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Productivity Improvement of Bread Factory Based on Statistical Process Control (SPC) and Kaizen – A Case Study

Dodi Sofyan Arief[1a], Ari Andriyas Puji[1b◆], Yogi Alfriadi Pratama[1c], Heri Siswanto[1d], Anita Susilawati[1e], Anggraini Dwi Saputri[1f], M. Dalil[1g], Salsabila Miftah Rezkia[1h]

Abstract. *The enhancement of productivity within the bakery sector presents a considerable obstacle, particularly for smaller enterprises operating under constrained resources. This research aims to investigate the implementation of Statistical Process Control (SPC) and Kaizen methodologies to improve the productivity of a bread factory. A case study was conducted at a small bread factory in Pekanbaru, Indonesia. The case study company faced a product defect rate of approximately 3%, primarily due to abnormal baking maturity level and insufficient dough rise with large pores, exceeding the company target of below 1%. This research employed SPC techniques to assist in the identification of product defect variability within the production process. The Kaizen philosophy provides a perpetual framework for process enhancement that enables continuous improvements in quality, technology, processes, company culture, productivity, safety, and leadership. The results of this research were suggestions for action on problems caused by several factors such as humans, materials, methods, and machines. Proposed improvements were made by adding an automatic gas ignition panel box to the oven and designing the Standard Operating Procedures (SOP) for the bread baking process. The implementation of the improvement plan resulted in a reduction in the percentage of defects to 0.93% in October and 0.90% in November.*

Keywords: *Product defects, Productivity improvement, Statistical Process Control (SPC), Kaizen*

I. INTRODUCTION

With the rapid flow of globalization and accelerated technological development, competition in the industrial sector is intensifying, both at the national and international levels. Industries are required to continuously improve their competitiveness, particularly through improving product quality to meet consumer expectations (Halim & Kusuma, 2018; Insyaroh & Asmedi, 2024; Wahjudi et al., 2015). However, in reality, not all companies pay adequate attention to product quality, resulting in frequent occurrences of defective products (Rahmawati & Abduh, 2023; Sadikin, 2023; Siallagan et al., 2025).

In the specific context of small and medium-sized enterprises (SMEs) in the bakery sector, previous research has highlighted the applicability of quality management tools. For instance, (Fitri et al., 2025) successfully applied Statistical Process Control (SPC) using p-charts to analyze and optimize bread production quality in Indonesian SMEs, identifying critical process variations in baking parameters. Similarly, studies on Kaizen implementation in food SMEs (e.g.,; (Wilujeng et al., 2021) and quality improvement projects in Jakarta bread SMEs combining control charts with Kaizen principles) have shown that continuous improvement philosophies can effectively reduce defects when tailored to resource-limited settings. The rationale for selecting SPC in this study lies in its proven capability to provide objective, data-driven monitoring of process stability through control charts, enabling early detection of special cause variations in critical baking variables such as oven temperature consistency and timing factors directly linked to the observed maturity and pore defects. Kaizen was chosen as the complementary methodology

[1] Mechanical Engineering Department, Faculty of Engineering, Universitas Riau, Jl. HR. Soebrantas KM. 12,5, Simpang Baru, Kec. Tampan, Kota Pekanbaru, Riau 28293.

[a] email: dodidarul@eng.unri.ac.id
[b] email: ari.andriyas@lecturer.unri.ac.id
[c] email: YogiAlfriadiPratama@gmail.com
[d] email: heri_ft_unri@yahoo.co.id
[e] email: anitasusilawati@lecturer.unri.ac.id
[f] email: anggraini.dwisaputri@lecturer.unri.ac.id
[g] email: mdalil@lecturer.unri.ac.id
[h] email: salsabilarezkia@umri.ac.id
◆ corresponding author

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because it emphasizes low-cost, incremental improvements and full employee participation, which is particularly suitable for SMEs that cannot afford large-scale automation or external consultants. The integration of these two approaches creates a powerful synergy: SPC supplies the analytical diagnostics, while Kaizen supplies the cultural and procedural mechanisms for sustainable corrective action.

According to (Gaspersz, 2002; Insyaroh & Asmedi, 2024; Rachmawati & Purnama, 2024), efforts to improve product quality should be carried out through quality control of the production process, which can systematically reduce the risk of defective products. Quality products will positively impact consumer satisfaction and market loyalty (Noroozi & Taherian, 2023; Rohmah & Suryadi, 2023; Taufik et al., 2022). In this context, quality refers not only to product function but also to consistent compliance with established standards (Kenyon & Sen, 2015; Zacharias, 2022).

