

Risk Analysis of the Fish Crackers Production Process Using FMEA and FTA Methods at CV. Tayamum K.A.M

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Article Information	ABSTRACT
Article History Received : February 03, 2025 Revised : March 01, 2025 Published : April 02, 2025 Keywords: <i>Failure Mode and Effect Analysis;</i> <i>Fault Tree Analysis;</i> <i>Defect;</i> <i>Fish Crackers;</i>	CV. Tayamum K.A.M is a small micro business that manages crackers made from various sea fish. During the production process, the company often faces problems. This research was conducted to evaluate the performance of the production process using FMEA and FTA methods. The results of the FMEA calculation used to determine the severity level, occurrence level, detection level which later obtained the highest RPN value which is a cracked product that is not up to cuil with a total RPN of 697, FTA analysis shows the root causes of errors such as not re-checking, improper drying time and poor air circulation. After knowing the results of the root cause of the problem, an improvement proposal is given, namely rechecking the machine before use, paying attention to weather conditions when drying, and adding enough ventilation holes or blowers.

INTRODUCTION

Quality is the positive and negative level of something, the degree, or level of quality of a product or service, quality is also a measure of satisfaction that is free from defects or failures that can meet consumer needs (Agustin & Wahyuni, 2023). The word quality has a very broad and different meaning so that the meaning of the word quality has a different context when it reaches consumers (Hidayat & Rochmoeljati, 2020). A product's quality is crucial to the business since it can serve as a valued signal of trust in the eyes of customers. (Revita, Suharto, & Izzudin, 2021). Quality here describes how the product has a plus from a company.

Quality control is a technique and planned activities or actions taken to achieve, maintain and improve a product or service's quality to ensure that it satisfies customer needs and meets established standards. The reason for quality control is to provide satisfaction to customers and reduce unnecessary costs (Supardi & Dharmanto, 2020). Quality control needs to be carried out so that the products offered are in accordance with consumer desires and are important in maintaining products in this industry competition (Revita, Suharto, & Izzudin, 2021). In addition, internal quality control also has a function as a way to reduce the economic value of production by reducing or minimizing defects or errors in products, so that the company does not lose time or production costs (Mukminin & Dahda, 2022).

Bunderan Village, Sidayu Subdistrict, Gresik Regency is known as one of the centers of fish crackers production in the region, which has natural resources in the form of abundant fish availability. CV. Tayamum K.A.M has great potential to be developed, but the quality of the

products produced needs to be improved, in practice there are still many problems related to the quality of fish crackers products caused by several defects caused by weather factors and lack of focus on running the machine. The traders try to make the quality of their products the best and most attractive to consumers (Sumiyati & Rohman, 2022).

Efforts to improve quality must be carried out thoroughly and continuously because the level of satisfaction of each consumer will continue to grow and certainly vary (Saifuddin & Aliyah, 2019). It can be seen that the problems of fish cracker products need to be improved to maintain the quality of fish cracker products at CV. Tayamum K.A.M. In this study, an approach using the Failure Mode and Effect Analysis (FMEA) and Fault Tree Analysis (FTA) methods was used. Failure Mode and Effect Analysis (FMEA) is an assessment method used to assess a system's dependability and ascertain the consequences of a system breakdown (Mahyar & Supryadi, 2020). Fault Tree Analysis (FTA) is a method of analyzing fault trees to identify risks that contribute to the occurrence of a failure (Muharrahmah, Adiinto, & Liansari, 2016).

RESEARCH METHODS

Data Collection Technique

The research conducted by the author is a qualitative description research, this research examines the cracker production industry. The data used is taken from the number of defective products in the company for 12 months, namely October 2023 to September 2024 as primary data. Secondary data sources include reviews of previous research. In the research conducted, the data collection technique used is direct research on the object of research by field observation to obtain information directly from the original source in the form of interviews and the results of these observations are used to collect data. The information collected is documents or archives related to the amount of production and the number of product defects. The data is analyzed using FMEA and FTA methods to determine the potential failure modes in the production process, the impact of these failures, the causes of these failures, how to detect them in the production process, and determine the severity, occurrence, detection, and nature of the root cause of failure assessment.

