to meet the demand for goods by users.

Source: Analysis results (2022)

Table 2. External operational failure modes and effects

Failure Mode	***Failure Effect***	***Failure Cause***	***Current Control Prevention***
Relationship with *Suppliers*			
Price agreement negotiations not reached	Do not get a supplier according to the wishes that have been determined.	No agreement was reached between the two sides.	Selection of suppliers who are trusted and follow the wishes of the company.
Incompatibility of criteria for goods that the company wants	The goods cannot be used because the specs do not match.	The provisions of the criteria for goods differ between the company and the supplier.	The selection of order materials and specs of goods must be conveyed to the supplier.
Plan coming stuff that non-compliant	Delays in work due to unavailable goods.	The occurrence of obstacles during the delivery process.	Choose a trusted delivery party.
Shipping By Expedition			
Absence street mail	Difficulty checking the compatibility of MRIS with the goods shipped.	The expedition party is less concerned with the road mail for the suitability of the goods sent.	Require the expedition to bring a road letter when shipping things.

Failure Mode	***Failure Effect***	***Failure Cause***	***Current Control Prevention***
Late delivery of goods due to obstacles	Delays in work due to unavailable goods.	The occurrence of obstacles during the delivery process.	Choosing a shipping party that is already Trusted.

Source: Analysis results (2022)

Table 3. Mode and effects of process operation failures

Failure Mode	***Failure Effect***	***Failure Cause***	***Current Control Prevention***
Warehouse Surveillance			
Collection of goods that are not following the procedure	The occurrence of misinformation regarding the number of goods and stocks in the warehouse.	The absence of supervision and collection of goods carried out outside working hours.	Provide understanding to all employees regarding the procedures and SOPs for picking goods from the warehouse.

Source: Analysis results (2022)

Table 4. Mode and effects of human operational failure

Failure Mode	***Failure Effect***	***Failure Cause***	***Current Control Prevention***
Warehouse Party Relationship With *User*			
The occurrence of communication errors in *material* requests	The material could not be used and the company suffered losses.	Miss communication between users and warehouse employees.	Establish good communication during material demand.
Uneven distribution of tasks in warehouse management	Duties of the employee who is less *handleable* in full.	Duties of the employee who is less *fully* handleable.	The existence of divisions and limits on the duties of employees depends on ability.
HR Management			
Exist The relationship between warehouse party with *suppliers*	Opens the likelihood the occurrence of cheating	Profiteering yourself through Spending company.	Preventing relationships directly between suppliers with warehouse employees.
Negligence of employees in carrying out duties in the warehouse	The occurrence of work accidents.	Do not apply established occupational safety guidelines.	Implement safety guidelines for the safety of oneself and together.

Source: Analysis results (2022)

In addition, based on the results of the assessment or calculation of the RPN, the following results are obtained:

Table 5. Calculation of the internal failure RPN value

No	Processing of logistics facilities	*Severityy*	*Occurrence*	*Detection*	*RPN*
1	Limited storage	8	8	9	576
2	Laying of investors part of the chamber	9	9	9	729
3	Collection of goods outside the working hours of warehouse employees	3	3	7	63
No	**Use of Logistic Technology**	***Severity***	***Occurrence***	***Detection***	***RPN***
1	Input errors in the system	8	6	9	432
2	Data not stored/lost	9	3	8	216
3	Network interference	4	3	4	48
No	**Invetaris management**	***Severity***	***Occurrence***	***Detection***	***RPN***
1	The amount of stock that does not match the availability of goods with the number of outgoing goods	3	3	8	72
2	Stacking of goods in the warehouse	5	5	8	200
3	unavailabilities of goods	3	3	8	72

Source: Analysis results (2022)

Table 6. Calculation of the RPN value of failure from the outside

No	Relationship with Suppliers	*Severity*	*Occurrence*	*Detection*	RPN
1	Price agreement negotiations not reached	2	2	6	24
2	Non-conformity with the criteria for goods requested by the company	3	3	7	63
3	The planned arrival of inappropriate items	3	3	7	63
No	**Shipping using expeditions**	***Severity***	***Occurrence***	***Detection***	**RPN**
1	No street mail	3	3	5	45
2	Delays in delivery due to constraints	3	3	4	36

Source: Analysis results (2022)

Table 6 shows the SOD value and RPN value of each of the external failure sub-indicators.

Table 7. Process failure RPN calculation

No	Warehouse Surveillance	*Severity*	*Occurrence*	*Detection*	*RPN*
1	Picking up goods is not under the rules	4	4	6	96

Source: Analysis results (2022)

Table **7** shows the SOD value and RPN value of each process failure sub-indicator.

Table 8. Human failure RPN calculation

No	The relationship between the warehouse and the user	*Severity*	*Occurrence*	*Detection*	*RPN*
1	The presence of communication errors in the demand for goods	2	3	4	24
2	uneven distribution of tasks in warehouse management	3	2	3	18
No	**Human resource management**	***Severity***	***Occurrence***	***Detection***	***RPN***
1	There is a settlement between the warehouse and the provider	2	2	3	12
2	negligence of employees in working in warehouses	5	4	5	100

Source: Analysis results (2022)

Table 8 shows the SOD value and RPN value of each sub-indicator of *human* failure.

