



Minimizing Waste in The Bread Production Process with The Waste Assessment Model and Failure Modes and Effect Analysis (FMEA) Method

Rizki Laturrahmi¹, Edy Fradinata², Husni³

Universitas Syiah Kuala, Indonesia

Email: rizkilaturrahmi@gmail.com¹

ABSTRACT

The achievement of production targets is a key goal for every company. To achieve these targets, it is crucial to enhance efficiency and minimize waste, such as defective products, unnecessary movements, overproduction, and excessive production time. This study aims to identify the types and amounts of waste, analyze the most dominant waste, and compare waste across three similar companies. The identification of waste was conducted using the WAM method across the three companies, revealing five major waste types with the highest percentages: Defect waste (23.489%, 21.144%, and 20.949%), Inventory waste (20.489%, 15.616%, and 18.694%), Overproduction waste (15.749%, 15.480%, and 15.391%), Waiting waste (9.382%, 12.651%, and 13.209%), and Motion waste (13.850%, 11.299%, and 10.739%). The analysis of waste causes used the Failure Mode and Effects Analysis (FMEA) method, where the highest Risk Priority Number (RPN) of 576 was associated with defective products. Recommendations to address this issue include periodic maintenance of oven machines, structured production scheduling, provision of material handling tools, and improvements in the production layout. The most dominant waste across the three companies was Defect waste, with Sarigut Bakery having the highest percentage of waste (23.489%), followed by Nafisah Bakery (21.144%) and Istana Bakery (20.949%). This study highlights the importance of addressing waste to improve production efficiency and achieve production targets.

Keywords: Minimizing Seven Waste, Bread Production, Waste Assessment Model (WAM), Failure Mode and Effects Analysis (FMEA).

INTRODUCTION

The achievement of production targets is something that every company expects. Because with the achievement of the production target, it can be assessed that the company's performance is very good (Najib & Wibowo, 2024; Ramadhan et al., 2019). Efforts that can be made to achieve production targets are by increasing the level of efficiency and minimizing waste such as defective products, minimizing movements that do not generate added value, excessive production and the most efficient production time possible in the production process (Pradana & Indiyanto, 2024).

Home Industry Sarigut Bakery Banda Aceh City which is located on the street. Bilal 1 Punge Balang Cut, Jaya Baru District, Banda Aceh City is one of the bread-making industries in Banda Aceh City that produces various kinds of bread such as coconut bread, meses bread, peeled white bread and burger bread, as well as the company Nafisah Bakery Banda Aceh City which is located on Jalan Sultan Iskandar Muda, Punge Blang Cut, Jaya Baru District where similar companies are engaged in the bakery industry with various kinds of bread such as coconut bread, meses bread, peeled white bread and burger buns. In addition to the two bakery companies, a similar company, namely the Bakery Palace located on Jalan Blang Pulo, Panggong village, Johan Pahlawan District, West Aceh Regency, where the bread making company with various kinds of bread such as coconut bread, meses bread, peeled white bread and burger bread (Irawan & Fitriani, 2022; Puspitaloka & Ekawati, 2023; Sharma et al., 2015).

The problems that are often experienced by the three companies are not much different where the company often cannot achieve the production targets that have been set, which causes the company to not be able to optimize the profits that should be obtained by the company (AFSSAAE, 2022; team, 2023; Zisopoulos & Blonk, 2016).

Based on data from the three bread production companies for 4 years, the production target was not achieved, where from 2020 to 2023 the average production target for 4 years for the Sarigut Bakery company reached 514,061 packs, for the Nafisah Bakery company the average reached 480,000 packs and the average achievement of 450,000 for Istana Bakery, this is far from the target set by the three companies, So it can be concluded that for 4 years for the three companies, the production target is not optimal (Buathong & Singhakowinta, 2003; Di Nunzio et al., 2020; Elizabeth, 2024b).

The company's target is not achieved due to high customer expectations, pressure to produce more, and tight deadlines and inefficient labor and waste during the production process such as too many defective products produced that cause a decrease in efficiency and non-achievement of production targets (Puspitaloka & Ekawati, 2023; Putri et al., 2023).

