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Analysis of Defects Dominant Incoming Material Using Pareto Diagram and Root Cause Analysis in the Incoming Quality Control section of PT. X

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Abstract

Incoming material quality is a critical factor affecting production continuity and final product quality. Nonconforming materials may increase rejection rates, raise production costs, and reduce operational efficiency. This study aims to identify the quality condition of incoming materials, determine the dominant defect type, and analyze the factors contributing to the occurrence of dominant defects in the Incoming Quality Control (IQC) department of PT. X. A quantitative descriptive approach was employed using NG Rate analysis, Pareto Analysis, and Root Cause Analysis (RCA) supported by a Fishbone Diagram. The research data were obtained from the Daily IQC Performance Report and Summary IPRR & IQC Claim Report for January 2026. The results revealed that Vendor MT recorded the highest rejection frequency and NG Rate. Pareto Analysis identified flash defects as the dominant defect category, contributing 26.43% of total defects, while the six most frequent defect types accounted for 80.07% of all incoming material nonconformities. Furthermore, RCA results indicated that flash defects were potentially influenced by material, machine, method, and human factors. The findings demonstrate that the integration of Pareto Analysis and RCA effectively supports the identification of critical quality problems and their potential causes, thereby enhancing quality control effectiveness and supplier performance evaluation.
Keywords: *incoming quality control, defect, NG rate, pareto analysis, root cause analysis*

Abstrak

Kualitas *incoming material* merupakan faktor penting yang memengaruhi kelancaran proses produksi dan kualitas produk akhir. Material yang tidak memenuhi standar dapat meningkatkan jumlah *reject*, menambah biaya produksi, serta menurunkan efisiensi operasional perusahaan. Penelitian ini bertujuan untuk mengidentifikasi kondisi kualitas *incoming material*, menentukan jenis *defect* dominan, serta menganalisis faktor-faktor yang berpotensi menyebabkan terjadinya *defect* dominan pada bagian *Incoming Quality Control* (IQC) PT. X. Metode yang digunakan adalah pendekatan deskriptif kuantitatif dengan analisis *NG Rate*, Diagram Pareto, dan *Root Cause Analysis* (RCA) menggunakan *Fishbone Diagram*. Data penelitian diperoleh dari laporan *Daily IQC Performance* dan *Summary IPRR & IQC Claim* periode Januari 2026. Hasil penelitian menunjukkan bahwa Vendor MT memiliki jumlah *reject* dan nilai *NG Rate* tertinggi. Analisis Pareto mengidentifikasi *flash defect* sebagai *defect* dominan dengan kontribusi sebesar 26,43% dari total *defect*, sedangkan enam jenis *defect* utama menyumbang 80,07% dari keseluruhan ketidaksesuaian material. Hasil RCA menunjukkan bahwa *flash defect* dipengaruhi oleh faktor *material*, *machine*, *method*, dan *man*. Temuan penelitian menunjukkan bahwa integrasi Diagram Pareto dan RCA efektif dalam mengidentifikasi prioritas permasalahan kualitas serta faktor penyebabnya, sehingga dapat mendukung peningkatan efektivitas pengendalian kualitas dan evaluasi kinerja pemasok.
Kata Kunci: *incoming quality control, defect, NG rate, diagram pareto, root cause analysis*

1. Introduction

Quality is one of the most important aspects of manufacturing activities because it is closely related to a company's ability to produce products that meet specifications and customer requirements [1]. Products that fail to meet quality standards may lead to increased defect rates, higher production costs, and reduced final product quality [2]. Therefore, quality control must be consistently implemented throughout every stage of the production process, including the receipt of materials from suppliers [3]. One form of quality control is Incoming Quality Control (IQC), which refers to the inspection of materials received from suppliers before they are used in production. This inspection aims to ensure that incoming materials comply with company quality standards and to minimize the use of defective materials in manufacturing processes

(Harti et al., 2024). Poor incoming material quality can increase material rejection rates, disrupt production activities, and negatively affect the quality of finished products [4].

Based on observations conducted in the Incoming Quality Control (IQC) department of PT. X, various types of defects were identified in incoming materials supplied by vendors. These defects included crack, silver, oily, bending, and several other nonconformities that contributed to an increase in the number of Not Good (NG) materials. In addition, differences in rejection quantities among suppliers indicated variations in the quality level of incoming materials received by the company [5]. Such conditions may disrupt production continuity if nonconforming materials are not promptly identified and controlled. Therefore, further analysis of incoming material inspection data is required to identify the most dominant defect types as a basis for evaluating and improving supplier quality control performance [6].

