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Analysis of Quality Control for Nusa Bess Products Using the Statistical Quality Control (SQC) Method to Reduce Defective Products at PT. XYZ

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Abstract

Quality consistency is essential in mass production because recurring defects reduce acceptable output and require corrective action. This study analyzes quality defects in Nusa Bess products at PT. XYZ using Statistical Quality Control (SQC), focusing on defect identification, Pareto prioritization, and Fishbone cause analysis. Data were obtained through direct observation, interviews with quality-control staff, company documentation, and production records. The analysis covered defect data from January to June 2025. During this period, 555,216 units were produced and 42,860 units were rejected. Fifteen defect categories were identified, with surface defects, chipping, edge defects, holes, stains, clave cracks, and breakage forming the dominant group and representing a cumulative contribution of 78% in the Pareto analysis. Fishbone analysis identified five causal dimensions: man, machine, environment, material, and method. The documented causes included insufficient operator attention and SOP compliance, unstable oven temperature and machine conditions, high humidity and extreme weather, excessive material moisture or unsuitable material composition, and limitations in manual inspection. Based on these findings, quality improvement should prioritize operator training, stricter SOP implementation, machine maintenance and parameter control, routine briefings, and tighter incoming-material inspection. The study provides an empirical basis for directing quality-control improvements toward dominant defects and process factors.

Keywords: *Chipping, Fishbone Diagram, Nusa Bess, Pareto Diagram, Statistical Quality Control.*

INTRODUCTION

Manufacturing competitiveness is increasingly determined by the ability of firms to maintain consistent product quality while sustaining production continuity, operational efficiency, and compliance with increasingly demanding customer requirements. Product quality is not limited to the physical condition of an output but encompasses attributes such as durability, reliability, accuracy, ease of operation, and other characteristics that determine whether a product can consistently fulfill user expectations (Armstrong et al., 2014). In contemporary manufacturing environments, production processes are exposed to variation originating from raw materials, machinery, operators, working conditions, and production methods, making systematic quality control essential for maintaining output within predetermined specifications (Nasti, 2019). Quality management has consequently shifted from a downstream inspection function toward an integrated operational mechanism that supports process stability, defect prevention, and continuous improvement throughout production activities (Achiraini et al., 2019). This shift is particularly important in mass-production industries because repeated small deviations can accumulate into substantial quantities of defective products, increasing production costs, reducing material utilization, and weakening delivery reliability. Building-material manufacturing presents an especially important context because defects may affect not only product appearance but also dimensional conformity, structural usability, handling characteristics, and customer acceptance, creating a direct relationship between process stability and the competitiveness of the final product.

Statistical Quality Control (SQC) has become a relevant analytical approach for translating routine inspection data into evidence that can support process monitoring and quality-improvement decisions. SQC provides a structured basis for organizing defect observations, identifying variation patterns, and distinguishing recurring quality problems from relatively insignificant nonconformities, allowing quality-control activities to move beyond simple counting of rejected products (Wardah et al., 2022). Empirical research has demonstrated that SQC can identify dominant defect categories and establish improvement priorities in manufacturing processes, although the effectiveness of such analysis depends on the extent to which statistical findings are connected with actual process conditions (Aini, 2024). Studies applying SQC to product-defect analysis have similarly shown that statistical identification of nonconformities can provide a more systematic basis for evaluating production performance and determining areas requiring corrective action (Almadani & Dahda, 2022). The broader quality-control literature also indicates that structured participation and systematic problem solving, as promoted through Quality Control Circle approaches, can strengthen organizational responses to recurring production problems (Baisalim & Soediantono, 2022). These findings suggest that defect records should be interpreted as process information rather than treated merely as historical rejection statistics. The analytical challenge lies in developing an approach that can simultaneously establish which defects require priority and explain the operational factors responsible for their occurrence.

The effectiveness of SQC-based quality improvement becomes stronger when quantitative defect prioritization is connected with systematic cause identification. A Pareto diagram enables defect categories to be ranked according to their frequency, allowing limited improvement resources to be directed toward problems that contribute most substantially to overall nonconformity (Mawadati, 2022). Fishbone analysis complements this prioritization by structuring potential causes into interconnected dimensions such as man, machine, material, method, and environment, thereby providing a broader explanation of why dominant defects emerge within a production process. Recent manufacturing research has increasingly combined statistical quality-control approaches with complementary analytical methods, including Failure Mode and Effects Analysis (FMEA), to move from defect measurement toward risk-based improvement and more targeted corrective action (Dahlia et al., 2024). Research using the New Seven Tools likewise demonstrates that systematic categorization and analysis of production problems can improve the ability to trace observed defects to relevant process conditions rather than relying exclusively on aggregate rejection levels (Annandita & Rochmoeljati, 2025). Recent studies further demonstrate the relevance of integrating statistical process control with process-capability analysis when defects need to be interpreted in relation to process performance and consistency (Nugroho et al., 2026). Despite these methodological developments, the application of relatively accessible SQC tools remains valuable for manufacturing settings in which the principal need is to establish defect priorities and identify actionable causes from available production records.

The empirical problem addressed in this study emerges from the production of Nusa Bess at PT. XYZ, a manufacturer of modern building materials in which quality consistency is important because production is performed through a make-to-stock system intended to maintain product availability in response to customer demand. Production quality control in such an environment must operate across raw-material inspection, process monitoring, and final-product inspection because quality deviations that remain undetected at an earlier stage can propagate into subsequent operations and ultimately increase the quantity of rejected products (Wiyanti et al., 2023). The Nusa Bess production process involves forming, stacking, cutting, autoclave, and distacking operations, meaning that product conformity is potentially influenced by interactions among material characteristics, equipment performance, operator practices, and process conditions. Human factors are particularly relevant because variations in operator movement, work methods, and workplace conditions can influence process consistency and the emergence of production defects (Wignjosoebroto, 2006). PT. XYZ has established quality-related controls and applies standards and certifications including SNI, ISO 9001:2015, ISO 14001:2015, ISO 45001:2018, Green Label, and TKDN, indicating that quality assurance is embedded within a broader organizational framework. The existence of these controls, however, does not eliminate the possibility of recurring defects, particularly when accumulated inspection data have not been sufficiently transformed into prioritized and causally interpretable improvement information. This condition creates a practical setting in which SQC can function not as a replacement for the existing quality system but as an analytical mechanism for extracting improvement priorities from the company's defect records.