The bakery industry, as part of the food manufacturing sector, faces a particular challenge: how to maintain bread quality while maintaining productivity, especially for small factories with limited resources and technology (Aurelius et al., 2025; Francesco, 2025; Kumar & Bora, 2023). Therefore, the application of Statistical Process Control (SPC) methods and the Kaizen philosophy is relevant as a strategy for improving quality and operational efficiency. SPC enables to ensure process stability and compliance with standards (Gejdoš, 2015; Handayani, 2020; Tesfay, 2021), while Kaizen encourages continuous improvement in processes, quality, work culture, and productivity without requiring significant investment (Alvarado-Ramírez et al., 2018; Sahmi & Abbadi, 2024; Syaputra & Aisyah, 2022).

As a case study, PT Deanova Bread Factory, a small and medium-sized enterprise (SME), established in Pekanbaru in 2017, faced serious problems due to ineffective production ovens and the absence of Standard Operating Procedures (SOPs), resulting in bread with inconsistent quality: uneven baking, large pores, and a non-conformity rate exceeding the 1% tolerance (Interview Results). Internal data shows that the average percentage of defective products in June 2024 was 3.37% and in July 2024 was 2.98%. This situation demonstrates the urgency of improving the production system.

This research proposes the integration of SPC and Kaizen as a systematic effort to reduce product defect rates below the company's tolerance limits. Therefore, this research is expected to provide empirical and practical contributions on how quality management methods and processes can be effectively applied in small-scale bakery industries, while also providing insights for similar MSMEs in improving product quality and competitiveness.

II. Research Method

This research methodology is designed to explore the application of SPC and Kaizen in a small bakery using a case study approach. The first step in this study is the collection of initial data that includes information about the current production process, productivity levels, and product defects that occur. This data is collected through direct observation in the factory, interviews with managers and employees, and analysis of production-related documents. Field observation activities were carried out by interviewing the owner of the Deanova bakery factory. At this stage the aim is to collect data. The data collected is in the form of company general description data, production data and production defects and their causal factors. SPC Implementation Procedure: (1) Define critical-to-quality characteristics here, the two primary defect types (abnormal maturity level and low-rise/large-pore bread) treated as attribute data for proportion defective (p-chart). (2) Establish data collection protocol using daily check sheets recording production volume and defect counts by category over a one-month period (June and July 2024 baselines). (3) Calculate process parameters: proportion defective (p), centerline (CL = average p), UCL and LCL using standard formulas for p-charts with variable sample sizes. (4) Construct and interpret control charts to identify out-of-control points and patterns indicating special causes. (5) Validate process instability when multiple points exceed limits or show non-random patterns.

After the initial data is collected, the next step is to apply SPC techniques to monitor variability in the production process. This includes periodic data collection on critical parameters such as baking temperature, baking time, and dough composition. This data is then analyzed using control charts to determine whether the process is within the established control limits (Fitri et al., 2025; Obinna, 2024; Pablo & Chero, 2019). In this way, the sources of variability can be identified and necessary corrective measures can be taken. Kaizen Implementation Procedure: (1) Assemble cross-functional improvement team including owner and production staff. (2) Conduct root-cause analysis using fishbone (Ishikawa) diagram categorized by traditional 4M factors, augmented with a structured Five-M Checklist (Man, Machine, Material, Method, Measurement) to ensure comprehensive coverage including verification of measurement system accuracy (e.g., oven thermometer calibration, timer reliability, and consistent defect classification criteria). (3) Prioritize causes and develop countermeasures via 5W+1H workshops. (4) Implement technical and procedural changes (oven automation hardware + SOP documentation). (5) Standardize successful changes through updated work instructions and periodic training. (6) Monitor sustainability using ongoing SPC and PDCA cycles. Employee involvement was facilitated through group discussions and training sessions to build ownership of improvements (Ix et al., 2016; Kharub et al., 2023). Furthermore, the Kaizen principle will be applied to involve all employees in the improvement process. This will be done through training sessions and group discussions aimed at identifying areas for improvement and developing effective solutions. In this process, employees will be encouraged to provide input and ideas that can improve production efficiency and quality. According to (Ix et al., 2016; Kharub et al., 2023; Schwarz et al., 2017), employee involvement is the key to the success of Kaizen implementation.