FMEA (Failure Mode and Effect Analysis)

This research uses the Failure Mode and Effect Analysis (FMEA) and Fault Tree Analysis (FTA) methods. FMEA is a method of evaluating the level of proficiency of a procedure to determine the consequences of the failure of the procedure. Any event that might cause a form (technique) to fail can be interpreted as a failure model (Pangestuti, Nastiti, & Husniaty, 2022). In the initial stage of this research, namely collecting data, the data obtained is production defect data for 12 months, starting from the October 2023-September 2024 period. To find possible failures, the first step is to give each failure a score between 1 and 10 depending on its occurrence, severity, and detection (Gautama & Marihot, 2021).

After obtaining the results of the value, it will produce an RPN value. Failure Mode and Effect Analysis (FMEA) such as knowing the job, job description, failure mode, calculating the Risk Priority Number (Severity x Occurrence x Detection) obtained the highest RPN (Wicaksono & Yamiti, 2022). In FMEA there is also a term called Risk Priority Number (RPN), to determine the RPN value, namely using the results of ranking scores on severity, occurrence, and detection (Waluny & Suhendar, 2023) ($RPN = S \times O \times D$). (1)

Severity (S)

This severity level can be established by calculating the extent of the damage that results from process failures in terms of plant operational activities and maintenance operations. (Adiyanto, Sutrisno, & Punuhsingon, 2017). This assessment is based on a severity value of 1 mild to 10 very severe.

Table 1. Severity

Rank	Criteria	Description
1	None	Customers will see no or insignificant adverse effects
2	Very little	Customer may experience slight disruption
3	A little	A minor deterioration in performance will irritate the customer.
4	Small	Customer dissatisfaction due to performance degradation
5	Medium	Customers are inconvenienced or their productivity is reduced sustained effect degradation
6	Severe	Repairs under warranty or serious issues with manufacture or assembly
7	High severity	Significant client discontent because of component failure
8	Very high severity	Extremely high degree of discontent because of the loss of functionality without compromising safety or legal requirements
9	Extreme severity	Customer risked because of negative consequences on the safe operation of the system with advance notice of malfunction or breach of legal requirements
10	Maximum severity	The customer was intimidated because of the negative consequences of dangerous systems operating without any previous notice of failure or legal infraction.

Occurrence (O)

Occurrence is an assessment with a certain level that refers to the frequency of defects in furniture products. The failure frequency value shows the frequency of a problem that occurs due to potential causes (Sari, Marpaung, Mellysa, & Handayani, 2018). This assessment is based on a frequency level value of 1 mild to 10 very severe.

Table 2. Occurrence

Rank	Description	Failure Rate
1	Likely to occur almost none	1 in 1,000,000
2	Chance of occurrence is rare	1 in 20,000
3	Very low likelihood of occurrence	1 in 4,000
4	Low likelihood of occurrence	1 in 1,000
5	Reasonably unlikely to occur	1 in 400
6	Quite likely to happen	1 in 80
7	Moderately high probability of happening	1 in 40
8	High likelihood of occurrence	1 in 20
9	Extremely likely to happen	1 in 8
10	extremely likely to occur	1 in 2

Detection (D)

Detection measures the capacity to prevent or manage potential failures. (Antony, 2018). This assessment is based on a frequency level value of 1 mild to 10 very severe.

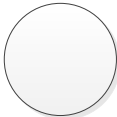
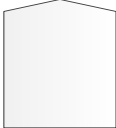
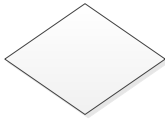
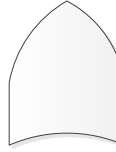
Table 3. Detection

Rank	Failure Rate	Description
1	1 in 1,000,000	Prevention methods are very effective, there is no chance of the cause reappears
2	1 in 20,000	Very low probability of occurrence
3	1 in 4,000	
4	1 in 1,000	Likelihood of occurrence is moderate, prevention methods can cause the problem to occur
5	1 in 400	
6	1 in 80	
7	1 in 40	Prevention strategies are less successful, and the likelihood of issues developing is still high.
8	1 in 20	
9	1 in 8	The likelihood of issues developing is extremely high, and preventative measures are ineffectual.
10	1 in 2	

FTA (Fault Tree Analysis)

Furthermore, the root cause of product failure or defect will be sought using the Fault Tree Analysis (FTA) method. FTA is a method that aims to analyze the failure of a system, the failure of a combination of several sub-systems and also component failures (Sidik, Andalia, & Tamalika, 2022). In making FTA, the top event is adjusted to the type of defect and in FTA using the and and or gate symbols (Yolanda, Ekawati, & Noya, 2023).