The need for such analysis becomes more apparent because the Nusa Bess production records contain fifteen defect categories, including surface-related defects, chipping, holes, stains, cracks, breakage, dimensional problems, delamination, and warping, which differ in frequency and potentially in their underlying causes. Treating all defect categories with equal priority can dilute corrective-action resources and make it difficult to determine which problems have the greatest influence on overall product rejection, particularly when manufacturing systems face multiple simultaneous sources of variation. Recent research on SQC-based quality control emphasizes the value of prioritizing dominant defects before corrective interventions are formulated, since improvement becomes less focused when numerous nonconformities are addressed without considering their relative contribution to total defects (Dewatmoko et al., 2025). Research on SQC applications also demonstrates that defect analysis can reveal critical patterns in production data and provide a basis for determining which quality problems require more immediate managerial attention (Hairiyah et al., 2024). Comparable studies of manufacturing quality control indicate that SQC remains applicable for identifying process-related defects, while Quality Control Circle and related approaches provide complementary mechanisms for organizing corrective action at the operational level (Diansari et al., 2024). Earlier industrial quality-control guidance similarly positions systematic group-based quality activities as an important means of converting identified production problems into structured improvement efforts (Haryadi, 2018). The unresolved issue is therefore not the absence of quality-control procedures at PT. XYZ, but the need to interpret the existing defect information in a way that distinguishes dominant problems from less influential ones and subsequently relates those problems to plausible process causes.

This study positions the analysis of Nusa Bess production quality at PT. XYZ within the intersection of statistical defect measurement, defect prioritization, and process-cause interpretation. The study aims to analyze product defects using the Statistical Quality Control method by identifying recorded nonconformities, determining the dominant defect categories through Pareto analysis, and examining their potential causes through Fishbone analysis. The analytical framework is designed to preserve the defect classifications, production records, process characteristics, and causal conditions documented in the underlying production report rather than introducing unsupported assumptions or external production parameters. Its theoretical contribution lies in strengthening the application of SQC as an interpretive quality-management framework in which quantitative defect frequency is connected to process-level causal reasoning. Its methodological contribution lies in integrating Pareto-based prioritization with Fishbone-based causal analysis so that statistical evidence can be translated into a structured understanding of the production factors associated with defective Nusa Bess products. Its practical contribution is the formulation of focused quality-improvement directions addressing human, machine, material, method, and environmental factors that are relevant to the dominant defects. The resulting framework is expected to provide a more targeted basis for reducing defective products and strengthening the consistency of quality-control practices in Nusa Bess production at PT. XYZ.

RESEARCH METHODS

This study employed an empirical descriptive-analytical design to evaluate quality control in the production of Nusa Bess products at PT. XYZ using the Statistical Quality Control (SQC) framework, with the production process treated as the operational system under investigation rather than as an experimental system. The study was conducted through direct observation, interviews with quality-control laboratory personnel, company documentation, and secondary production records, while the primary materials for analysis consisted of Nusa Bess production and defect records generated during routine manufacturing activities. The production flow examined comprised forming sheet, stacking, cutting, autoclave, and distacking stages, with quality-control activities considered from raw-material inspection through process monitoring and final-product inspection. The main analytical data were attribute data consisting of defect types and defect quantities, and the defect classifications followed the categories documented by the company without introducing new classifications or altering the original records. The data collection and organization followed the principle that statistical quality-control techniques can transform inspection observations into structured information for monitoring production variation and identifying quality problems (Wardah et al., 2022). The implementation stage consisted of compiling the check-sheet records by month and consolidating the production-defect data for January–June 2025, which was the period explicitly represented in the monthly and overall recapitulation tables used in the analysis. The resulting dataset was prepared as the empirical basis for subsequent defect prioritization and causal analysis, consistent with previous applications of SQC for identifying dominant defect categories in manufacturing processes (Aini, 2024).

The testing and analytical procedure began by calculating the frequency of each of the fifteen recorded defect categories from the consolidated January–June 2025 check-sheet data and arranging the categories from the highest to the lowest frequency. A Pareto diagram was then constructed to determine the cumulative contribution of each defect category and establish which defects represented the principal quality problems requiring improvement priority, following the use of Pareto analysis as a mechanism for focusing quality-improvement resources on the most influential defects (Mawadati, 2022). The source report also included an attribute-control-chart stage within its SQC processing, but this article does not introduce additional control-limit values because the reported interpretation and final conclusions primarily rely on the defect-frequency and Pareto results. After the dominant defect categories were identified, Fishbone analysis was applied to examine their potential causes according to five dimensions, namely man, machine, material, method, and environment, thereby connecting quantitative defect patterns with observable production conditions. This combination of statistical prioritization and structured cause analysis is consistent with quality-control studies that integrate statistical approaches with complementary analytical techniques to identify the sources of recurring manufacturing defects (Dahlia et al., 2024). The performance evaluation of the quality-control process was based on defect frequency, percentage contribution, cumulative percentage, and the identification of dominant defect categories, while causal validation was performed by comparing the identified causes with direct observations, interviews, and conditions documented in the production report rather than by introducing new experimental measurements or inferential statistical tests.

RESULTS AND DISCUSSION

Production and Defect Profile of Nusa Bess Products

The consolidated production records for January–June 2025 indicate that Nusa Bess production reached 555,216 units, with 42,860 units recorded as rejected products. Monthly production varied from 79,020 units in May to 104,849 units in June, while the number of rejected units ranged from 6,504 in May to 7,875 in June. This variation indicates that the interpretation of reject performance should consider production volume rather than relying solely on the absolute number of rejected units. The monthly records also demonstrate that rejected products occurred continuously throughout the six-month observation period rather than being concentrated in a single production month. Such recurring nonconformities indicate the need for systematic quality monitoring because repeated defect occurrence can reflect variation within routine production activities (Diansari et al., 2024). Table 1 presents the monthly production and reject records used as the empirical basis for examining the quality profile of Nusa Bess products.

Table 1. Monthly Production and Reject Records, January–June 2025

Month	Total Production	Total Reject
January	91,157	6,673
February	101,040	7,866
March	86,716	6,660
April	92,434	7,282
May	79,020	6,504
June	104,849	7,875

The data in Table 1 show that June recorded the highest production volume at 104,849 units and also the highest number of rejects at 7,875 units, whereas May had both the lowest production volume and the lowest reject count. The correspondence between production volume and reject count suggests that absolute reject frequency is partly associated with the amount of production processed during each month. February provides an additional indication of this pattern, with 101,040 units produced and 7,866 rejects, a reject count close to that of June despite a lower production volume. However, the available data do not establish a statistical causal relationship between production volume and defect occurrence, so the pattern is interpreted only as an operational characteristic of the observed production records. From a manufacturing quality perspective, monitoring defect occurrence alongside production activity is important because quality variation needs to be evaluated within the context of the production process and its operating conditions (Nasti, 2019). The monthly profile therefore functions as an initial diagnostic layer before the analysis is narrowed to individual defect categories. The observed variation also indicates that quality evaluation should remain connected to actual production conditions rather than being based exclusively on accumulated reject counts.