Several previous studies have employed quality control methods to identify dominant defect types. One study conducted applied the Seven Tools method to analyze product defects and demonstrated that Pareto Analysis is effective in identifying defect categories with the highest occurrence frequencies [7]. Another study reported that the Seven Tools approach supports quality control activities by facilitating defect identification and quality improvement prioritization [8]. Another study explained that Pareto Analysis can be used to prioritize quality problems based on defect frequency, enabling companies to focus improvement efforts on the most significant issues [9]. Furthermore, a study conducted [10] found that Fishbone Diagrams, as part of the Root Cause Analysis (RCA) approach, are capable of identifying factors contributing to defect occurrence and can serve as a basis for developing corrective actions [11].

Although previous studies have successfully identified dominant defects and their causes, most of them focused on internal production processes and paid limited attention to quality problems associated with incoming materials in the Incoming Quality Control (IQC) function. In addition, prior studies generally utilized Pareto Analysis solely to prioritize quality issues based on defect frequency without further investigating the root causes of defects in the context of incoming materials. In practice, identifying the factors contributing to dominant defects is essential for supplier quality evaluation and the development of more effective quality control strategies. Therefore, the novelty of this study lies in the integrated application of Pareto Analysis and Root Cause Analysis (RCA) to analyze dominant defects in incoming materials within the Incoming Quality Control (IQC) department of PT. X.

Pareto Analysis was used to identify defect types that contributed most significantly to total incoming material defects, while Root Cause Analysis (RCA) supported by a Fishbone Diagram was employed to determine the factors potentially responsible for the occurrence of dominant defects [12]. The combination of these methods is expected to provide a more comprehensive understanding of incoming material quality, not only in terms of defect prioritization but also regarding the underlying causes of quality problems.

Based on the issues described above, this study aims to identify the quality condition of incoming materials based on Incoming Quality Control (IQC) inspection data, determine the dominant defect types using Pareto Analysis, and identify the factors contributing to dominant defects through Root Cause Analysis (RCA) [13]. The findings are expected to contribute to improving the effectiveness of incoming material quality control, supporting supplier quality evaluation, and providing a reference for future studies related to defect analysis and quality control within the Incoming Quality Control (IQC) function.

2. Material and Methods

This study employed a quantitative descriptive approach to identify the dominant defect types in incoming materials and analyze the factors potentially contributing to their occurrence. The research was conducted in the Incoming Quality Control (IQC) department of PT. X during the internship period. The object of the study consisted of incoming materials received from suppliers and inspected by the IQC department before being released to the production process [14].

The study utilized both secondary and primary data sources. Secondary data were obtained from company documents, namely the Daily IQC Performance Report and Summary IPRR & IQC Claim Report for January 2026. These data included information regarding the quantity of received materials, rejected materials, defect types, supplier identities, and corrective actions taken for materials that did not meet the company's quality standards [15]. Primary data were collected through direct observation during the internship period and discussions with IQC personnel to support the identification of factors contributing to dominant defects.

Data collection was conducted through three methods: observation, documentation, and literature review. Observation was carried out to understand the incoming material inspection process and the handling procedures for nonconforming materials. Documentation involved collecting and reviewing inspection records and quality reports maintained by the company. In addition, a literature review was performed to examine previous studies and theoretical references related to quality control, Pareto Analysis, and Root Cause Analysis (RCA) as the conceptual foundation of this research [8].

The data analysis process was conducted in several stages. First, the condition of incoming material quality was analyzed based on IQC inspection data [16]. Second, the Not Good (NG) Rate was calculated to determine the level of material nonconformity for each supplier using Equation (1).

$$\text{NG Rate (\%)} = (\text{Number of Rejected Materials} / \text{Total Received Materials}) \times 100\% \quad (1)$$

Third, Pareto Analysis was applied to identify the dominant defect types based on their frequency of occurrence. Defect data were arranged in descending order, followed by the calculation of percentage and cumulative percentage values to determine quality problem priorities according to the Pareto principle. The defect type with the highest contribution to total defects was selected as the focus of further analysis.