Table 4. Fault Tree Analysis Symbol

Symbol	Meaning	Symbol	Meaning
	Basic Event: A simple fault initiation that doesn't need optimization.		External Event: Event that is expected to occur
	Event Conditioning: Indicate circumstances that different logic gates can be subject to.		AND Gate: Manual error due to all problem inputs
	Undevelopment Event: An event that is no longer possible to be developed due to a lack of available information.		OR Gate: An error occurs due to one of the problem inputs

RESULTS AND DISCUSSION

Data Collection

In this study, data collection on fish cracker defects was carried out by interview and direct observation at CV. Tayamum K.A.M which is summarized in the form of a check sheet to make it easier to analyze defects.

Check Sheet

After conducting observations from October 2023 to September 2024, researchers were able to collect a list of various defect data. The product defect data for the period October 2023 to September 2024 is summarized below.

Table 5. Defect Check Sheet

Year	Month	Defect Type			Total	Percentage	Percentage Cumulative
		Crushed	Not Fluffy	Thick			
2023	October	250	225	215	690	8%	8%
	November	320	225	250	795	10%	18%
	December	355	200	215	770	9%	28%
	January	210	200	180	590	7%	35%
	February	285	210	150	645	8%	43%
2024	March	280	200	185	665	8%	51%
	April	225	190	200	615	8%	59%
	May	280	175	190	645	8%	67%
	June	250	165	180	595	7%	74%

July	285	180	150	615	8%	82%
August	300	255	210	765	9%	91%
September	300	250	180	730	9%	100%
Total	3340	2475	2305	8120	100%	

Data Processing

Calculation of RPN Value Using FMEA Method

After calculating the RPN (Risk Priority Number) value of each failure mode, the largest to smallest the value of RPN (Risk Priority Number) is sorted (Saleh & Fitria, 2021).

Table 6. RPN Value Calculation

Failure Type	Potential Effects Of Failure	Factor	Potential Causes Of Failure	S	O	D	RPN	Total RPN
Crack	Product Cracks Not To The Point Of Fracture	Machine	Drying machine heat is uneven	4	6	5	120	697
			Less fine grinding	6	4	4	96	
		Methods	Drying too fast or too late	7	5	6	210	
			Uneven mixing of dough	6	4	4	96	
Not Fluffy	Hard And Non-Crispy Texture Defect	Environment	Uncontrolled room temperature	5	7	5	175	555
		Machine	Drying oven heat is uneven	5	6	5	150	
			Unstable frying temperature	7	3	3	63	
		Man	Errors in setting the drying and frying time	6	3	5	90	
			Incomplete drying process	5	6	6	180	
		Methods	Uneven mixing of raw materials	6	4	3	72	
Thick	Non-Uniform Thickness Defect	Methods	Inconsistent pressure on the cutting machine	6	6	5	180	518
			Errors in operating the cracker cutting machine	4	4	4	64	
		Machine	Dough slicing machine not functioning properly	6	5	3	90	
			Inappropriate machine settings	7	4	3	84	
		Man	Workers are not careful in the process of cutting crackers	5	5	4	100	

From the results of the table 6 it can be seen that the error with the highest RPN and has the greatest risk is due to cracks that are not cuil with an RPN value of 697. The next fault is the hard and not crispy texture defect with an RPN value of 555. The last error is the non-uniform thickness defect with an RPN value of 518. The highest RPN value must be prioritized first, so that operations in this business are not disrupted.

FTA (Failure Tree Analysis)

The next step is to use common logic symbols to generate a fault tree that describes the reasons behind defect issues as a tree diagram (Mayangsari, Adiinto, & Yuniati, 2015).