Table 9. Overall RPN value

No	Sub Indicators	Value of RPN
	Logistics facility management	
1	Limited storage	576
2	Laying of investors part of the chamber	729
3	Collection of goods outside the working hours of warehouse employees	63
	Use of Logistic Technology	
1	Input errors in the system	432
2	Data not stored/lost	216
3	Network interference	48
	Investors management	
1	The amount of stock that does not match the availability of goods with the number of outgoing goods	72
2	Stacking of goods in the warehouse	200
3	unavailability of goods	72
	Relationship with Suppliers	
1	Negotiation of price agreement not reached	24
2	non-conformity with the criteria for goods requested by the company	63
3	The planned arrival of inappropriate items	63
	Shipping using expeditions	
1	No street mail	45
2	Delays in delivery due to constraints	36
	Warehouse Surveillance	
1	Picking up goods is not following the rules	96
	The relationship between the warehouse and the user	
1	The presence of communication errors in the demand for goods	24
2	uneven distribution of tasks in warehouse management	18
	Human resource management	
1	There is a settlement between the warehouse and the provider	12
2	negligence of employees in working in warehouses	100

Source: Analysis results (2022)

Table 9 shows the *effects* that may occur in the logistics section caused by several failure modes during work operations. To avoid the number of *effects* that will occur, prevention must be carried out by employing improvement. This repair depends on the value

of the RPN score. The RPN results in the table above have several priority actions that must be taken, namely for failure mode in the form of limited *storage*, placing *spare part* inventory, not at the locator, data input errors in the system, data not stored or lost, and accumulation of *inventory* items in the warehouse.

The data above shows that there are several aspects with the highest RPN that should be improved immediately, namely in the management of logistics facilities and the use of logistics technology. The aspect of logistics facility management that occupies the highest RPN is the placement of inventory in the part of the space that is not appropriate or does not match the value of RPN 729 and storage space that is limited with a value of RPN 576. Meanwhile, in the aspect of using logistics technology, the RPN value was 432 in the aspect of input errors in the system.

On the other hand, there is a section with the lowest RPN value, namely in the human resource management sub-indicator, precisely the relationship point between the warehouse and the provider with a value of 12.

With this, the researcher advises PT XZY to make improvements even though it is done slowly, but it is important to prioritize improving the sub-indicator with the highest RPN value because the high RPN value indicates the type of defect that is as difficult as it occurs.

First, in the inventory laying section of the room. We recommend that PT XZY employees have an orderly inventory placement plan to facilitate the process of calculating goods or returning and picking up goods for use. Secondly, Limited space storage can be used to arrange items efficiently and effectively with a neat and effective spatial arrangement. If one day PT XZY has funds, they should be allocated to expand storage space such as adding building units or renovating rooms. Third, the quality of PT XZY employees should always be improved to have superior competence both in the use of technology and in inputting products in the system so that no misinformation harms the company.

The results of this study show that the FMEA method is quite effective for determining the damage or defect that occurs in PT XZY. This is in line with the research conducted by Seoul Imam and Dessy Merry Nilasari Pakpahan regarding the use of the FMEA method in research which shows the results that the failures that occur in the production process of folding carton packaging at PT Interact Corpindo are the lack of in-process QC human resources, lack of operator experience, and the incomprehension of operators in carrying out their respective duties and functions [23]. On the other hand, research conducted by Ling-Lang Tang, Shun-Hsing Chen, and Chia-Chen Lin also using FMEA show that attention and satisfaction with each item should be prioritized in the repair process because this failure occurs in the presence of disagreements between employees and internal customers. So that several things need to be immediately corrected or improved, namely regarding the damage to incoming goods and the incompatibility of the number of goods sent [24].

In addition, Tedi Dahniar and Adi Chandra provided research results that the RPN value processed in each defect produced some data that must be corrected in the repair process such as dirty total regulator bodies, loose nipple outlet threads, and so on [25] Not stopping here, Adek Suherman and Baby Jutika Cahyana through their research with the FMEA method, showed a value of 49.765% for the non-standard dimensions that cause failure or disability. This study also provides proposals to make various improvements, for example by installing an inverter on damaged HE liquid to improve product quality as required standards [26]. Finally, research conducted by Muhammad Zahidil Mukhtar, Moh Jufriyanto, and Yanuar Pandu Negoro stated that the highest RPN value in the aspect of defects in UD Lajamin regarding bag products is in the aspect of untidy stitches, the presence of torn bag fabrics and a variety of damaged bag accessories so that the performance of the bag is reduced. With this, it is known that various improvement steps are understood by business owners to improve the quality of the bags produced [27].

Some of the data above provide information that the FMEA method makes a fairly effective contribution to knowing the damage that occurs in the process in a company. Based on this, the researcher advised PT XZY to pay attention to the various effects that were then used as a basis for improvement to producing higher-quality products. In addition, researchers also believe that the use of FMEA and RPN methods can also be applied by other companies

to improve the quality of products to minimize defects. Researchers also hope that the results of this study can be used as a reference for researchers.

4. Conclusion

Based on the problem identification and fmea calculation results, 19 operational risks were obtained in the logistics department of PT. XZY and varying RPN values, with the smallest value being 12 and the largest value being 729. Thus, it is concluded that the 3 highest risks in operations that can hinder work activities are limited product storage, improper placement of spare parts, and input errors in the system. To minimize the defect, PT XZY can carry out several things including First, in the inventory laying section of the room. We recommend that PT XZY employees have an orderly inventory placement plan to facilitate the process of calculating goods or returning and picking up goods for use. Secondly, Limited space storage can be used to arrange items efficiently and effectively with a neat and effective spatial arrangement. If one day PT XZY has funds, they should be allocated to expand storage space such as adding building units or renovating rooms. Third, the quality of PT XZY employees should always be improved to have superior competence both in the use of technology and in inputting products in the system so that no misinformation harms the company.

With this, the researcher advises the managers of the company to analyze the existing effects carefully to determine the steps of the follow-up. In addition, researchers also hope that the results of this study can contribute thoughts to their research.

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