The consolidated records further show that the rejected products were distributed across fifteen documented defect categories, indicating that product nonconformity occurred in several forms rather than being represented by a single defect mechanism. As presented in Table 2, Surface defect recorded the highest frequency with 5,381 cases, followed closely by Chipping with 5,367 cases. Edge defect and Holes contributed 4,818 and 4,810 cases, respectively, while Stains, Clave cracks, and Breakage each exceeded 4,000 cases. The remaining eight categories had substantially lower frequencies, ranging from 1,154 to 1,270 cases. This distribution demonstrates a pronounced concentration of rejected products in a limited number of categories, making frequency-based prioritization appropriate for the subsequent SQC analysis (Hairiyah et al., 2024). Table 2 retains the complete defect classification documented in the production report and provides the quantitative basis for determining the dominant defect group.

Table 2. Consolidated Defect Data, January–June 2025

No.	Defect Type	Count	Percentage	Cumulative
1	Surface defect	5381	13%	13%
2	Chipping	5367	13%	25%
3	Edge defect	4818	11%	36%
4	Holes	4810	11%	48%
5	Stains (Flek)	4322	10%	58%
6	Clave cracks	4283	10%	68%
7	Breakage	4262	10%	78%
8	Adhesive cracks	1270	3%	81%
9	Waste (Afval)	1268	3%	83%
10	Blistering	1220	3%	86%
11	Blocks	1193	3%	89%
12	Warping	1180	3%	92%
13	Under-cured	1174	3%	95%
14	Thick/Thin	1158	3%	97%
15	Delamination	1154	3%	100%

The distribution in Table 2 reveals a substantial difference between the seven highest-frequency defect categories and the remaining categories, with the former accounting for the majority of recorded defect occurrences. Surface defect and Chipping each contributed approximately 13% based on the rounded percentages reported in the table, followed by Edge defect and Holes at approximately 11% each. Stains, Clave cracks, and Breakage each contributed approximately 10%, producing a reported cumulative contribution of 78% for the first seven categories. This concentration indicates that the quality problem is structurally uneven, because a relatively small number of defect types account for a considerably larger portion of recorded nonconformities than the other categories. Such concentration is relevant to quality management because defect data can be used to distinguish priority problems from less frequent nonconformities and to allocate improvement efforts according to their observed contribution (Achiraini et al., 2019). The finding establishes an empirical basis for applying Pareto analysis rather than treating all fifteen categories as having equivalent improvement priority.

The lower-frequency categories consist of Adhesive cracks, Waste, Blistering, Blocks, Warping, Under-cured, Thick/Thin, and Delamination, each contributing approximately 3% according to the rounded values in Table 2. Although their individual frequencies are considerably lower than those of the seven dominant categories, their cumulative contribution remains relevant because they collectively account for the remaining portion of recorded defects. This distinction is important for quality-control decision making because low-frequency defects should not automatically be interpreted as negligible or eliminated from monitoring. Instead, their lower occurrence places them behind the dominant categories in the sequence of corrective-action priorities established by the available empirical data. The use of structured defect records allows these categories to remain traceable while directing analytical attention toward the problems with greater observed frequency (Walujo et al., 2020). The defect classification also facilitates consistent comparison among categories because each recorded nonconformity remains linked to the classification applied by the company. Such structured categorization is essential for subsequent statistical prioritization because inconsistent classification could distort the relative contribution of individual defect types.

The empirical profile obtained from the January–June 2025 records shows that quality control at PT. XYZ involves recurring and heterogeneous product nonconformities distributed across fifteen documented categories. The combination of monthly production–reject records and consolidated defect frequencies provides two complementary levels of information, namely the temporal occurrence of rejected products and the composition of those rejects. The first level indicates that reject occurrence persisted throughout the observation period, while the second identifies a marked concentration in seven major defect categories. This distinction is important because aggregate reject counts alone cannot determine which product characteristics require the greatest corrective attention. Statistical Quality Control provides a structured approach for converting inspection records into information that supports identification of dominant defect categories and subsequent quality improvement decisions (Aini, 2024). The resulting profile becomes the quantitative foundation for the Pareto prioritization and causal investigation presented in the following analysis.

Pareto Prioritization of Product Defects

The Pareto analysis was conducted using the consolidated defect frequencies for the fifteen Nusa Bess defect categories recorded during January–June 2025. Each defect category was arranged from the highest to the lowest frequency to determine the relative contribution of individual nonconformities to the recorded rejects. The ranking places Surface defect and Chipping at the highest positions, followed by Edge defect, Holes, Stains, Clave cracks, and Breakage. The remaining eight categories occupy considerably lower positions, indicating that defect occurrence is unevenly distributed across the product-quality profile. This approach allows quality-control activities to focus on defect categories with the greatest observed contribution rather than allocating corrective resources equally among all categories (Mawadati, 2022). The resulting ranking provides the quantitative basis for determining the principal defects requiring further investigation.

The consolidated results show that Surface defect contributed 13%, Chipping 13%, Edge defect 11%, Holes 11%, Stains 10%, Clave cracks 10%, and Breakage 10% of the recorded defects. These seven categories generated a reported cumulative contribution of 78%, while the remaining eight categories accounted for the balance of the defect distribution. The concentration demonstrates that the principal quality problems are represented by a relatively limited group of defect types despite the presence of fifteen documented categories. Such a distribution provides a rational basis for directing improvement activities toward defects with greater observed frequency and contribution. Statistical quality-control applications commonly use this type of defect ranking to determine priority problems before more detailed causal investigations are conducted (Setiawan & Pramudito, 2026). The Pareto result therefore converts the raw defect records into an ordered quality profile that can support operational decision making. Figure 1 visualizes the frequency ranking and cumulative contribution of the fifteen defect categories.