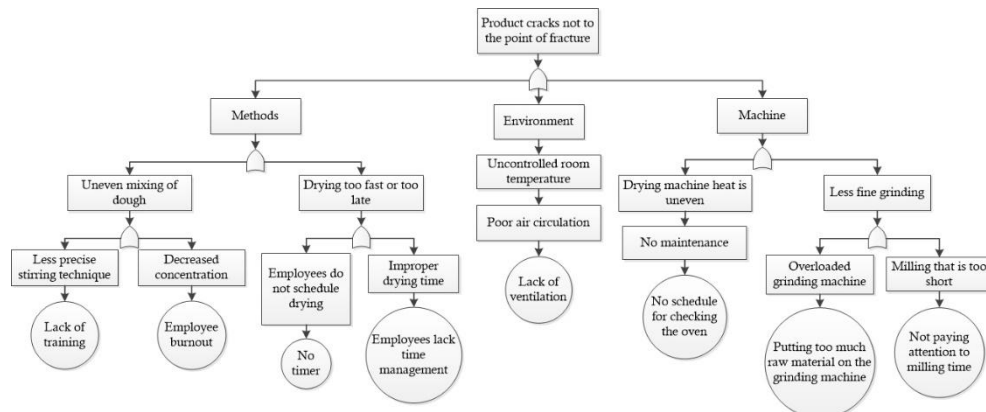


Figure 1. Product Cracks Not To The Point Of Fracture

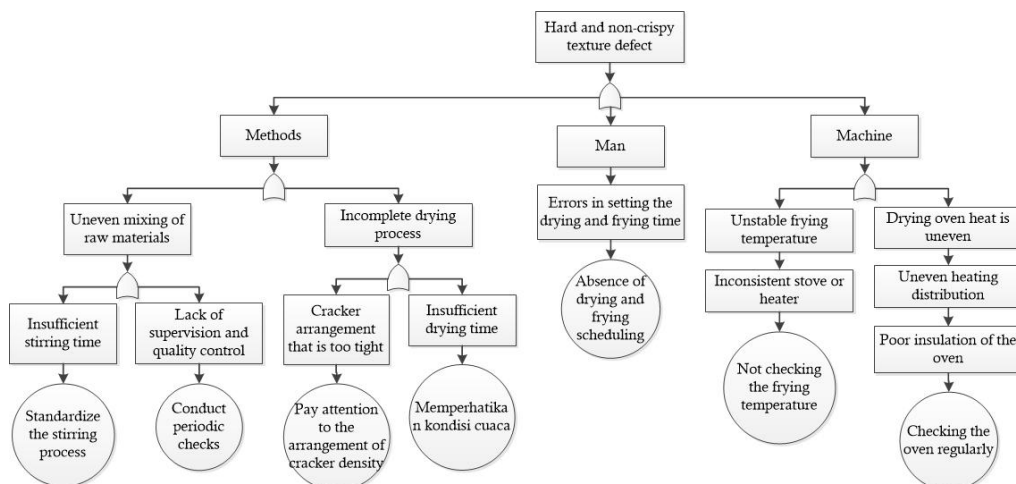


Figure 2. Hard And Non-Crispy Texture Defect

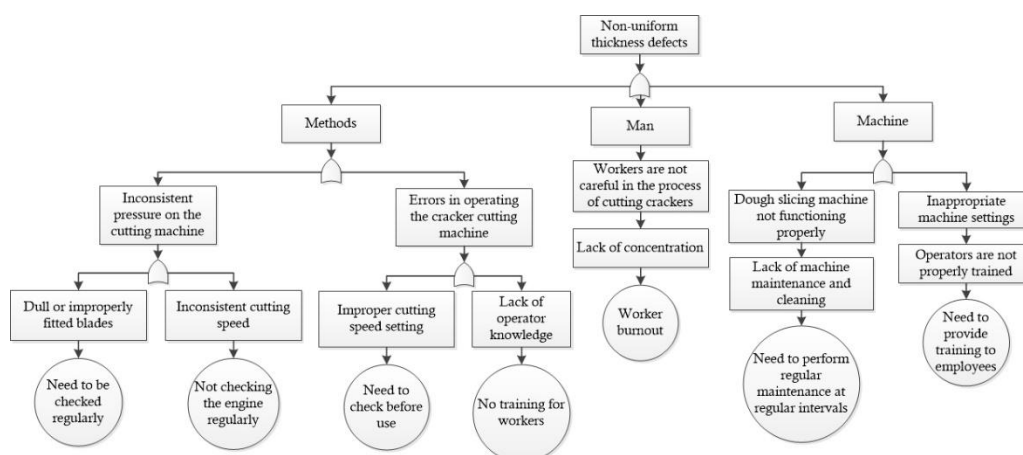


Figure 3. Non-Uniform Thickness Defect

The results of figures 1, 2, 3 above show that each product defect has its own cause. The FTA explains from the top event of the type of product defect cracking not to cuil, hard and not crispy texture defects, non-uniform thickness defects to the root cause or basic event. After knowing all the root causes, the next step is to make recommendations for enhancements to defects that have the highest RPN value.

Proposed Improvements

This stage suggests fixes for all potential failure kinds (Farrizqi & Andesta, 2024). The following are suggestions for improvements that can be made by UD. Tayamum K.A.M to prioritize improvements to the types of failures that arise due to FMEA identification, the highest RPN value, and FTA. Proposed improvements made to the highest RPN value with the aim of reducing the impact that may occur are as follows:

Table 7. Proposed Improvements

Failure Type	Causes Of Failure	Proposed Improvements
Product Cracks Not To The Point Of Fracture	Machine	No maintenance
		No schedule for checking the oven
		Putting too much raw material on the grinding machine
	Methods	Milling that is too short
		Not paying attention to milling time
		Provide training on proper stirring techniques
		Provide adequate rest time
	Environment	Make a drying schedule
		Pay attention to weather conditions when drying
	Environment	Addition of sufficient ventilation holes or blowers

From the results of table 7, it is known that defects in cracked products that are not up to cuil are caused by several factors including machines, methods, environment. From these problem factors, the following improvement proposals are made, namely, rechecking before use, performing regular maintenance, grinding in stages and carrying out routine maintenance, evaluating the grinding process, providing training on proper stirring techniques, providing sufficient rest time, making a drying schedule, paying attention to weather conditions when drying, and adding enough ventilation holes or blowers.

Research Implications