Efforts to reduce the occurrence of waste, one of which is the waste of defective products that result in production targets not being achieved, namely by using the Waste Assessment Model (WAM) method where this method aims to explain the definition of 7 existing wastes such as overproduction, waiting, transportation, unnecessary inventory, inappropriate processing, defects and unnecessary motion (Rahmanitya, 2019; Zorzenon et al., 2022). A criterion is created to determine the relationship between each waste, and then there is also the creation of a matrix for waste that groups based on the strength of each relationship of the existing waste using a scale from the smallest to the largest relationship between waste. After that, the waste assessment questionnaire tools are used, this aims to get the highest waste from the combination of the relationship matrix and the assessment questionnaire This Waste Assessment Model has Seven Waste Relationship (SWR), Waste Relationship Matrix (WRM) and Waste Assessment Questionnaire (WAQ), then analyzed and improved with the Failure Mode Effect Analysis (FMEA) method starting by analyzing the failure factors or roots problems that occur in the production process (Carnero, 2020; Elizabeth, 2024a).

The goal to be achieved in this study is to determine the amount of waste in the bread production area using the Waste Assessment Model (WAM) method (Laturrahmi, 2025; Suhardi et al., 2020). Analyze the most dominant waste and find the factors that cause waste with the FMEA method, and compare waste from the three similar companies so that it can minimize waste that occurs in the production process of Bread Home Bakery Industry.

Previous research by Cobalea et al.,(2019) explored the impact of waste minimization techniques in food production industries, focusing on identifying and reducing defects and inefficiencies using lean methodologies. Their study, which applied the Waste Assessment Model (WAM), demonstrated how waste reduction could optimize production processes and improve profit margins in the bakery sector. In another study, Patel & Shah (2021) examined waste reduction in the bakery industry, applying the FMEA method to identify the root causes of defects and inefficiencies in production lines. Their findings highlighted significant waste due to defects and suggested several operational changes for improved efficiency. This research builds on those studies by specifically focusing on three bakery companies in Banda Aceh City and analyzing the types of waste in the bread production process using the WAM method, combined with the FMEA method to identify and minimize defects. The novelty of this study lies in comparing the waste levels across three similar companies and offering tailored solutions to address inefficiencies, ultimately aiming to optimize production and meet targets.

The objective of this study is to identify the types of waste in the production processes of three bakery companies in Banda Aceh using the Waste Assessment Model (WAM) and

analyze the dominant waste types. The benefits of this research include providing a framework for waste reduction in the bakery industry, optimizing production processes, and enhancing profitability by improving efficiency and minimizing unnecessary waste.

RESEARCH METHODS

This research follows a descriptive approach aimed at systematically and factually explaining the solutions to existing problems based on the data collected. The study was conducted across three similar home bread processing companies located in Banda Aceh City and West Aceh Regency: UD. Sarigut Bakery in Jaya Baru District, UD. Nafisah Bakery in Punge Blang Cut, and Istana Bakery in Panggong Village, Johan Pahlawan District. The research was carried out over six months, focusing on identifying, analyzing, and minimizing waste in the bread production process. To achieve the objectives, various instruments were employed, including the Seven Waste Relationship (SWR) to identify the interrelations between different waste types, the Waste Relationship Matrix to measure the influence between wastes, and the Waste Assessment Questionnaire (WAQ) to assess waste levels in the production process. In addition, a stopwatch and measuring tape were used to monitor production times and layout dimensions.

Data for the research was collected from both primary and secondary sources. Primary data was obtained through direct observation and field research, focusing on material flow and questionnaire responses from company leaders and operators. Secondary data, which included production data, product type details, production layouts, and the number of operators, were gathered from company records. The data processing involved several stages, including waste identification using WAM questionnaires, weighting waste based on the Seven Waste Relationship, and calculating waste ratings using the WAQ method. The Failure Mode Effect Analysis (FMEA) was employed to analyze the causes of waste and determine the highest Risk Priority Number (RPN). Ultimately, this research aimed to provide actionable recommendations to reduce waste and optimize production in the bakery industry.