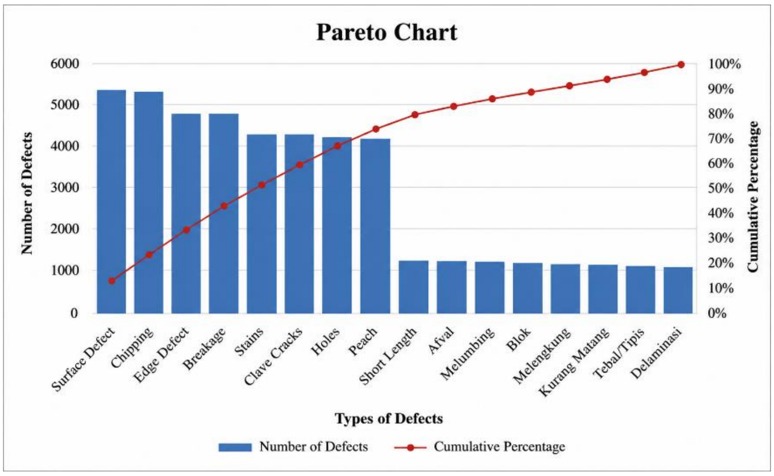

Figure 1. Pareto Diagram of Nusa Bess Product Defects

The Pareto diagram in Figure 1 visually confirms the concentration of defect occurrences within the seven leading categories identified from the consolidated records. Surface defect and Chipping occupy the highest positions, while Edge defect and Holes follow with relatively similar frequencies, creating a marked separation from the lower-ranked categories. The detailed Pareto discussion in the source report records 12.6% for Cacat Permukaan, 12.5% for Cuil, 11.2% for Cacat Pinggir, 12.2% for Berlubang, 10.1% for Flek, 10% for Retak Clave, and 9.9% for Pecah. These detailed percentages are retained as reported and are not recalculated against the rounded percentages in Table 2, because the analysis follows the numerical reporting contained in the original source. The close contribution values among the dominant categories indicate that improvement attention should not be directed toward only the single highest-frequency defect, but should encompass the principal group identified through the Pareto procedure. This interpretation is consistent with the use of SQC to identify dominant defect categories as a basis for systematic quality improvement (Dewatmoko et al., 2025).

The seven dominant categories represent visible and structural forms of product nonconformity, comprising surface defects, chipping, edge defects, holes, stains, cracks, and breakage. Their occurrence across different physical characteristics indicates that the quality problem is not restricted to one specific form of product deterioration. The presence of these defects can be interpreted as an indication that multiple operational conditions may contribute to the quality performance of Nusa Bess products. Pareto analysis, however, only establishes the relative magnitude of the recorded problems and does not independently determine the production factors responsible for their occurrence. The distinction between problem prioritization and causal identification is important because effective quality improvement requires statistical evidence to be followed by analysis of the process conditions associated with the prioritized defects (Baisalim & Soediantono, 2022). The Pareto findings therefore establish the scope of the subsequent Fishbone investigation rather than constituting a complete explanation of defect formation.

The lower-ranked categories consist of Adhesive cracks, Waste, Blistering, Blocks, Warping, Under-cured, Thick/Thin, and Delamination, each contributing approximately 3% based on the rounded values presented in Table 2. Their individual frequencies are substantially lower than those of the seven principal categories, which places them at a lower level of immediate corrective priority. This lower priority does not indicate that these defects are irrelevant to quality control because their occurrence remains part of the documented production profile. Continued monitoring is required because changes in process conditions or improvements in the dominant categories could alter the relative distribution of defects in subsequent production periods. A structured ranking system enables quality personnel to maintain traceability of less frequent defects while concentrating analytical resources on categories with greater documented contributions (Nugroho et al., 2026). The distinction between priority and exclusion allows the quality-control system to remain comprehensive while maintaining an operational focus on the most frequent problems.

The Pareto analysis establishes Surface defect, Chipping, Edge defect, Holes, Stains, Clave cracks, and Breakage as the principal defect categories requiring further causal investigation. The reported cumulative contribution of 78% indicates that these categories represent the dominant portion of the recorded defect profile during January–June 2025. This concentration provides an empirical basis for establishing the sequence of quality-improvement activities because corrective attention can initially be directed toward defects with the greatest documented frequency. The result also demonstrates the analytical value of combining check-sheet data with Pareto visualization, since the raw frequencies become easier to interpret when arranged according to relative contribution and cumulative percentage. Previous defect-analysis research supports the use of statistical prioritization as an initial stage before examining the operational causes underlying major nonconformities (Annandita & Rochmoeljati, 2025). The Pareto findings consequently provide the transition from quantitative defect prioritization to qualitative causal analysis. The next stage examines the factors associated with the prioritized defects through Fishbone analysis using the Man, Machine, Environment, Material, and Method dimensions.

Fishbone Analysis of Dominant Defects

The Fishbone analysis was conducted to identify the potential causes of the seven dominant defect categories obtained from the Pareto analysis, namely Surface defect, Chipping, Edge defect, Holes, Stains, Clave cracks, and Breakage. The analysis considers five causal dimensions, namely Man, Machine, Environment, Material, and Method. These dimensions provide a structured approach for relating the recorded defects to conditions occurring during production and inspection. Cause-and-effect analysis is relevant to quality control because defect frequency alone cannot explain the operational factors underlying product nonconformities (Kementerian Perindustrian, 2007). The causes presented in the analysis follow the conditions documented in the production report without introducing additional causal classifications. The individual Fishbone diagrams are presented below according to the dominant defect categories identified through the Pareto analysis.

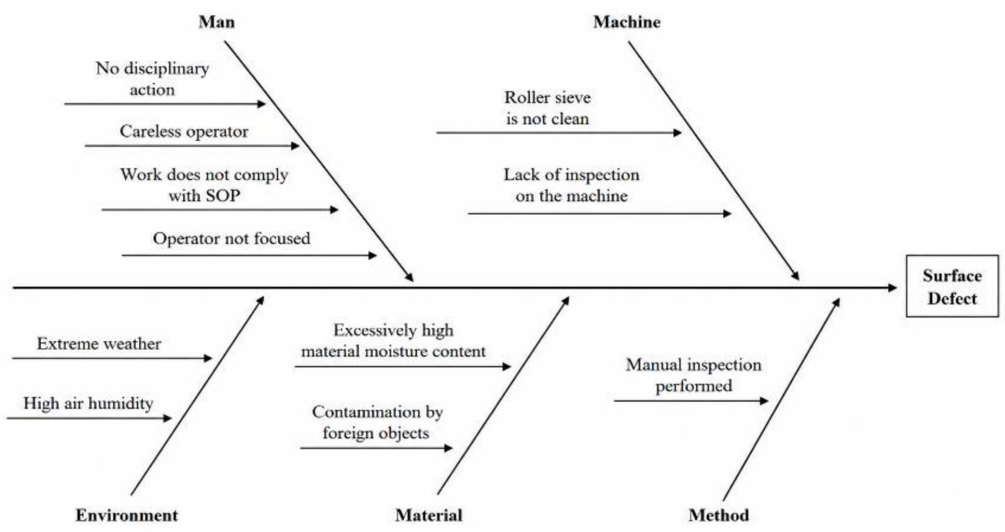

Figure 2. Fishbone Diagram of Surface Defect

The Fishbone diagram in Figure 2 shows that Surface defect is associated with several factors involving operators, machines, materials, environmental conditions, and inspection activities. The documented causes include insufficient operator attention, machine cleanliness, oven-temperature conditions, material contamination, and limitations in manual inspection. These factors indicate that surface defects may arise from interactions between production handling and process conditions rather than from a single activity. Operator concentration and consistent implementation of work procedures are particularly relevant because surface conditions can be affected during several production stages. Human performance and process consistency are important elements in maintaining product quality during repetitive manufacturing activities (Haryadi, 2018). The identified causes therefore provide a basis for improving operator supervision, machine cleanliness, process monitoring, and inspection practices.