Consistent quality, such as crispy texture, appropriate flavor, and attractive appearance, will make fish crackers more favorable to customers, increase customer loyalty, and strengthen the producer's market position. High quality standards can open the door to export markets or premium markets. The results of this study encourage further research on food product development focusing on sensory quality, which is an important factor in customer satisfaction. Fish cracker manufacturers can reduce product defects, such as burnt, cracked, or less crispy crackers, by using better quality control methods. This will reduce the waste of raw materials and energy, improving the efficiency of the production process. In addition, ideal quality control can reduce expired product losses and extend product shelf life. The results of this study can be used as a reference for optimizing production parameters in other food products involving similar processes, such as frying or drying, to reduce the amount of waste generated.

CONCLUSION

The conclusions that can be drawn in research at CV. Tayamum K.A.M, namely there are 3 defects, namely cracked products that are not cuil, hard and non-crispy texture defects, and non-uniform thickness defects. Following that, the object of study is given questionnaires to complete

in order to carry out FMEA identification. The next process is the calculation of the RPN value, from outcomes of these computations, the maximum RPN value is obtained in cracked products that are not until cuil with a total RPN value of 697. The next process is the identification of FTA and produces basic events from the highest total RPN value of the cause of this type of failure, it can be seen that the machine, method, and environment are input factors that cause failure.

After the results are known, the proposed improvements to the machine factor are to recheck before use, perform regular maintenance, perform grinding in stages and carry out routine maintenance, evaluate the grinding process, for the method factor is to provide training on proper stirring techniques, provide sufficient rest time, make a drying schedule, pay attention to weather conditions when drying, and for environmental factors is the addition of sufficient ventilation holes or blowers.

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