After the implementation of SPC and Kaizen, production data will be collected again to evaluate the impact of both methods. Statistical analysis will be conducted to compare the level of productivity and product defects before and after implementation. The results of this analysis will provide a clear picture of the effectiveness of SPC and Kaizen implementation in increasing productivity at Deanova factory's bread.

III. RESULT AND DISCUSSION

Check Sheet

Check sheets were utilized to systematically collect and categorize defect data, enabling efficient Pareto and trend analysis. Key aggregated results (detailed daily data in Tables 1 and 2) revealed that in June 2024, total production reached 14,435 units with 486 defects (3.37% defect rate), dominated by low-rise/large-pore defects (287 cases, 1.99%). In July, production was 15,095 units with 451 defects (2.98%), again with texture/volume issues prominent (242 cases). These figures substantially exceeded the <1% target, confirming process incapability.

Histogram

Histogram analysis (Figure 1) confirmed the bimodal defect distribution, with texture/volume defects consistently outnumbering maturity defects across both months. This Pareto-like insight directed improvement priority toward dough handling, proofing conditions, and—critically oven baking consistency, as both defect categories were exacerbated by uncontrolled baking parameters.

Based on the picture, it can be seen that this MSME has 2 types of defects along with the number of defects, namely the level of maturity is not normal and the bread is less fluffy and has large pores. The number of defects in abnormal maturity levels was in June with a total of 199 pcs and in July with a total of 209 pcs of defective products, while defects in bread that was less fluffy and had large pores were in June with a total of 287 pcs and in July with a total of 242 pcs of defective products.

Control Map

Control charts are often used to determine whether product defects are within acceptable

Table 1. Number of Production Defects at the Deanova Bakery Factory in June 2024

Date	Production Amount	Number of Production Defects		Number of Defects	Date	Production Amount	Number of Production Defects		Number of Defects
		Abnormal Maturity Level	Low Rise Bread and Large Pores				Abnormal Maturity Level	Low Rise Bread and Large Pores	
1	530	5	9	14	16	350	12	9	21
2	350	7	11	18	17	500	7	10	17
3	510	6	15	21	18	470	5	9	14
4	545	5	9	14	19	530	9	6	15
5	500	5	7	12	20	515	6	8	14
6	550	4	9	13	21	370	9	6	15
7	480	4	12	16	22	510	5	13	18
8	520	6	9	15	23	370	7	7	14
9	340	4	14	18	24	510	7	6	13
10	530	7	6	13	25	540	6	9	15
11	490	6	13	19	26	490	9	7	16
12	510	9	10	19	27	530	10	9	19
13	520	8	14	22	28	500	5	10	15
14	490	6	10	16	29	520	8	13	21
15	505	7	6	13	30	360	5	11	16
						14435	199	287	486
						Amount	1.38%	1.99%	3,37 %

Table 2. Number of Production Defects at the Deanova Bakery Factory in July 2024

Date	Production Amount	Number of Production Defects		Number of Defects	Date	Production Amount	Number of Production Defects		Number of Defects
		Abnormal Maturity Level	Low Rise Bread and Large Pores				Abnormal Maturity Level	Low Rise Bread and Large Pores	
1	510	7	8	15	16	520	9	8	17
2	540	9	6	15	17	545	5	15	20
3	525	6	8	14	18	510	5	9	14
4	500	5	6	11	19	525	11	6	17
5	480	7	5	12	20	530	8	8	16
6	550	8	6	14	21	385	7	6	13
7	380	6	8	14	22	515	9	7	16
8	530	7	12	19	23	535	6	10	16
9	515	4	12	16	24	550	9	7	16
10	520	6	10	16	25	510	4	10	14
11	505	5	7	12	26	530	7	9	16
12	520	10	5	15	27	545	8	10	18
13	530	7	6	13	28	390	6	5	11
14	360	5	10	15	29	530	9	6	15
15	500	6	7	13	30	510	8	10	18
						15.095	209	242	451
						Amount	1.38%	1.60%	2,98%

limits or not, if they exceed the limits then they must be repaired.