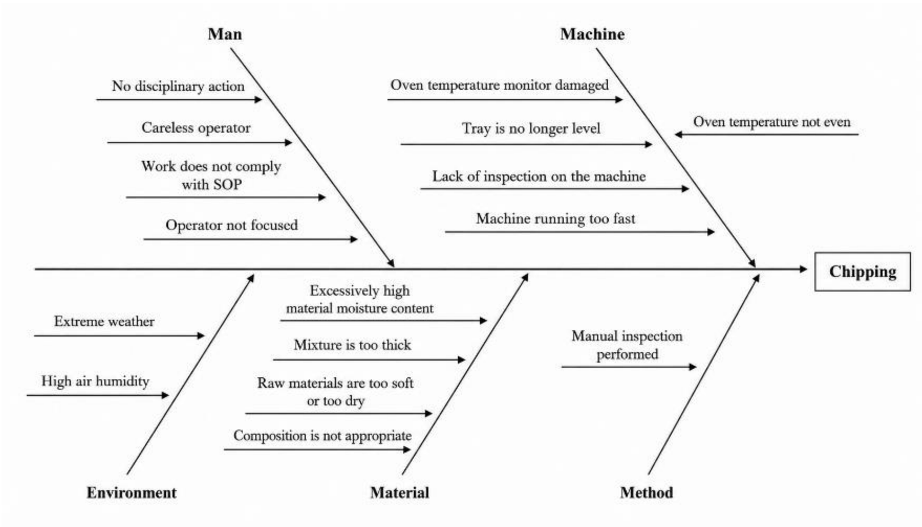

Figure 3. Fishbone Diagram of Chipping

Figure 3 indicates that Chipping is related to operator handling, machine and equipment conditions, material characteristics, and production procedures. The documented factors include roll cleanliness, vacuum clamping, pallet condition, material consistency, and operator attention. These conditions can influence the physical integrity of the product during forming and handling processes. Inconsistent material conditions may increase the possibility of chipping when the product undergoes mechanical handling or processing. Control of equipment condition and material consistency should therefore accompany operator supervision in addressing this defect (Dahlia et al., 2024). The diagram provides a specific view of the operational factors that require attention for Chipping.

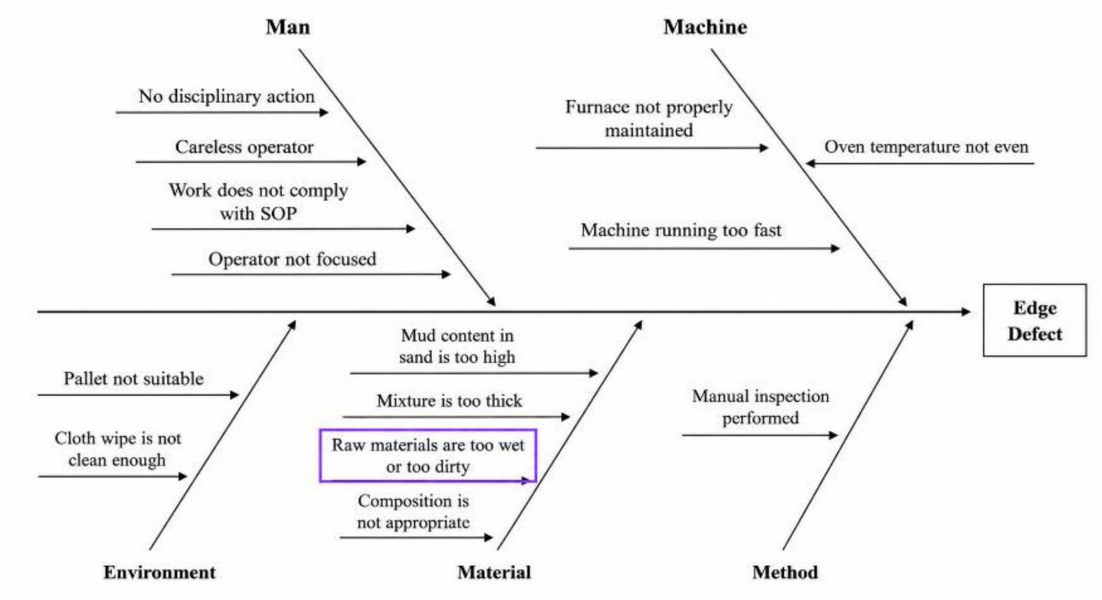

Figure 4. Fishbone Diagram of Edge defect

Figure 4 presents the causal factors associated with Edge defect, particularly those related to cutting, equipment condition, material characteristics, and operator performance. Conditions involving cutting equipment, roll cleanliness, material consistency, and work procedures can influence the uniformity of product edges. The defect therefore has a direct relationship with the consistency of production and handling activities. Inconsistent execution of standard procedures may increase variation in cutting and subsequent product handling. Standardized production procedures and consistent inspection are important for maintaining product conformity during manufacturing operations (Wiyanti et al., 2023). The Fishbone diagram helps identify the process areas that require closer control to reduce Edge defect occurrence.

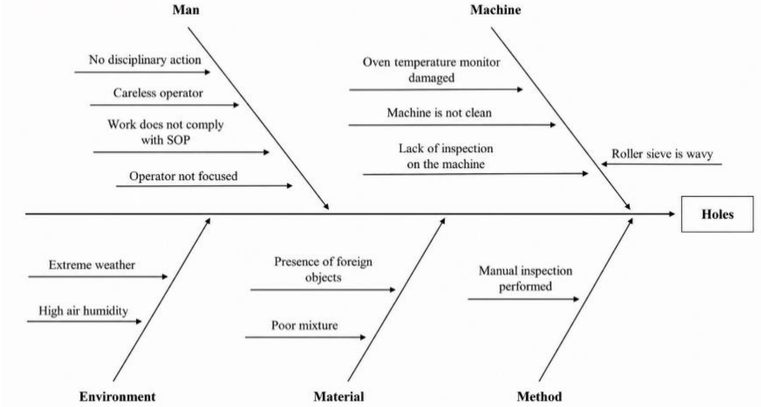

Figure 5. Fishbone Diagram of Holes

The Fishbone diagram in Figure 5 shows that Holes are associated with machine, material, environmental, human, and method-related factors. The documented causes include unstable oven temperature, ineffective temperature monitoring, excessive material moisture, incomplete drying, and limitations in inspection. These conditions indicate that both material preparation and process control can influence the occurrence of holes. Inadequate inspection may also allow defects generated during processing to remain undetected until later stages. The identification of equipment and process conditions as potential defect sources is consistent with quality-control approaches that integrate process monitoring with defect analysis (Azeryan et al., 2026). The diagram therefore highlights the importance of temperature control, material-condition monitoring, and inspection consistency.