The final stage involved identifying the root causes of the dominant defect using the Root Cause Analysis (RCA) approach supported by a Fishbone Diagram. The analysis was based on inspection data, direct observations, and information obtained from IQC personnel. Potential causes were categorized into four major factors: man, method, material, and machine, to facilitate the identification of relationships between quality problems and their contributing factors.

This study assumes that the IQC inspection data collected during January 2026 adequately represent the incoming material quality condition during the observation period. Furthermore, all company records used in the analysis are assumed to be valid and verified by the relevant department. This research does not include direct investigations of supplier production processes or supplier quality management systems. Therefore, factors associated with supplier operations were identified based on company records, observational findings, and relevant literature.

3. Results and Discussion

Incoming Material Defect Condition

The inspection results of incoming materials conducted by the Incoming Quality Control (IQC) department at PT. X during January 2026 indicated that several suppliers contributed to a considerable number of rejected materials. These findings reflect variations in the quality of materials supplied to the company and highlight the importance of monitoring supplier performance. A summary of rejected incoming materials is presented in **Table 1**.

Table 1. Incoming Material Rejection Data in January 2026

No.	Vendor	Dominant Defect Type	Total Reject
1	MT	Flash	1017
2	PP	Remain Trimming	641
3	FP	Dirty	567
4	IT	Scratch	301
5	TP	Gate Long	283
6	SA	Dimension Out	272
7	TI	Appearance	217
8	AP	Broken	194
9	SI	Mix Part	194
10	YI	Warpage	166

As shown in **Table 1**, vendor MT recorded the highest number of rejected materials, with 1,017 cases associated with the flash defect. This number was substantially higher than those of other vendors, such as vendor PP with 641 cases of remain trimming defects and vendor FP with 567 cases of dirty defects. These findings indicate that the conformity level of incoming materials varied considerably among suppliers.

The differences in rejection rates suggest inconsistencies in suppliers' abilities to meet the quality specifications established by the company. Suppliers with a high number of rejected materials may increase inspection workload, sorting activities, and return-to-vendor processes, potentially disrupting production schedules and reducing operational efficiency. Therefore, suppliers exhibiting the highest rejection frequencies should be prioritized in supplier evaluation and quality improvement initiatives.

Furthermore, the findings demonstrate that the role of Incoming Quality Control (IQC) extends beyond preventing nonconforming materials from entering the production process. The inspection outcomes also provide valuable information regarding supplier quality performance, which can serve as a basis for supplier assessment, quality monitoring, and the development of corrective actions aimed at reducing the occurrence of incoming material defects.

Analysis of Incoming Material NG Rate

The NG (Not Good) rate analysis was conducted to evaluate the level of material nonconformity identified during the incoming inspection process. The NG rate represents the proportion of rejected materials relative to the total number of materials received from each supplier. This indicator was used to assess supplier quality performance and identify suppliers requiring further evaluation.

Table 2. Incoming Material NG Rate in January 2026

No.	Vendor	Total Received	Total Reject	NG Rate
1	MT	12,500	1,017	8.14%
2	PP	9,800	641	6.54%
3	FP	8,700	567	6.52%
4	IT	7,600	301	3.96%
5	TP	6,900	283	4.10%
6	SA	7,280	272	3.74%
7	TI	6,950	217	3.12%
8	AP	6,510	194	2.98%
9	SI	6,760	194	2.87%
10	YI	6,780	166	2.45%

Table 2 shows that vendor MT had the highest NG rate at 8.14%, corresponding to 1,017 rejected materials out of 12,500 received units. Vendors PP and FP followed with NG rates of 6.54% and 6.52%, respectively. These findings indicate that a considerable proportion of incoming materials from certain suppliers did not comply with the quality standards established by the company.

The variation in NG rates among suppliers reflects differences in the consistency of supplier quality performance. Suppliers with higher NG rates demonstrated a greater likelihood of delivering nonconforming materials, thereby increasing the risk of production disruptions, additional inspection activities, sorting processes, and return-to-vendor procedures. Consequently, suppliers with elevated NG rates should be prioritized for supplier quality evaluation and corrective action initiatives.