Control chart analysis (p-chart, Figure 2) for June revealed 15 out of 30 points outside control

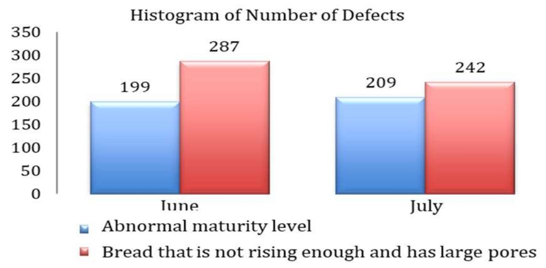


Figure 1. Histogram Before Repair

Table 3. Control Map in June Before Improvement

Date	Production Amount	Number of Defects	PK	CL	UCL	LCL
1	530	14	0.026	0.034	0.04	0.028
2	350	18	0.051	0.034	0.04	0.028
3	510	21	0.041	0.034	0.04	0.028
4	545	14	0.026	0.034	0.04	0.028
5	500	12	0.024	0.034	0.04	0.028
6	550	13	0.024	0.034	0.04	0.028
7	480	16	0.033	0.034	0.04	0.028
8	520	15	0.029	0.034	0.04	0.028
9	340	18	0.053	0.034	0.04	0.028
10	530	13	0.025	0.034	0.04	0.028
11	490	19	0.039	0.034	0.04	0.028
12	510	19	0.037	0.034	0.04	0.028
13	520	22	0.042	0.034	0.04	0.028
14	490	16	0.033	0.034	0.04	0.028
15	505	13	0.026	0.034	0.04	0.028
16	350	21	0.060	0.034	0.04	0.028
17	500	17	0.034	0.034	0.04	0.028
18	470	14	0.030	0.034	0.04	0.028
19	530	15	0.028	0.034	0.04	0.028
20	515	14	0.027	0.034	0.04	0.028
21	370	15	0.041	0.034	0.04	0.028
22	510	18	0.035	0.034	0.04	0.028
23	370	14	0.038	0.034	0.04	0.028
24	510	13	0.025	0.034	0.04	0.028
25	540	15	0.028	0.034	0.04	0.028
26	490	16	0.033	0.034	0.04	0.028
27	530	19	0.036	0.034	0.04	0.028
28	500	15	0.030	0.034	0.04	0.028
29	520	21	0.040	0.034	0.04	0.028
30	360	16	0.044	0.034	0.04	0.028
	14.435	486				

limits (7 above UCL, 8 below LCL), indicating a statistically unstable process with both special and common cause variation present. July data

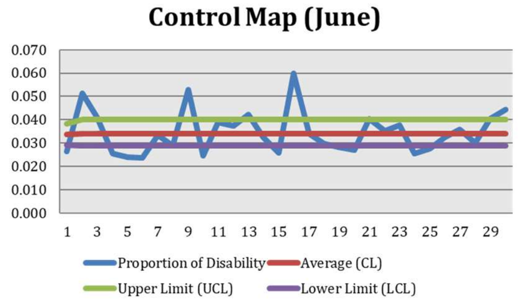


Figure 2. Control Map in June Before Improvement

Table 4. Control Map in July Before Repair

Date	Production Amount	Number of Defects	PK	CL	UCL	LCL
1	510	15	0.029	0.030	0.033	0.027
2	540	15	0.028	0.030	0.033	0.027
3	525	14	0.027	0.030	0.033	0.027
4	500	11	0.022	0.030	0.033	0.027
5	480	12	0.025	0.030	0.033	0.027
6	550	14	0.025	0.030	0.033	0.027
7	380	14	0.037	0.030	0.033	0.027
8	530	19	0.036	0.030	0.033	0.027
9	515	16	0.031	0.030	0.033	0.027
10	520	16	0.031	0.030	0.033	0.027
11	505	12	0.024	0.030	0.033	0.027
12	520	15	0.029	0.030	0.033	0.027
13	530	13	0.025	0.030	0.033	0.027
14	360	15	0.042	0.030	0.033	0.027
15	500	13	0.026	0.030	0.033	0.027
16	520	17	0.033	0.030	0.033	0.027
17	545	20	0.037	0.030	0.033	0.027
18	510	14	0.027	0.030	0.033	0.027
19	525	17	0.032	0.030	0.033	0.027
20	530	16	0.030	0.030	0.033	0.027
21	385	13	0.034	0.030	0.033	0.027
22	515	16	0.031	0.030	0.033	0.027
23	535	16	0.030	0.030	0.033	0.027
24	550	16	0.029	0.030	0.033	0.027
25	510	14	0.027	0.030	0.033	0.027
26	530	16	0.030	0.030	0.033	0.027
27	545	18	0.033	0.030	0.033	0.027
28	390	11	0.028	0.030	0.033	0.027
29	530	15	0.028	0.030	0.033	0.027
30	510	18	0.035	0.030	0.033	0.027
	15.095	451				