RESULTS AND DISCUSSION

A. Determination of the *Waste Relationship Matrix*

Based on the results of the calculation of waste linkage, the next step is to create a matrix of linkage between waste as shown in appendix 3. After the matrix of inter-waste relationships is obtained as stated in attachment 3, the next step is to convert each letter back so that each letter becomes a number with values A=10, E=8, I=6, O=4, U=2 and X=0, after being converted into a number, the next step is to determine the percentage score for each column and row as for the method of calculating the percentage as follows:

$$\text{Total Score Nilai O} = \frac{36}{248} \times 100 = 14,52\%$$

Based on the calculation method above, in the same way the overall results of the calculation can be seen in appendix 4. Meanwhile, the result of the percentage value of the matrix of the relationship between waste where the highest value of the seven types of waste for the percentage from the three bakery companies is for the Sarigut Bakery company on waiting with a percentage of 19.35%, for the Nafisah Bakery company the highest value of the seven types of waste, namely waiting with a percentage of 16.22% and for the Istana Bakery company, the highest value of the seven types of waste, namely waiting with a percentage of 17.93% while for the percentage to the highest value of the three companies for the Sarigut Bakery company, namely in inappropriate processing (P) with a percentage of 18.55%, for the percentage to the highest value in the Nafisah Bakery company, namely in defect (D) with a percentage of 18.92 and for the percentage to the highest value in the Istana Bakery company, namely in defect (D) with a percentage of 17.93 for more clarity

the percentage from from the seven types of waste to the The three bakery companies can be seen in Figure 1.

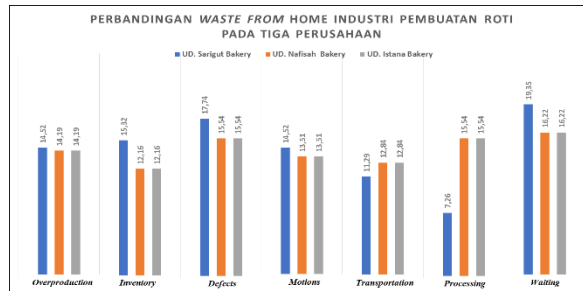


Figure 1. Percentage of From to Seven Waste at Sarigut Bakery, Nafisah Bakery and Istana Bakery

Based on Figure 1, the percentage from results for the value of the relationship matrix of the seven types of waste for the three companies, namely Sarigut Bakery, which is 19.35%, the percentage from for the value of the relationship matrix of the seven types of waste for the Nafisah Bakery company, which is 16.22% and the result of the percentage from for the value of the relationship matrix of the seven types of waste for the Istana Bakery company, which is 17.93%, while for the percentage of To from to seven waste from the three companies for more details, see Figure 2.

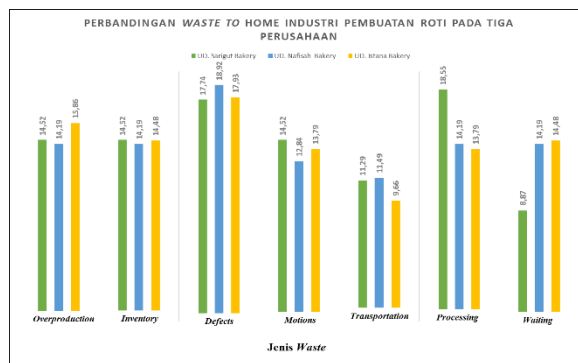


Figure 2. Percentage of To from Seven Waste at Sarigut Bakery

Based on Figure 2. above, the percentage to result for the highest linkage matrix value of the seven types of waste in the Sarigut Bakery company, namely in the type of waste Inappropriate Processing with a percentage of 18.55%, for the value of the highest linkage matrix of the seven types of waste in the Nafisah Bakery company, namely in the type of waste Defects with a percentage of 18.92% and the highest linkage matrix of the seven types of waste in the Istana Bakery company, namely in the type of waste defect with a percentage level of 17.93%.