Among all suppliers evaluated, vendor MT exhibited the poorest quality performance during the observation period. The relatively high NG rate suggests that incoming materials supplied by this vendor had a higher probability of failing to meet the required specifications compared with materials supplied by other vendors. Therefore, vendor MT was identified as a critical supplier requiring further investigation to determine the underlying causes of material nonconformities.

The results of the NG rate analysis provide valuable insights for supplier performance monitoring and decision-making within the Incoming Quality Control (IQC) function. By periodically evaluating NG rates, companies can identify quality trends, establish supplier improvement priorities, and implement preventive actions aimed at reducing incoming material defects. Such efforts are essential to maintaining production continuity and ensuring that only materials conforming to quality standards are released for subsequent manufacturing processes.

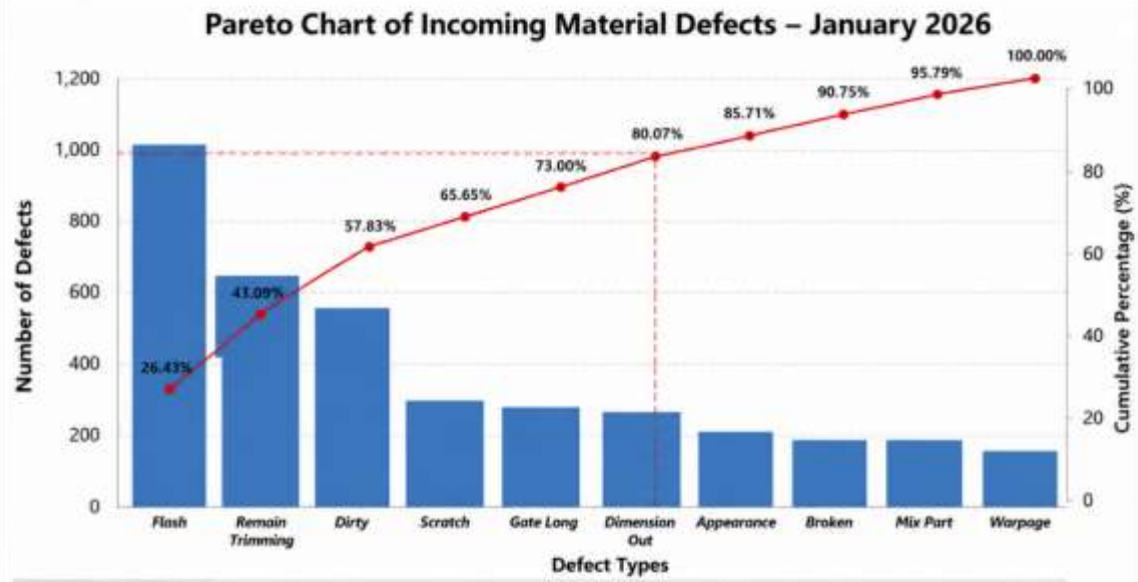
Analysis of Incoming Material NG Rate

The Pareto analysis was conducted to identify the dominant defect types found during the incoming material inspection process at PT. X. The analysis was based on defect data collected by the Incoming Quality Control (IQC) department during January 2026. Defects were arranged in descending order according to their frequency of occurrence to determine the most critical quality issues requiring corrective action. The results of the Pareto analysis are presented in **Table 3**, while the graphical representation is shown in **Figure 1**.

Table 3. Pareto Analysis of Incoming Material Defects in January 2026

No.	Defect Type	Frequency	Percentage	Cumulative Percentage
1	Flash	1,017	26.43%	26.43%
2	Remain Trimming	641	16.66%	43.09%
3	Dirty	567	14.74%	57.83%
4	Scratch	301	7.82%	65.65%

No.	Defect Type	Frequency	Percentage	Cumulative Percentage
5	Gate Long	283	7.35%	73.00%
6	Dimension Out	272	7.07%	80.07%
7	Appearance	217	5.64%	85.71%
8	Broken	194	5.04%	90.75%
9	Mix Part	194	5.04%	95.79%
10	Warpage	166	4.21%	100.00%



Number of Defects	1,017	641	567	301	283	272	217	194	194	166
Percentage	26.43%	16.66%	14.74%	7.82%	7.35%	7.07%	5.64%	5.04%	5.04%	4.21%
Cumulative Percentage	26.43%	43.09%	57.83%	65.65%	73.00%	80.07%	85.71%	90.75%	95.79%	100.00%

Source: Daily IQC Performance Data of PT. X, January 2026 (processed by the author)

Fig. 1: Percentage of the area of Banda Aceh city by land us

The Pareto analysis revealed that flash was the most dominant defect type, accounting for 1,017 cases or 26.43% of the total defects identified during the observation period. This was followed by remain trimming and dirty defects, which contributed 16.66% and 14.74% of total defects, respectively. These findings indicate that a relatively small number of defect categories contributed substantially to the overall incoming material quality problems.