(Figure 3) showed 12 out-of-control points, confirming persistent instability. These

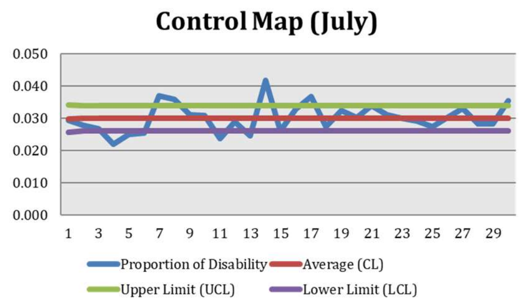


Figure 3. Control Map in July Before Improvement

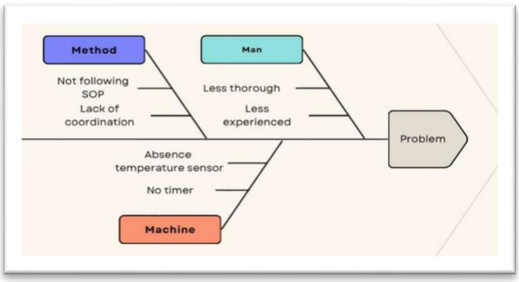


Figure 4. Cause-and-Effect Diagram of Abnormal Bread Baking

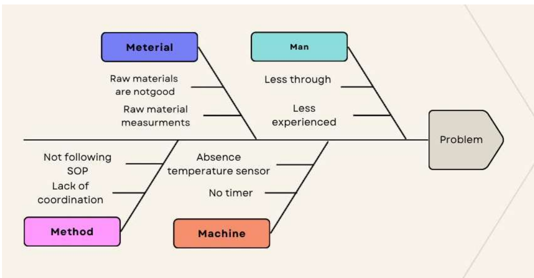


Figure 5. Cause and effect diagram of bread that lacks expansion and has large pores

quantitative diagnostics from SPC provided irrefutable evidence that the baking process was not capable of meeting the 1% defect target under existing conditions, necessitating root-cause intervention via Kaizen.

After getting the value Center Line (CL), Upper Control Limit (UCL), and Lower Control Limit (LCL) then the next step is to create a control chart diagram using manual calculations microsoft excel.

To overcome this problem, a cause-and-effect (fishbone) diagram analysis was carried out to identify root causes, supplemented by the Five-M Checklist for exhaustive factor coverage. Post-improvement verification (October–November 2024) employed the identical SPC protocol: daily check sheets and p-chart construction over full production months (~15,000 units/month). The resulting defect rates of 0.93% (October) and 0.90% (November) were accompanied by control charts showing all points within UCL/LCL and no non-random patterns demonstrating that the process had achieved statistical control and capability relative to the 1% specification limit. This before-after comparison, grounded in the same measurement system, provides robust evidence that the observed reduction was attributable to the implemented changes rather than random fluctuation or measurement artifacts.

Fishbone Diagram

The cause-and-effect diagram of the fishbone diagram is used to analyze product defect factors. From the results of observation interviews by workers, several factors were found that caused defects in bread production. By carrying out a thorough investigation of the production process, factors were found that caused defects in the production of bread products before and during the production process. As a result, the causal factors of the problem are outlined in the cause-and-effect diagram (fishbone). The following is the result of a cause-and-effect diagram (fishbone).

1. **Cook abnormal bread.** Based on the cause and effect diagram of abnormal bread cooking, it can be seen that there are 3 categories that can be analyzed as causes:
   a. **Man.** Defect due to factors man (human) comes from workers who are less careful and don't care about quality, and don't have the skills or expertise when carrying out the bread baking process
   b. **Method.** The defect is because the method originates from the bread production target which is immediately sent and the standard work operational process (sop) at the factory is not clear when carrying out the bread baking process, resulting in less than perfect bread results.

c. **Machine.** The defect is because the machine comes from an oven that has been used for too long and there is no temperature and time control on the oven used so the bread baking process is done manually.