B. Waste Assesment Questionnaire

The waste value obtained from the Waste Relationship Matrix (WRM) is then used for the initial assessment of WAQ based on the type of question. This assessment questionnaire consists of 68 different questions. The results of the WAQ questionnaire had the largest value in the Sarigut bakery company, namely in waste from defects and from waiting with the same average answer of 0.85, for the largest WAQ value in the Nafisah Bakery company, namely in waste to waiting with an average answer of 0.90 and for the largest WAQ value in the Istana Bakery company, namely in waste from process with an average answer of 0.90. The next step is the results of the average answers of respondents

to the three bread making companies above, so it can be grouped into the types of questions as in Table 1.

Table 1. Grouping Question Types on Three Bakery Companies

No	Question Type	Total Ni
1	To Motion	9
2	From Motion	11
3	From Defects	8
4	To Defects	4
5	From Process	7
6	To Waiting	4
7	From Waiting	9
8	From Inventory	6
9	From Transportation	4
10	To Transportation	3
11	From Overproduction	3
Total		68

Based on Table 1 above, to calculate the total Ni, namely by grouping the types of questions, for the three companies after grouping the types of questions there are 9 types of To Motion question groups which means there is a total of 9 Ni, the next step is to calculate the Waste Relationship Matrix (WRM).

C. Waste factor

Calculate the value of the final waste factor (Y_j final) by entering the probability factor of the influence between types of waste (P_j) based on the total "from" and "To" in the WRM. Then present the final form of waste factor obtained so that the level rating of each waste from the three bakery companies can be known. Based on the most dominant waste results of the three companies, the types of waste from the three companies can be seen in Figure 3.

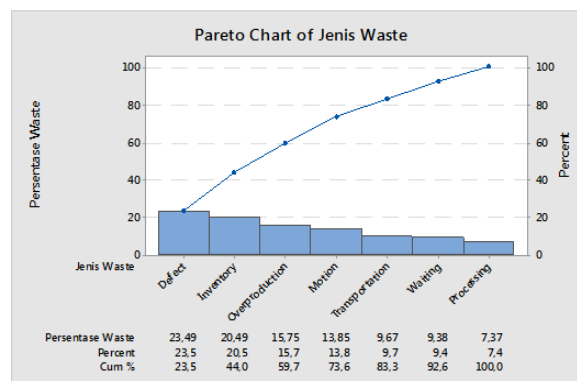


Figure 3. Pareto Diagram of Waste Assessment Model Results at Sarigut Bakery Company

Based on Figure 3. Above, the dominant waste results were obtained with the largest percentage weight being in Defect waste with a percentage of 23.49%, the second largest waste, namely in the Inventory waste type with a percentage of 20.49%, the third largest waste, namely in the type of waste Overproduction with a percentage of 15.75%, the fourth largest waste, namely in the type of waste Motions with a percentage of 13.85%, The fifth largest waste is in the type of waste Transportation with a percentage of 9.67%, the sixth is in the type of waste Processing with a percentage of 9.38% and the smallest is in the type of waste Waiting, with a percentage of 7.37%. As for the pareto diagram of the waste assessment model results at Nafisah Bakery Company, it can be seen in Figure 4.

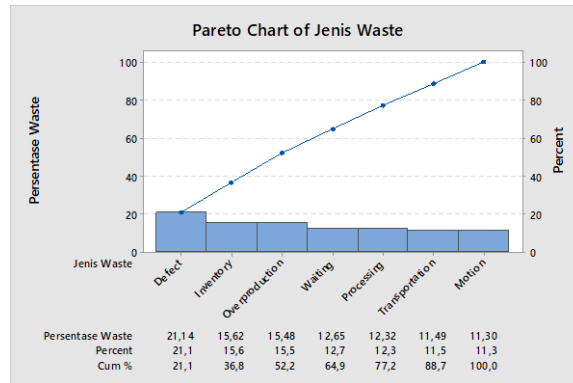


Figure 4. Pareto Chart of Waste Assessment Model Results at Nafisah Bakery Company

Based on Figure 4 above, the dominant waste results are obtained with the largest percentage weight being in Defect waste with a percentage of 21.144%, the second largest waste, namely in the Inventory waste type with a percentage of 15.616%, the third largest waste, namely in the Overproduction waste type with a percentage of 15.480%, the fourth largest waste, namely in the Waiting waste type, with a percentage of 12.651%, the fifth largest waste is in the type of waste Processing with a percentage of 12.317%, the sixth is in the type of waste Transportation with a percentage of 11.493% and the smallest is in the type of waste Motions with a percentage of 11.299%. As for the pareto diagram of the waste assessment model results at the Istana Bakery Company, it can be seen in Figure 5.