Based on the cumulative percentages presented in Table 3, the first six defect categories (flash, remain trimming, dirty, scratch, gate long, and dimension out) accounted for 80.07% of all detected defects. This result is consistent with the Pareto principle, which suggests that the majority of quality problems are often generated by a limited number of critical causes. Therefore, focusing improvement initiatives on these dominant defects is expected to yield a greater impact on reducing the overall rejection rate.

Among all defect categories, flash was identified as the most critical issue requiring immediate attention. The high frequency of this defect indicates that it significantly contributed to incoming material rejection and may have adversely affected production efficiency through increased inspection efforts, sorting activities, and material handling processes. Consequently, addressing the root causes of flash defects has the potential to improve incoming material quality and reduce operational inefficiencies.

The application of Pareto analysis enabled the company to establish priorities for quality improvement based on objective defect data. Rather than allocating resources equally across all defect types, the results provide a basis for directing quality control efforts toward the most significant contributors to material nonconformities. This prioritization approach supports more effective decision-making in supplier quality management and incoming inspection activities.

Given that flash defects represented the largest proportion of incoming material defects, this defect type was selected for further investigation using the Root Cause Analysis (RCA) approach. The subsequent analysis aimed to identify the potential factors contributing to the occurrence of flash defects and to provide insights for developing appropriate corrective actions.

Quality Control Practices for Incoming Materials

Quality control activities within the Incoming Quality Control (IQC) department of PT. X are conducted to ensure that incoming materials received from suppliers conform to the company's quality standards before being released to the production process. The inspection process includes visual examination, dimensional measurement, functional testing, and documentation of inspection results during incoming material verification. These activities serve as the first line of defense against the use of nonconforming materials that may adversely affect production quality and operational performance.

Based on the Summary IPRR & IQC Claim data, several incoming materials were found to have quality nonconformities that required corrective handling by the IQC department. Various quality control actions were implemented depending on the severity and characteristics of the defects identified. The handling actions applied to rejected materials are summarized in **Table 4**.

Table 4. Quality Control Actions for Rejected Incoming Materials in January 2026

No.	Vendor	Defect Type	IQC Action
1	MT	Flash	Reject and Return to Vendor (RTV)
2	PP	Remain Trimming	Sorting
3	FP	Dirty	Cleaning and Sorting
4	IT	Scratch	Material Rejection
5	TP	Gate Long	Supplier Claim
6	SA	Dimension Out	Sorting and Recheck
7	TI	Appearance	Visual Checking
8	AP	Broken	Reject
9	SI	Mix Part	Sorting
10	YI	Warpage	Return to Vendor (RTV)

As presented in **Table 4**, the Incoming Quality Control (IQC) department implemented various corrective actions according to the type and severity of defects identified during incoming inspection. Materials with critical defects, such as flash, broken, and warpage, were subjected to rejection or Return to Vendor (RTV) procedures to prevent nonconforming materials from entering the production process. Meanwhile, defects that could still be corrected or segregated, such as remain trimming, dirty, and mix part, were addressed through sorting, cleaning, or rechecking activities. These actions demonstrate the role of IQC in ensuring that only materials meeting the company's quality requirements are released for production.

The quality control measures also provide valuable information for supplier performance evaluation and continuous improvement initiatives. Based on the Pareto analysis, flash was identified as the most dominant defect, accounting for 1,017 occurrences or 26.43% of the total defects recorded during January 2026. This finding indicates that flash defects represent the most critical quality issue affecting incoming materials and should therefore become the primary focus of improvement efforts. Consequently, further analysis using the Root Cause Analysis (RCA) approach was conducted to identify the factors contributing to the occurrence of flash defects and to support the development of appropriate corrective actions.