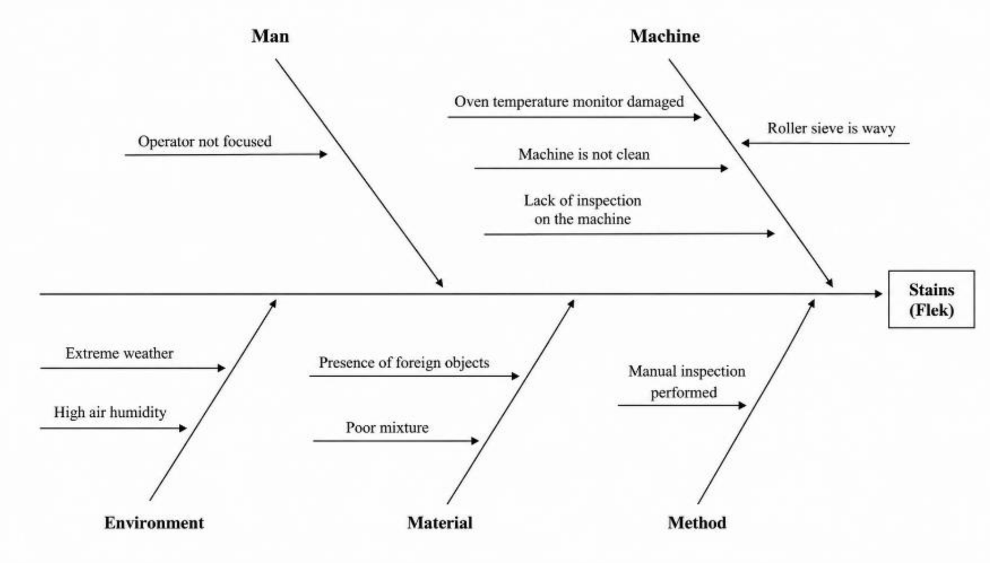

Figure 6. Fishbone Diagram of Stains (Flek)

Figure 6 illustrates the factors associated with Stains, including operator attention, environmental humidity, machine cleanliness, and material contamination. The documented causes indicate that inadequate attention during production and poor control of equipment or material cleanliness may contribute to the appearance of stains. Environmental conditions, particularly high humidity, may also affect material and drying conditions during production. These factors demonstrate the importance of controlling cleanliness and material conditions throughout the production process. Linking visible defects with their potential process causes allows quality personnel to identify preventive controls rather than relying exclusively on final inspection (Walujo et al., 2020). The diagram consequently provides a basis for strengthening cleanliness, environmental monitoring, and material inspection.

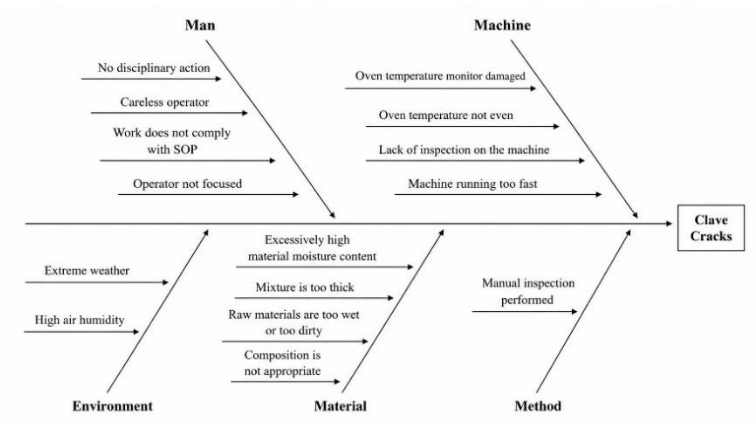

Figure 7. Fishbone Diagram of Clave cracks

The Fishbone diagram in Figure 7 identifies several factors related to the occurrence of Clave cracks, including operator performance, machine and oven conditions, material moisture and consistency, and production methods. Unstable temperature conditions and inappropriate material conditions may affect product integrity during processing. Inconsistent implementation of production procedures can also increase process variation and contribute to the formation of cracks. The interaction between material and process conditions is therefore relevant when examining this defect category. Statistical quality-control approaches can be strengthened by subsequent causal analysis to determine the operational factors associated with dominant defects (Mawadati, 2022). Figure 7 provides the basis for directing corrective attention toward temperature control, material condition, and production-method consistency.

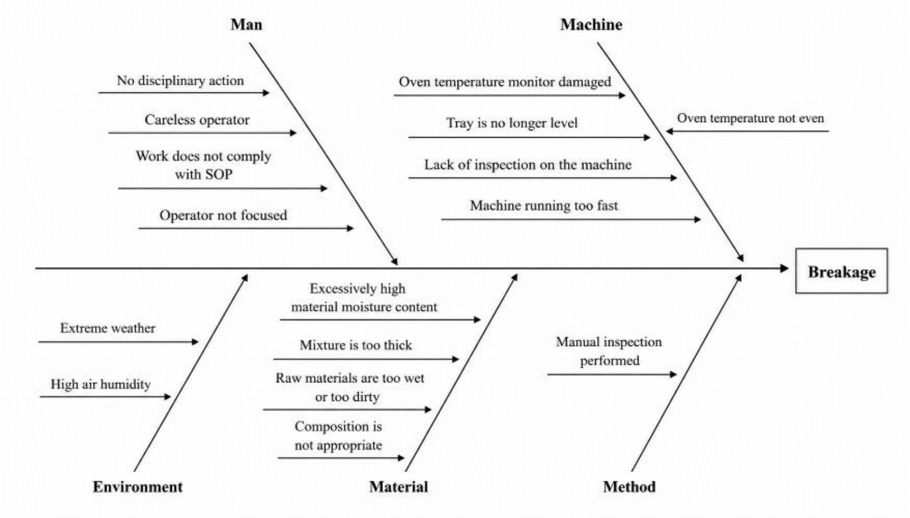

Figure 8. Fishbone Diagram of Breakage

Figure 8 shows that Breakage is associated with human, machine, material, and method factors occurring during production and handling. Operator attention, machine condition, material properties, and production procedures are documented as relevant factors in the occurrence of this defect. Inadequate material consistency or inappropriate process conditions may affect the physical stability of the product during handling. Insufficient inspection may also allow damaged products to continue to subsequent production stages. Integrating defect identification with process monitoring and causal analysis is important for establishing appropriate quality-control improvements (Aini, 2024). The diagram therefore emphasizes the need for consistent handling, machine control, material inspection, and quality checking.