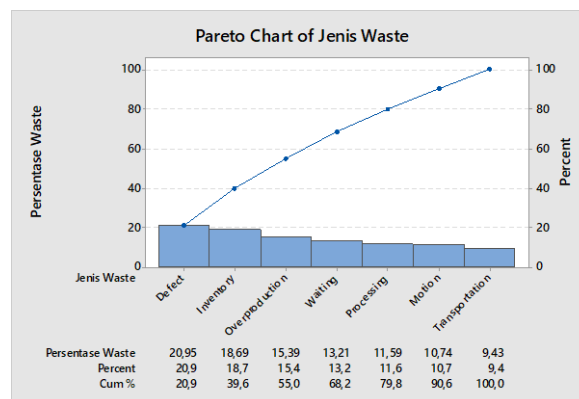


Figure 5. Pareto Diagram of Waste Assessment Model Results at Istana Bakery Company

Based on Figure 5 above, the dominant waste results are obtained with the largest percentage weight being in Defect waste with a percentage of 20.949%, the second largest waste, namely in the Inventory waste type with a percentage of 18.694%, the third largest waste, namely in the Overproduction waste type with a percentage of 15.391%, The fourth largest waste is in the type of waste waiting with a percentage of 13.209%, the fifth largest waste is in the type of waste Processing with a percentage of 11.586%, the sixth largest waste is in the type of waste Motions with a percentage of 10.739%, the smallest waste or the seventh is in the type of waste Transportation with a percentage of 9.433%.

D. Calculation using the Failure Mode Effect Analysis (FMEA) Method

After identifying waste with the Waste Assessment Model (WAM) method in the production area of bread making in the three companies. The following is a weighting for each severity (S), occurrence (O) and detection (D) values of waste that has the highest percentage, namely Defect, Inventory, Overproduction, Waiting and Motion waste to

calculate the RPN (Risk Priority Number) value which aims to determine repair priorities and provide recommendations in the Failure Mode and Effect Analysis (FMEA) analysis for the three bakery companies.

The analysis process with the Failure Mode Effect Analysis (FMEA) Method began by analyzing the failure factors in the production process obtained from interviews with owners and operators in the three bakery companies in the production section. The purpose of the implementation of FMEA is to prevent problems from occurring in the production process of bread making. The results of the calculation of RPN (risk priority number) using the FMEA method through the results of multiplication between rating severity (S), occurrence (O) and detection (D) to determine priority in recommendations for corrective actions. Based on the calculation of RPN (Risk Priority Number) for more information, you can see Table 2. next:

Table 2. Calculation with Meethod Failure Mode Effect Analysis

Failure Category	Failure Mode	S	O	D	RPN	Improvement Suggestion
Defects	Burnt due to oven temperature too high	8	9	8	576	Oven maintenance
Defects	Undercooked due to low oven temperature	7	8	6	336	Oven maintenance
Defects	Operator fatigue due to high production load	6	7	6	252	Add more workers
Defects	Operator inaccuracy during dough process	8	7	6	336	Operator recheck before process
Defects	Poor quality of raw materials	8	9	6	432	Raw material quality control
Defects	Misaligned bread slices due to position error	7	9	6	378	Slicing process inspection
Inventory	Wastage in raw material stock	7	9	5	315	Provide material handling
Inventory	Overstocking of flour to ensure continuous production	6	4	3	72	Proper production scheduling
Inventory	Overstocked raw materials exceeding capacity	8	9	6	540	Proper production scheduling
Overproduction	Overproduction leading to unsold stock	7	8	8	448	Match production to demand
Overproduction	Production before order is placed	6	5	7	210	Adjust production and customer orders
Waiting	Machine breakdown causing production delays	9	7	7	441	Regular machine maintenance
Waiting	Overstocking affects waiting time for processing	7	7	6	249	Proper production scheduling
Waiting	Improper layout causing process delay	7	6	5	210	Propose layout improvement
Motion	Irregular working methods	5	5	5	175	Propose layout improvement
Motion	Messy workplace	6	7	7	294	Propose layout improvement
Motion	Poor workstation layout	7	8	7	280	Propose layout improvement
Motion	Unorganized raw materials	8	6	7	336	Propose layout improvement
Motion	Process not yet completed moved to next station	8	9	6	432	Mechanism adjustment