Root Cause Analysis of Flash Defects

To identify the factors contributing to the occurrence of flash defects, a Root Cause Analysis (RCA) was conducted using a Fishbone Diagram. The analysis was based on IQC inspection data, observations during the internship period, and relevant literature. The Fishbone Diagram was employed to systematically categorize the potential causes of flash defects and to facilitate the identification of the most influential factors affecting incoming material quality.

Based on **Figure 2**, the occurrence of flash defects is potentially influenced by four major factors, namely material, machine, method, and man. Material-related factors include incoming materials that do not fully comply with company specifications and variations in supplier quality consistency. Machine-related factors are associated with mold wear and improper machine settings during the supplier's production process, which may result in excess material formation and increase the likelihood of flash defects. Although the supplier's production process was not directly observed, these factors were identified based on literature findings and defect characteristics observed during incoming inspections.

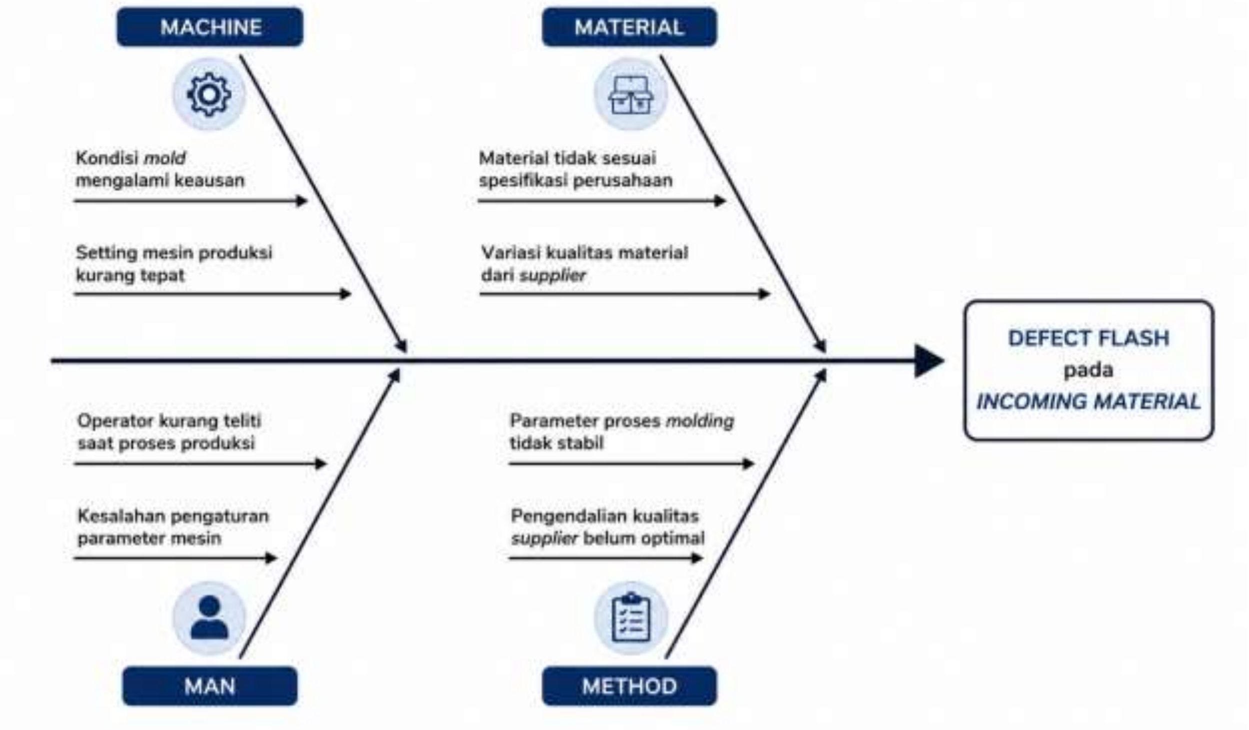


Fig. 2: Fishbone Diagram of Flash Defects in Incoming Materials

In addition, method and human factors were identified as potential contributors to flash defects. Method-related issues include inconsistent production procedures, unstable molding parameters, and inadequate quality control practices at the supplier level. Meanwhile, human factors are associated with operator errors and insufficient attention when setting production parameters. These findings indicate that flash defects are influenced by multiple interconnected factors rather than a single root cause. Therefore, improving supplier process control, strengthening quality monitoring activities, and conducting periodic supplier evaluations are expected to reduce the occurrence of flash defects and improve the quality performance of incoming materials.