2. **Bread that does not expand and has large pores.** Based on the cause and effect diagram for bread that does not rise enough and has large pores, it can be seen that there are 4 categories that can be analyzed as causes:
   a. **Man.** Defect due to factors man (human) comes from workers who are not careful when measuring the dough, causing the bread produced to not meet standards.
   b. **Raw Material.** Defects due to manual factors (raw materials) come from poor raw materials which affect the quality of the wheat which can cause large pores, causing the product quality to not be as desired.
   c. **Method.** Defect because method comes from unclear standard operating procedures (SOP) when carrying out the production process and lack of coordination.
   d. **Machine.** Defect because (machine comes from the fact that there is no temperature and time control when baking bread in the oven, causing the bread production process to become less fluffy and porous.

From the results of interviews and observations of workers, several factors were found that caused defects in bread. In abnormal maturity level defects, there are 3 causal factors, namely humans, methods and machines. Meanwhile, for defects in bread that is less fluffy and has large pores, 4 causal factors were found, namely humans, materials, methods and machines. To ensure analytical completeness, a Five-M Checklist was systematically applied: (1) Man – skill gaps, inconsistent attention to detail during dough scaling/mixing and oven loading/unloading, lack of standardized training; (2) Machine – aging oven without automated temperature/time control, leading to manual estimation errors and thermal inconsistency; (3) Material – variable flour quality (protein content, moisture) from suppliers affecting dough rheology and gas retention; (4) Method – absence of documented SOPs for critical baking parameters (target core temperature, bake time by loaf size) and proofing conditions; (5) Measurement – lack of calibrated oven thermometers/timers and inconsistent defect categorization criteria among operators, introducing measurement system variation that could mask true process signals. This structured checklist confirmed that machine (oven control) and method (SOP absence) factors were the dominant controllable levers for immediate impact, while also highlighting measurement system improvement as essential for future SPC reliability.

Kaizen 5W+1H

The 5W+1H method (what, why, where, when, who, and how) is used to implement kaizen events. These six simple questions are the basis for studying processes to produce better process improvement proposals. (Kato & Smalley, 2010). The Kaizen 5W+1H method was applied to translate fishbone and Five-M findings into actionable improvement plans (Tables 5 and 6). Rather than exhaustive tabulation, the core actions implemented were: (a) installation of an automatic gas ignition panel box equipped with digital thermostat and timer on the oven (addressing Machine and Method factors simultaneously by enabling precise, repeatable baking profiles at 180°C for ~30 min); (b) development and deployment of a formal SOP for the entire oven process (standardizing preparation, loading, parameter setting, unloading, and post-bake handling); and (c) quarterly worker training plus tightened supervisory oversight (addressing Man factor). Critical analytical insight: The selected interventions exemplify Kaizen's principle of "low-cost, high-impact" changes—adding hardware was modest yet eliminated the primary source of special-cause variation (manual oven control), while creating SOPs institutionalized the improvement and reduced reliance on tacit knowledge. This dual technical-procedural approach, informed by SPC diagnostics, explains why defect reduction was both rapid (within two

Table 5. 5W+1H Action Plan for abnormal bread cooking

Factor	5W+1H	Description	Action
Man	What	Workers are not careful when carrying out the bread baking process.	Conduct training for workers every 3 months to concentrate more on the products produced Be more careful when baking (oven) bread.
	Why	Inexperienced employees, so employees can know their responsibilities	
	Where	In the production process	
	When	In the production process from June to July	
	Who	Production Team	
	How	In tightening supervision carried out by the head of production so that workers can concentrate more and minimize the lack of accuracy of workers	
Method	What	There is a product non-conformity, namely there is a bread product that cooks abnormally	Carry out corrective actions related to the work methods applied to the bread baking (oven) process Determine the temperature standards required in the bread oven process and determine the length of process time required to obtain the appropriate level of bread maturity.
	Why	There are no special standards or provisions regarding the temperature and length of time for a good bread baking process.	
	Where	In the bread oven section	
	When	While the bread baking process is taking place	
	Who	Workers when carrying out the production process	
	How	Hold training or training regarding the appropriate method for baking (oven) bread	
Machine	What	There is no temperature control and length of baking (oven) time in the oven used	Carry out regular machine maintenance Add tools such as temperature control and automatic time sensors to the oven to make the baking process easier
	Why	Carry out regular machine maintenance every month	
	Where	On the machine used for the bread production process	
	When	During the production process	
	Who	Workers who operate in the machine and production section	
	How	Adding tools to the machine such as controlling the temperature and time in the oven	

months) and sustainable (maintained below target in subsequent monitoring). The synergy between SPC (which flagged the oven as the leverage point) and Kaizen (which delivered the fix through employee-involved planning) proved more effective than either tool in isolation, offering a replicable model for other SME food processors.