Based on Table 2 above, it can be known the root of the problem of the three bread making companies that dominate from 7 (seven) waste, namely due to waste defects, this is evidenced by the highest RPN value, which is 576 with the problem being a defect factor where the problem of charred bread is caused by too high oven temperature, the second highest RPN value is 540, namely in the problem of storing raw materials in the warehouse that exceeds the capacity, namely in waste Inventory, for the third highest RPN value, namely in the problem of overproduction so that there is a buildup of unsold products in waste overproduction with a value of 448, for the fourth highest RPN value with the problem

of production machinery suddenly experiencing damage can cause the production process to stop to wait for machine repairs, namely waste waiting with an RPN value of 441, while the fourth highest RPN value is in the problem of the process of making bread or products still exists manually with an RPN value of 432.

E. Proposed Improvements

Based on the results of the analysis using *the Failure Mode and Effect Analysis* (FMEA) method which is seen based on the highest RPN value, the recommendations for improvement for the three bakery companies will be carried out as follows:

- a. Repair of defective products where the bread is burnt due to the oven temperature is too high to reduce the occurrence of defects in the production process of bread making, then the recommendation given is to maintain the oven machine on a scheduled basis so that the problem of unstable oven machine temperature can be repaired.
- b. Inventory improvement in the storage of raw materials in the warehouse that exceeds the capacity, namely to reduce the accumulation of raw materials in the warehouse, it is necessary to mechanize material *handling* equipment and schedule production that is structured in the production process.
- c. Improvements to overproduction or accumulation of products that are not sold out are the need to estimate the products that must be produced so that there is no overproduction (Production Scheduling).
- d. Improvements to *Waiting* (waiting time) Where production machines that suddenly experience damage can cause a halt to the production process, so it is recommended to maintain machines regularly and clean production machines after use in order to reduce the occurrence of machine damage.
- e. Improvements to ineffective layouts recommended improvements to reduce the occurrence of waiting times are to provide production *layout* proposals.

Discussion

The results of the weighting score of seven waste relationships above the conversion value results from the data in Table 1-3. previously, the total weighting score of seven largest waste was obtained in the Sarigut Bakery company in relation to waste transport and waiting (T_W) with a total SWR score of 18, for the Nafisah Bakery company the relationship between waste defect and waiting (D_W) and transportastion and waiting (T_W) with a total SWR score of 17 and for the Istana Bakery company the relationship between waste motion and processing (M_P) and transportastion and waiting (T_W) with The total SWR score is the same which is 16.

The result of the percentage value of the matrix between waste where the highest value of the seven types of waste for the percentage from the three bakery companies is for the Sarigut Bakery company on waiting with a percentage of 19.35%, for the Nafisah Bakery company the highest value of the seven types of waste, namely waiting with a percentage of 16.22% and for the Istana Bakery company, the highest value of the seven types of waste, namely waiting with a percentage of 17.93% while for the highest percentage to value of the three companies for the Sarigut Bakery company, namely in inappropriate processing (P) with a percentage of 18.55%, for the highest percentage to value in the Nafisah Bakery company, namely in defect (D) with a percentage of 18.92 and for the highest percentage to value in the Istana Bakery company, namely in defect (D) with a percentage of 17.93, while the percentage result to for the highest linkage matrix value of the seven types of waste in the Sarigut Bakery company, namely in the type of Inappropriate Processing waste with a percentage of 18.55%, for the value of the highest linkage matrix of the seven types of waste in the Nafisah Bakery company,

namely in the type of waste Defects with a percentage of 18.92% and the highest linkage matrix of the seven types of waste in the Istana Bakery company, namely in the type of waste Defect with The percentage rate is 17.93%.