Quality Control Improvement Efforts

Based on the results of the defect analysis, NG rate evaluation, Pareto analysis, and Root Cause Analysis (RCA) of flash defects, several quality control improvement efforts are required to minimize the occurrence of nonconforming incoming materials. These efforts are intended to ensure that materials received from suppliers consistently meet the quality specifications established by the company and can be safely released for production activities.

One of the primary quality control measures implemented by the company is the Incoming Quality Control (IQC) inspection process, which includes visual inspection, dimensional verification, functional testing, and documentation of inspection results according to established quality standards. Through these inspection activities, nonconforming materials can be identified and isolated before entering the production process. In addition, corrective actions such as sorting, rechecking, material rejection, and Return to Vendor (RTV) procedures are applied to defective materials to prevent quality issues from affecting downstream manufacturing operations.

Supplier quality evaluation also plays a significant role in quality improvement initiatives. The evaluation is conducted based on material rejection data, NG rates, and defect trends identified during incoming inspections. The results provide valuable information for communication and coordination with suppliers regarding quality issues and corrective actions. Furthermore, suppliers associated with high defect frequencies, particularly flash defects, should receive closer monitoring and periodic performance reviews. Continuous implementation of these quality control efforts is expected to reduce incoming material defects, improve supplier quality performance, and support production continuity by ensuring that incoming materials consistently comply with company quality requirements.

4. Conclusion

This study analyzed the quality performance of incoming materials inspected by the Incoming Quality Control (IQC) department of PT. X using NG Rate analysis, Pareto analysis, and Root Cause Analysis (RCA). The results revealed that variations in incoming material quality still existed among suppliers, as indicated by differences in rejection levels and NG rates. Vendor MT exhibited the highest rejection frequency and NG rate, highlighting the need for closer supplier quality monitoring. Pareto analysis identified flash defects as the most dominant defect category, contributing 26.43% of total defects, while the six most frequent defect types accounted for 80.07% of overall incoming material nonconformities. Furthermore, the RCA results indicated that flash defects were potentially influenced by material, machine, method, and human factors, suggesting that defect occurrence was associated with both supplier production conditions and quality management practices. These findings demonstrate that integrating NG Rate analysis, Pareto analysis, and RCA can effectively support the identification of critical quality problems and their potential causes, thereby providing a basis for prioritizing quality improvement initiatives.

Practically, the results can be utilized by the company to strengthen incoming material inspection, improve supplier evaluation programs, and enhance quality control effectiveness to reduce material rejection and support production continuity. Future studies are recommended to conduct direct investigations at supplier production facilities and apply additional analytical approaches, such as 5 Why Analysis or Failure Mode and Effects Analysis (FMEA), to obtain a more comprehensive understanding of defect causes and improvement opportunities.

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6. References

[1] S. Sarah, S. Syamsudin, A. Asngadi, and A. D. Kadek, “Pelaksanaan Quality Control yang Efektif Dalam Sistem Produksi dan Operasional pada CV. Sofie Tunggadewi Industri di Kota Palu,” *Jurnal Cahaya Mandalika*, pp. 622–630, 2024.

[2] A. M. Harti, J. Gultom, M. Ginting, M. Mayshinta, and O. I. Pratiwi, “Peran Quality Control Terhadap Kecacatan Produk (Studi Kasus pada Industri Kecil Menengah Sowita Garment),” *Jurnal Akuntansi, Manajemen, dan Perencanaan Kebijakan*, vol. 1, no. 4, pp. 2–7, Jun. 2024, doi: 10.47134/jampk.v1i4.368.

[3] M. F. Idris and I. Yuwono, “Analisis Pengendalian Kualitas Produk Kertas dengan Metode Statistical Quality Control pada PT Adiprima Suraprinta Gresik,” *Jurnal Ilmiah Teknik dan Manajemen Industri*, vol. 3, no. 1, pp. 431–461, 2023, doi: 10.46306/tgc.v3i1.

[4] M. Muaz, S. Sajid, T. Schulze, C. Liu, N. Klasen, and B. Drescher, “Explainable AI for Correct Root Cause Analysis of Product Quality in Injection Moulding,” *Hong Kong Industrial Artificial Intelligence and Robotics Centre*, pp. 1–5, Apr. 2025, doi: 10.1016/j.jmapro.2025.03.114.