The seven Fishbone diagrams show that the dominant Nusa Bess defects involve recurring combinations of Man, Machine, Environment, Material, and Method factors. Although each defect has specific causal conditions, operator attention, machine condition, material consistency, temperature control, and inspection practices appear repeatedly across the analyzed categories. This pattern indicates that quality improvement can address common process-control weaknesses while retaining specific corrective actions for individual defects. The identified improvement directions include operator training, stricter SOP implementation, routine machine inspection, preventive maintenance, incoming-material inspection, and more consistent quality checking. Product quality depends not only on final inspection but also on the consistency of production activities throughout the manufacturing process (Armstrong et al., 2014). The Fishbone analysis therefore provides the causal basis for determining quality-control improvement priorities following the Pareto prioritization.

Quality Control Implications and Improvement Priorities

The production records indicate that quality control needs to consider both production volume and the occurrence of rejected products during the January–June 2025 period. The defect records further show that nonconformities were distributed across fifteen categories with different levels of frequency.

The concentration of defects in several dominant categories provides a basis for determining which problems require greater attention within the production process. Statistical Quality Control enables inspection records to be organized into structured information that can support quality evaluation and improvement priorities (Wardah et al., 2022). The analytical information is therefore not limited to recording the number of defective products but also supports the identification of quality problems that require further investigation. The relationship between production records and defect classifications provides the empirical foundation for the subsequent improvement priorities.

The quality-control analysis connects defect frequency with the selection of improvement priorities through a sequential analytical process. The check-sheet data first document the occurrence of defects during production and provide the frequency information required for further analysis. Pareto analysis then ranks the defect categories according to their contribution and identifies the principal defects requiring attention. Fishbone analysis subsequently examines the potential causes associated with the prioritized defect categories based on Man, Machine, Environment, Material, and Method factors. This sequence can be represented as frequency → priority → cause → action, creating a logical connection between quantitative defect records and operational improvement. The integration of statistical prioritization and causal analysis is consistent with the application of quality-control methods to determine dominant defects and formulate appropriate improvement actions (Mawadati, 2022). In the Nusa Bess production process, this approach provides a structured basis for moving from defect identification toward targeted quality-control decisions.

Table 4. Quality-Control Analysis Flow for Nusa Bess Products

Quality-Control Stage	Information Generated	Improvement Function
Check Sheet	Production and defect records	Systematic documentation of defects
Defect Classification	Fifteen defect categories	Identification of nonconformity types
Pareto Analysis	Frequency and cumulative contribution	Determination of dominant defects
Fishbone Analysis	Man, Machine, Environment, Material, Method	Identification of potential causes
Improvement Priority	Dominant defects and causal factors	Basis for corrective and preventive action

The human and procedural factors identified in the Fishbone analysis indicate that operator performance and SOP implementation should receive attention in the improvement process. The documented Man factors include lack of attention, lack of focus, fatigue, production pressure, and inconsistent compliance with established procedures. The Method factors include limitations in manual inspection, uneven mixing, and inconsistent execution of SOPs. Improvement actions can therefore include operator training, routine supervision, regular briefings, and reinforcement of standardized work procedures. Consistent implementation of quality procedures is important because differences in operator practices can influence the stability of repetitive manufacturing activities (Haryadi, 2018). Strengthening operator competence and procedural discipline can support more consistent production and inspection activities without introducing additional experimental intervention.

Machine-related factors indicate the need for systematic equipment maintenance and process-parameter control. The Fishbone analysis identifies unstable oven temperature, ineffective temperature monitoring, unsuitable oven plates, excessive machine speed, and insufficient machine checking as documented machine-related conditions. Routine inspection and preventive maintenance can be directed toward equipment components and operating conditions associated with the identified defects. Temperature monitoring requires particular attention because oven conditions are documented as relevant to several defects, including holes and cracks. Regular monitoring of machine settings can also help detect process abnormalities before they contribute to larger quantities of nonconforming products. Research integrating statistical process control with failure analysis supports the importance of combining process monitoring with preventive control of equipment-related factors (Azeryan et al., 2026). Machine maintenance and parameter supervision should therefore complement final-product inspection as part of the overall quality-control process.

Material and environmental conditions represent additional priorities identified from the causal analysis. Incoming-material inspection should focus on documented conditions such as moisture content, material softness, composition, contamination, and consistency before materials enter subsequent production stages. Routine briefings can reinforce proper material handling and awareness of environmental conditions that may influence production. Consistent SOP implementation is also required to maintain uniformity in material preparation and processing activities. Environmental conditions such as high humidity and extreme weather should be considered when monitoring factors associated with drying and product quality. The integration of material, environmental, and process controls is consistent with quality-control approaches that identify and manage potential sources of defective products (Dahlia et al., 2024). These controls provide opportunities to address potential quality problems at earlier production stages rather than relying exclusively on final-product inspection.

The analysis establishes seven dominant defect categories, namely Surface defect, Chipping, Edge defect, Holes, Stains, Clave cracks, and Breakage, as the principal quality priorities identified from the documented defect distribution. The Fishbone analysis further identifies recurring potential causes involving Man, Machine, Environment, Material, and Method. These findings support improvement priorities involving operator training, SOP supervision, machine maintenance, process-parameter monitoring, incoming-material inspection, environmental control, and systematic inspection. The proposed priorities are derived from the empirical production and defect records and the causal conditions documented in the source analysis. No additional numerical measurements, experimental treatments, or statistical tests are introduced beyond the available data. The use of check sheets, Pareto analysis, and Fishbone analysis provides a structured means of translating production-quality data into information for corrective and preventive decision making (Walujo et al., 2020). This framework can support the strengthening of quality control and the reduction of dominant defect problems in the Nusa Bess production process.