Table 5 shows 5W+1H action plan for abnormal bread cooking, from the results of interviews with company owners (2024). Table 6 shows 5W+1H action plan for bread that doesn't rise enough and has large pores, from the results of interviews with company owners (2024).

After analyzing the problems in the production process, improvements were made to the Deanova bakery factory. The following are suggestions for improvements that will be given:

1. **Addition of Automatic Gas Switching Panel Box Aids to Oven Machines**. From the analysis, we can see that there are deficiencies in the bread oven. So, the addition of an automatic gas ignition panel box tool was added to the bread oven. The automatic gas ignition box panel is used in the bread baking

Table 6. 5W+1H action plan for bread that doesn't rise enough and has large pores

Factor	5W+1H	Description	Action
Man	What	The lack of thoroughness of workers when doing the production process	Conduct training for workers every 3 months to concentrate more on the products produced. Be more careful when checking, measuring and mixing raw materials.
	Why	Lack of employee experience, so that employees can know their responsibilities	
	Where	In the production process	
	When	In the production process from June to July	
	Who	Production Team	
	How	In tightening supervision carried out by the head of production so that workers can concentrate more and minimize the lack of accuracy of workers	
Material (raw materials)	What	This results in bread that expands and has large pores	Choose supplier others and checking the raw materials to be used. Carry out regular material checks.
	Why	Choose supplier others and check the materials to be used	
	Where	In the production process of making dough	
	When	During the production process	
	Who	Workers when carrying out the production process	
	How	To get quality results, the materials used must have good quality standards	
Method	What	The workers lack experience when carrying out the production process	Conduct training for workers to become more experienced when carrying out the production process Create standard operational procedures (SOP) for the baking process to produce quality production
	Why	In order to get products that meet company standards	
	Where	To workers when carrying out the production process	
	When	While the production process is going on	
	Who	Workers who operate in the machine and production section	
	How	Create standard operating procedures (SOP) for baking (oven) to get perfect results	
Machine	What	Lack of maintenance on the machine so that when mixing the dough it is not perfect There is no temperature control and the length of time in the oven so that the results are not in accordance with company standards	Adding tools to the oven, such as automatic temperature and time controls for bread baking tools. Create standard operating procedures (SOP) when carrying out the baking process in the oven
	Why	Reduces the level of losses resulting from lack of maintenance on the machine such as uneven dough results	
	Where	In the production process	
	When	In the production process from June to July	
	Who	Workers who operate in the machinery and production section	
	How	Perform maintenance on the machine Added additional temperature and time controls to the oven	

process carried out at the Deanova toast factory to be able to determine and control the temperature and the length of time the bread baking process takes. The following are the components used to make this tool.

2. **Making Standards Operational Procedures (SOP) on Process Roasting (oven) Bread Production**. It can be seen in the analysis above that there are factors that cause bread production to experience defects in the absence of standard operating procedures (SOP) used in the production process. The following are standard operational procedures carried out. Standard operational procedures (SOP) in the bread production process. A standard operational procedure (SOP) was