[5] S. H. Sakdiyah, N. Eltivia, and A. Afandi, “Root Cause Analysis Using Fishbone Diagram: Company Management Decision Making,” *Journal of Applied Business, Taxation and Economics Research*, vol. 1, no. 6, pp. 566–576, Aug. 2022, doi: 10.54408/jabter.v1i6.103.

[6] K. Nadiyah and G. S. Dewi, “Quality Control Analysis Using Flowchart, Check Sheet, P-Chart, Pareto Diagram and Fishbone Diagram,” *OPSI*, vol. 15, no. 2, p. 183, Dec. 2022, doi: 10.31315/opsi.v15i2.7445.

[7] M. Akbar, W. Wahyudin, and A. Khoirullah, “Analisis Tingkat Kecacatan Kemasan pada Produk dengan Menggunakan Metode Seven Tools di PT.ABC,” *Journal of Industrial Engineering and Operation Management*, vol. 6, no. 1, pp. 17–6, Jun. 2023, doi: 10.31602/jieom.v6i1.9593.

[8] Z. N. Halizah and A. D. Sumarna, “The Quality Control Using Seven Tools Method for Defect Product on Scanner Production,” *JURNALAKUNIDA*, vol. 9, pp. 25–6, Jun. 2023.

[9] A. Rahmadina and D. Herwanto, “Penerapan Metode Seven Tools pada Pengendalian Kualitas Proses Isolasi di PT X,” *Industri Inovatif - Jurnal Teknik Industri ITN Malang*, pp. 213–220, Mar. 2025.

[10] A. N. Ramadhona, F. A. Handoyo, A. N. Fatimah, N. S. Nadira, and A. Aulia, "Analisis Pengendalian Kualitas Susu Kambing Bubuk Menggunakan Pareto dan Fishbone Di Indo Natural Farm Indo Natural Farm's Goat Milk Powder: Quality Control Analysis Using Pareto And Fishbone," *Jurnal Teknologi Agro-Industri*, vol. 12, no. 1, pp. 47–60, Jun. 2025.

[11] Y. A. Kusuma, H. A. Khoiri, I. M. A. A, and B. Herlambang, "Quality control to reduce production defects using control chart, fishbone diagram, and FMEA," *TEKNOSAINS : Jurnal Sains, Teknologi dan Informatika*, vol. 11, no. 1, pp. 176–186, Jan. 2024, doi: 10.37373/tekno.v11i1.968.

[12] F. D. Saputra and D. S. Nugroho, "Analisis Pengendalian Kualitas Menggunakan Metode Seven Tools dan Perbaikan Proses dengan Pendekatan PDCA," *Metode Jurnal Teknik Industri*, vol. 12, no. 1, pp. 132–2, Mar. 2026.

[13] A. Kurniawan, "Analisis Pengendalian Kualitas Produk Tigercat 005 Menggunakan Fishbone Diagram dan FMEA," *Jurnal Multidisiplin Ilmu Akademik*, vol. 3, no. 1, pp. 650–660, Feb. 2026, doi: 10.61722/jmia.v3i1.8151.

[14] A. S. N. Sari and S. Sunarso, "Optimalisasi Quality Control Menggunakan Metode Statistical Quality Control untuk Mengurangi Jumlah Kerusakan Produk Kain (Studi Kasus pada PT Regar Sport Industri Indonesia di Wonogiri)," *Jurnal Ekonomi dan Manajemen*, vol. 2, pp. 830–844, Sep. 2024, doi: 10.62710/jpe01373.

[15] Z. Sinaga, S. Solihin, R. O. Kawi, and R. C. Hermawan, "Analisis Kualitas Produk Pada Proses Instalasi Model Fortuner Dengan Menggunakan Metode Six Sigma DMAIC," *Jurnal Mekanova*, vol. 8, no. 1, pp. 23–35, Apr. 2022.

[16] M. S. Mahaputra, "Analisis Pengendalian Kualitas Produk Rodding System Point Menggunakan Metode Statistical Quality Control (SQC) di PT. Smart Teknik Utama Bandung," *Media Nusantara*, pp. 197–206, 2021.