The results of the WAQ questionnaire recapitulation where the respondents' answers were converted into weights according to the answers of each of the respondents on 68 questions according to the WAQ questionnaire standards, the largest value in the Sarigut bakery company was in the waste from defects and from waiting with the same average answer of 0.85, for the largest WAQ value in the Nafisah Bakery company, namely in the waste to waiting with an average answer of 0.90 and for the largest WAQ value in the Palace company Bakery is on waste from process with an average answer of 0.90.

As for the most dominant waste results of the three companies, the type of waste defect where of the three companies for the highest waste is in the Sarigut Bakery company with a waste defect percentage of 23.489%, the second is in the Nafisah Bakery company with a waste defect percentage of 21,144 and the lowest waste percentage, namely in the Istana Bakeri company with a waste defect percentage of 20.949%.

The results of the analysis using the Failure Mode Effect Analysis (FMEA) method are known that the root of the problem of the three bread manufacturing companies which dominate of 7 (seven) waste, namely due to waste defects, this is evidenced by the highest RPN value which is 576 with the problem being a defect factor where the problem of burnt bread is caused by too high oven temperature, the second highest RPN value is 540, namely in the problem of storing raw materials in the warehouse which exceeds capacity, namely in the waste inventory, for the third highest RPN value, namely in the problem of overproduction so that there is a buildup of products that are not sold out in waste overproduction with a value of 448, for the fourth highest RPN value with the problem of production machinery suddenly experiencing damage can cause the production process to stop to wait for machine repairs, namely waste waiting with an RPN value of 441, while the fourth highest RPN value is in the problem of the process of making bread or products still exists manually with an RPN value of 432.

CONCLUSION

After conducting discussions, several conclusions were obtained that the results of the identification of waste using the WAM method from three companies showed five types of waste with the highest percentage, namely Defect of 23.489%, 21.144%, and 20.949%, Inventory of 20.489%, 15.616%, and 18.694%, Overproduction of 15.749%, 15.480%, and 15.391%, Waiting of 9.382%, 12.651%, and 13.209%, and Motion of 13.850%, 11.299%, and 10.739%; to minimize waste, an analysis was carried out using the FMEA method which showed the defect factor with the highest RPN value of 576, so improvements were proposed in the form of periodic maintenance of oven machines, structured production scheduling, provision of material handling tools, and improvements to production layouts to facilitate workflow; the results of the comparison show that waste defect is the most dominant in the three companies with Sarigut Bakery having the highest percentage of 23.489%, followed by Nafisah Bakery 21.144%, and Istana Bakeri 20.949%; The suggestions submitted include that the three bakery companies should routinely carry out machine maintenance to reduce defective products, pay attention to the production layout to be more efficient and understand the concept of 7 waste to avoid losses, and for further research, it is recommended to use other lean manufacturing methods that are more detailed to improve the identification of waste in the future.