Table 7. Standard Operating Procedures (SOP) for Oven Production Process

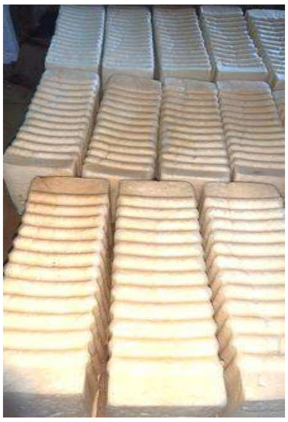
Standard Operating Procedures (SOP) Bread Production Process Deanova factory					
Activity Title		Toaster			
Objective		Ensure that the bread baking activities are carried out well and meet the quality and quantity standard targets that have been implemented			
Related parties		Owner and Employee			
No	Activity Stage	Machines and Tools Used	Expected results	Information	Provision
1.	Preparation of Baking Equipment (Oven)	Gas oven machine with the addition of an automatic gas ignition panel box	The gas oven to be used is ready to be operated and the gas content has been checked and its safety has been ensured (there are no leaks in the gas cylinder) Set the cooling temperature to ensure the bread doesn't get damaged.	The grill reaches a temperature of 180°	Operators involved in the bread baking process are required to wear heat-resistant gloves to avoid scalding or burning their hands.
2.	Bread Baking Process		The bread dough has been stored in the baking machine (oven) until it produces an increased volume of bread dough (inflates perfectly) Set the desired length of time so that the bread does not burn during the baking process	Baking time is around 30 minutes	Bread that has been removed from the oven must be removed from the baking dish no less than 2 minutes after the bread is cooked.
3.	Removing Baking Pans and Grilling Tools (Oven)		The dough in the pan is removed from the baking tool if it has exceeded the specified time limit and has reached the desired level of doneness.	The bread produced meets the criteria of good bread when it meets the following criteria: a. A full and interesting development of the bread volume b. Symmetry of shape and cleanliness of the outside c. The skin of the bread is light brown and not rough d. Soft and elastic texture.	
4.	Remove the bread from the pan		Bread that is cooked and removed from the oven is immediately moved from the dough pan to avoid the possibility of burning the bottom surface of the bread in direct contact with the pan used.		

designed for baking (oven) bread. By designing standard operating procedures (SOP) for ovens, it is hoped that it can increase operational efficiency, minimizing the risk of errors at the baking production stage of the Deanova bakery factory. The following is a draft standard operating procedure (SOP) for the bread baking production process

Based on the proposed improvements made, the proposed improvements were then implemented on the Deanova bakery oven machine. It was including additional equipment such as an automatic gas ignition panel box in the roasting process, which can be seen in Table 8.

From the analysis above, the quality of the Deanova Bread Factory's bread production

Table 8. Implementation of Proposed Improvements

Factor	Machine Parts	Production result
Before Repair		
After Repair		

process improved when the design of an additional tool for an automatic gas lighter panel box equipped with a temperature controller and length of time in the oven during the production process was implemented. The bread produced before adding tools was slightly yellowish and had large pores, after adding tools during the baking process (oven) in the oven the bread was white.

After improvements to the baking process, the average defect in October was 0.93% and November 0.90%, better than the average defect in June (3.37%) and July (2.98%). These improvements reduce bread defects, especially the problem of bread that is not fully cooked and does not rise. The use of automatic gas lighter panel boxes has proven to be efficient in improving the quality of grilling, producing better products for marketing. Overall, the results of this study indicate that the implementation of SPC and Kaizen can make a important contribution to increasing the productivity in the case study company.

IV. Conclusion

Based on observations made by researchers, there are various types of defects in the Deanova factory's bread products, such as abnormal bread cooking and bread that does not rise and has large pores. This bread defect can be caused by several factors such as humans, materials, methods and machines. The Five-M Checklist ensured no critical dimension (including Measurement system reliability) was overlooked during diagnosis. The various factors have been identified that influence the occurrence of defects in bread products. After improvement take in accounted, which resulted the improvements were successful in making conditions more controlled and stable. On analysis fishbone (cause and effect) there are various factors that influence the abnormal cooking results of bread, which are caused by human factors, methods and machines. In identification using the 5W+1H kaizen method (what, why, where, when, who, and how), several factors causing problems were found, such as people, materials, methods, and machines. As a solution, improvements were made to the oven by adding an automatic gas ignition panel box equipped with a digital thermostat and timer. The purpose of adding this tool is to control the temperature and time of the bread oven process at the Deanova factory. In addition, standard operating procedures (SOP) for roasting were created as a reference for employees. Previously, the percentage of product defects in June was 3.37%, and in July 2.98%. After improvement, the defect rate decreased to 0.93% in October and 0.90% in November, which met the tolerance limit of 1%. Rigorous before-after SPC monitoring confirmed that the process transitioned from unstable (multiple out-of-control points) to fully stable (all points within limits, no special causes), validating that the Kaizen interventions successfully eliminated the assignable causes identified by SPC. In this way, the bread products produced are of higher quality and competitive in the quality market and can compete in the industrial market.

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