CONCLUSION

The study found that Nusa Bess production at PT. XYZ generated 555,216 units with 42,860 rejected units during January–June 2025. Fifteen defect categories were identified, with Surface defect, Chipping, Edge defect, Holes, Stains, Clave cracks, and Breakage constituting the dominant group with a reported cumulative contribution of 78%. The detailed Pareto analysis identified Surface defect as the highest-priority defect while retaining the percentages reported in the original source. Fishbone analysis identified Man, Machine, Environment, Material, and Method as the five causal dimensions associated with the observed defects. The main documented conditions included operator inattention and SOP noncompliance, unstable oven temperature and machine conditions, high humidity and extreme weather, unsuitable material moisture or composition, and limitations in manual inspection. These findings fulfill the research objective of identifying the dominant defects and their principal causal factors within the Nusa Bess quality-control process. The results provide an empirical basis for directing subsequent quality-control improvements toward the most frequently occurring defect categories and their associated process conditions.

The improvement priorities derived from the analysis include strengthening operator training and supervision, enforcing SOP and machine-setting controls, conducting scheduled machine maintenance, replacing critical components, providing routine operator briefings, and improving incoming-material inspection. These recommendations are based on the documented causal findings and existing recommendations in the practicum report without introducing additional performance targets or statistical claims. The methodological contribution of the study lies in integrating consolidated defect records with Pareto prioritization and Fishbone cause analysis. This integration provides a structured basis for moving from defect frequency to priority identification and causal evaluation. The practical implication is a more focused quality-control framework for directing corrective attention toward frequently occurring defects and their associated process factors. Implementation of these recommendations remains subject to PT. XYZ's operational decisions and existing production, inspection, and quality standards. The proposed approach can serve as a practical basis for strengthening quality-control activities and supporting continuous improvement in the Nusa Bess production process.

REFERENCES

Achiraini, R., Pertiwi, S., & Pramudita, R. (2019). *Manajemen mutu dan pengendalian kualitas produk*. Prenada Media Group.

Aini, L. Q. (2024). Analisis Pengendalian Kualitas Produk Menggunakan Metode Statistical Quality Control (SQC) di PT. Bumimulia Indah Lestari. *UNISTEK*, *11*(1), 25-39. https://doi.org/10.33592/unistek.v11i1.3729

Almadani, D. A. I., & Dahda, S. S. (2022). Product defect analysis using statistical quality control method at PT. XYZ. *JENIUS: Jurnal Terapan Teknik Industri, 3*(2), 103–113. https://doi.org/10.37373/jenius.v3i2.324

Annandita, A. R., & Rochmoeljati, R. (2025). Analysis Defect Products in Silencers Using the New Seven Tools Method. *Journal La Multiapp*, *6*(2), 257-275. https://doi.org/10.37899/journallamultiapp.v6i2.1986

Armstrong, G., Kotler, P., Harker, M., & Brennan, R. (2014). *Marketing: An introduction* (12th ed.). Pearson Education Limited.

Azeryan, V., Dwicahyani, A. R., & Maharani, D. (2026). Integrating statistical process control and failure mode and effects analysis to reduce product defects in oil filter manufacturing (Case study: CV XYZ). *Journal of Advances in Information and Industrial Technology, 8*(1), 21–32. https://doi.org/10.52435/jaiit.v8i1.710

Baisalim, M. F., & Soediantono, D. (2022). Literature Review of Quality Control Circle (QCC) and Implementation Recommendation to the Defense Industries. *Journal of Industrial Engineering & Management Research*, *3*(2), 61-72. https://doi.org/10.7777/jiemar.v3i2.277

Dahlia, A., Tongsuku, L. O. A. S., & Gunawan, S. (2024). Quality control analysis to minimize the risk of defective products using statistical process control (SPC) and failure modes and effect analysis (FMEA) methods (Case study: PT XYZ Samarinda). *Indonesian Journal of Industrial Engineering and Management, 5*(2), 620. https://doi.org/10.22441/ijiem.v5i2.24039

Dewatmoko, S., Nurmartiani, E., & Ramdhany, M. A. (2025). Analysis of Doll Product Quality Control Using Statistical Quality Control (SQC) Methods at PT Aurora World Cianjur. *Multifinance*, *3*(2), 102-113. https://doi.org/10.61397/mfc.v3i2.489

Diansari, B. N., Waluyono, G. F., & Fauzan, F. (2024). Pengendalian kualitas produk dengan metode Statistical Quality Control (SQC) di PT. XYZ. *Jurnal Penelitian Rumpun Ilmu Teknik, 3*(2), 77–87. https://doi.org/10.55606/juprit.v3i2.3979

Hairiyah, N., Amalia, R. R., & Nuryati. (2024). Quality control of SIR 20 product using the Statistical Quality Control (SQC) at PT. WLK. *Jurnal Teknologi Agro-Industri, 11*(1). https://doi.org/10.34128/jtai.v11i1.191

Haryadi. (2018). *Analisa pengendalian kualitas untuk mengurangi jumlah cacat produk dari proses cutting dengan metode Quality Control Circle (QCC) pada PT. Toyota Boshoku Indonesia (TBINA)*. Kementerian Perindustrian.

Kementerian Perindustrian. (2007). *Gugus kendali mutu (GKM)*.

Mawadati, A. (2022). Proposed quality improvement of clutch disc products using Statistical Quality Control and Fault Tree Analysis methods at PT. Exedy Manufacturing Indonesia. *Jurnal Engineering, 13*(2), 138–148. https://doi.org/10.24905/jureng.v13i2.54

Nasti, M. (2019). *Pengendalian mutu dalam industri manufaktur*. Andi Offset.

Nugroho, Y., Azizah, F. N., & Hidayat, T. R. (2026). Product defects analysis at PT Naigai Shirts Indonesia using process control statistics and process capability analysis. *Barometer, 11*(2), 89–93. https://doi.org/10.35261/barometer.v11i2.13217

Setiawan, Y. A., & Pramudito, O. (2026). Quality Control Analysis in an Effort to Reduce Product Defects in Coin Material Production at PT. Bintang Tenaga Multikarya. *Business, Economics, Law, Communication, and Social Sciences*, *2*(1), 1-13. https://doi.org/10.66755/belacoss.v2i1.150

Walujo, D. A., Koesjati, T., & Utomo, Y. (2020). *Pengendalian kualitas* (D. A. Walujo, Ed.). Scopindo Media Pustaka.

Wardah, S., Rahmawati, D., & Fauziah, N. (2022). *Statistical quality control: Konsep dan aplikasi di industri manufaktur*. Rajawali Pers.

Wignjosoebroto, S. (2006). *Ergonomi: Studi gerak dan waktu*. Guna Widya.

.

Wiyanti, T., Lestari, F., Yoedani, Y., & Iskandar, Y. (2023). Production Quality Control as An Important Factor to Meet Buyer Quality Standards at The Garment Company PT. Sukabumi Single Estuary. *Devotion: Journal of Research and Community Service*, *4*(5), 1195-1210. https://doi.org/10.59188/devotion.v4i5.432