REFERENCES

- AFSSAAE. (2022). *Improved FMEA for sustainable risk management in the agri-food industry sector: A mini-review*. afssaae.ub.ac.id
- Buathong, A., & Singhakowinta, A. (2003). Reduction of production loss in production process by using failure modes/effects analysis (FMEA) technique. *Journal of Science Technology and Humanities*, 1(2), 1–15. teknomekanik.ppj.unp.ac.id
- Carnero, M. C. (2020). Waste segregation FMEA model integrating intuitionistic fuzzy set and the PAPRIKA method. *Mathematics*, 8(8). <https://doi.org/10.3390/math8081375>
- Cobalea, H. B., Oribe Garcia, I., Vargas Viedma, M. V., & others. (2019). New methodology for facilitating the food wastage quantification: Identifying gaps and data inconsistencies. *arXiv preprint*. arxiv.org
- Di Nunzio, M., Picone, G., Pasini, F., & others. (2020). Olive oil by-product as functional ingredient in bakery products. *arXiv preprint*. arxiv.org
- Elizabeth, E. M. (2024a). Production process waste analysis with Lean manufacturing approach in copper crafts industry. *Journal of Industrial Engineering and Halal Industries*, 1(1), 3471. <https://doi.org/10.14421/jiehis.3471>
- Elizabeth, E. M. (2024b). Reduction of waste with the application of Lean Manufacturing in the Krawangan GRC production process at the XYZ Factory. *Journal of Optimization System and Ergonomy Implementation*, 1(2). <https://doi.org/10.54378/joseon.v1i02.7501>
- Irawan, Y. B., & Fitriani, K. (2022). Waste Assessment Model (WAM): How does the company assess the waste? *Jurnal Sains & Teknologi Lingkungan*, 16(2), art 4. <https://doi.org/10.20885/jstl.vol16.iss2.art4>
- Laturrahmi, R. (2025). Minimizing Waste in The Bread Production Process With The Waste Assessment Model and Failure Modes and Effect Analysis (FMEA) Method. *Jurnal Syntax Transformation*, 6(5).
- Najib, N. D., & Wibowo, D. H. (2024). Perbaikan kualitas produksi roti tawar dengan metode FMEA dan SQC di Tefa Bakery Politeknik Negeri Jember. *Journal of Food Engineering*, 2(1). <https://doi.org/10.25047/jofe.v2i1.3412>
- Pradana, F. Y., & Indiyanto, R. (2024). Bakery bread production system analysis with Failure Mode and Effect Analysis method: Case study of the Armina Food Bread Business. *Journal La Multiapp*, 5(3), 251–259. <https://doi.org/10.37899/journallamultiapp.v5i3.1415>
- Puspitaloka, M. A. C. D., & Ekawati, Y. (2023). Analisis perbaikan kualitas proses produksi di PT XYZ menggunakan metode Fuzzy FMEA. *Jurnal Sains & Aplikasi Keilmuan Teknik Industri (SAKTI)*, 2(1). <https://doi.org/10.33479/jtiumc.v2i1.19>
- Putri, N. T., Fatrias, D., & Simbolon, S. R. R. (2023). 5S implementation to minimize waste in bread production process (Case Study: Madani Bakery). In H. Kohl & others (Ed.), *Manufacturing Driving Circular Economy* (hal. —). Springer. https://doi.org/10.1007/978-3-031-28839-5_40
- Rahmanitya, F. R. (2019). *Upaya minimasi waste pada proses produksi roti dengan pendekatan Lean Manufacturing: Studi kasus Dipo Bakery, Sewon, Bantul* [Universitas Pembangunan Nasional “Veteran” Yogyakarta]. ejournal.uin-suka.ac.id
- Ramadhan, R. F., Widowati, E., & Mardiana, M. (2019). Failure Mode and Effect Analysis (FMEA) application for safety risk assessment design of “X” bakery. *Unnes Journal of Public Health*, 8(1), 38–44. <https://doi.org/10.15294/ujph.v8i1.22534>
- Sharma, P., Sharma, N. K., & Singh, M. (2015). Process improvement by implementation of Kaizen as a quality tool within defined constraints: A case study in manufacturing industry. *MATTER: International Journal of Science and Technology*, 1(1), 182–194. grdspublishing.org
- Suhardi, B., Hermas Putri KS, M., & Jauhari, W. A. (2020). Implementation of value stream

- mapping to reduce waste in a textile products industry. *Cogent Engineering*, 7(1), 1842148.
- team, M. (2023). A simulation approach for waste reduction in the bread supply chain. *Logistics*, 7(1), 2. <https://doi.org/10.3390/logistics7010002>
- Zisopoulos, D. G., & Blonk, H. (2016). Assessing alternative production options for eco-efficient food supply chains using multi-objective optimization: A case study of a bread supply chain in the Netherlands. *Annals of Operations Research*. link.springer.com
- Zorzenon, D., Zaiets, N., & Raisch, J. (2022). Switched max-plus linear-dual inequalities for makespan minimization: A case study of an industrial bakery shop. *arXiv preprint*. arxiv.org
-

First publication rights:
[Syntax Transformation Journal](#)

This article is licensed under:

