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## Quality Control Analysis in an Effort to Reduce Product Defects in Coin Material Production at PT. Bintang Tenaga Multikarya

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### ABSTRACT

*This study aims to analyze quality control in an effort to reduce product defects in coin material production at PT. Bintang Tenaga Multikarya. The study population includes all production data from January to August 2024 with a total of 628,788 kg and 14,984 kg of defects, while the sample was selected using a purposive sampling method. The analysis was carried out using checksheets, control charts, Pareto diagrams, and fishbone charts. The results showed that the average defect rate was still above the company standard, namely 2.38% compared to the maximum target of 1.5%, with the dominant types of defects being scratches (53%), under/over thickness (29%), and oil staining (18%). The main causative factors come from humans, machines, work methods, and materials. Proposed improvements are made through the 5W + 1H approach, namely increasing operator training, routine machine maintenance, stricter supervision, and standardizing work procedures.*

**Keywords :** *Quality Control; Quality Standards; Defective Products.*

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**INTRODUCTION**

Industry plays a crucial role in the Indonesian economy, particularly in the face of increasingly fierce global competition. Companies are required to be highly competitive by producing quality products and maintaining productivity. Quality is key to success because it directly relates to customer satisfaction, cost efficiency, and business continuity. Quality control functions to monitor, assess, and ensure product compliance with standards, while reducing the risk of losses due to defective products. Various methods are used, ranging from Statistical Quality Control (SQC) to the implementation of seven quality control tools (check sheets, histograms, Pareto diagrams, cause-and-effect diagrams, scatter diagrams, flow charts, and control charts), to ensure defect-free products meet market standards. PT. Bintang Tenaga Multikarya, which was established in 2014 and operates in the downstream aluminum industry and trade, faces similar challenges. Fierce competition demands that the company maintain the quality of its products to remain superior in both domestic and international markets. However, the company often experiences losses due to the high number of defective products caused by a lack of planning, supervision, and production control. This condition indicates that suboptimal quality control has a direct impact on the high number of product defects, as seen in the case of the production of Rp. 500 coin material. Data on the production volume and the number of defective products of Rp. 500 coin material at PT. Bintang Tenaga Multikarya can be seen in the following table.

Table 1. Data on Production Results and Production Failures of PT. Bintang Tenaga Multikarya in 2024

Date	Output Machine (Kg)	Reject (Kg)			Total
		Scratch	Staining Oil	Under/Over Thick	
Jan-24	40.323	581	274	153	1.008
%		1,4%	0,7%	0,4%	2,5%
Feb-24	74.585	1.124	309	404	1.837
%		1,5%	0,4%	0,5%	2,5%
Mar-24	114.842	1.467	507	370	2.344
%		1,3%	0,4%	0,3%	2,0%
Apr-24	89.867	1.654	298	185	2.137
%		1,8%	0,3%	0,2%	2,4%
May-24	76.794	1.254	432	284	1.970
%		1,6%	0,6%	0,4%	2,6%
Jun-24	92.569	1.756	345	298	2.399
%		1,9%	0,4%	0,3%	2,6%
Jul-24	107.457	1.432	387	442	2.261
%		1,3%	0,4%	0,4%	2,1%
Aug-24	32.351	543	183	302	1.028
%		1,7%	0,6%	0,9%	3,2%
TOTAL	628.788	9.811	2.735	2.438	14.984
%		1,6%	0,4%	0,4%	2,38%

Source: Data from the Operational sDivision of PT Bintang Tenaga Multikarya, 2024

Based on Table 1, PT. Bintang Tenaga Multikarya's monthly production volume varies depending on the number of orders received. Over eight months, total production reached 628,788 kg, with defects amounting to 14,984 kg, or 2.4% of total production. This figure exceeds the company's tolerance target of a maximum of 1.5% in eight months. This

condition indicates that there are still weaknesses in quality control, so an in-depth analysis is needed to determine the cause of the high number of defective products and corrective measures to reduce losses due to scrap. According to the Quality Target Guidelines, coin material products are considered high quality if the production results meet the established standards and defects do not exceed the 1.5% limit. Products that do not meet the standards will be rejected and categorized as scrap because they have no economic value, thus potentially causing waste. Therefore, this study aims to analyze the effectiveness of the company's quality control and provide suggestions for improvements using the Statistical Quality Control approach and the 5W + 1H method to minimize the percentage of defects.

## LITERATURE REVIEW

### Operational Management

According to various experts, operational management is an activity related to the process of creating goods or services through the conversion of inputs into outputs. Hidayat in Alamsyah et al. (2023) calls it the activities of all parts of the organization in creating goods or services, while Heizer and Render in Tambunan et al. (2025) define it as a series of activities that create value by converting inputs into outputs. Tampubolon in Santoso et al. (2023) emphasizes the use of facilities such as land, labor, and capital in the conversion process, while Richard L. Daft highlights the role of special techniques and tools to solve production problems. Thus, operational management can be concluded as the activity of managing the production process of goods or services by utilizing certain resources and techniques to produce outputs according to requirements.

### Quality Control

According to Andespa (2020), good quality control will improve product quality, one of which is through the application of the PDCA (Plan-Do-Check-Action) cycle introduced by Deming.

Figure 1. PDCA Cycle



Source: <https://www.istockphoto.com/id/f 1>

The PDCA cycle is used to test and implement changes to improve the performance of a product, process, or system. The stages include:

**Plan** - planning and establishing specifications and quality standards

**Do** - implementing the plan in stages by dividing tasks according to capacity

**Check** - checking compliance with the plan and comparing production results with standards to identify the cause of failure

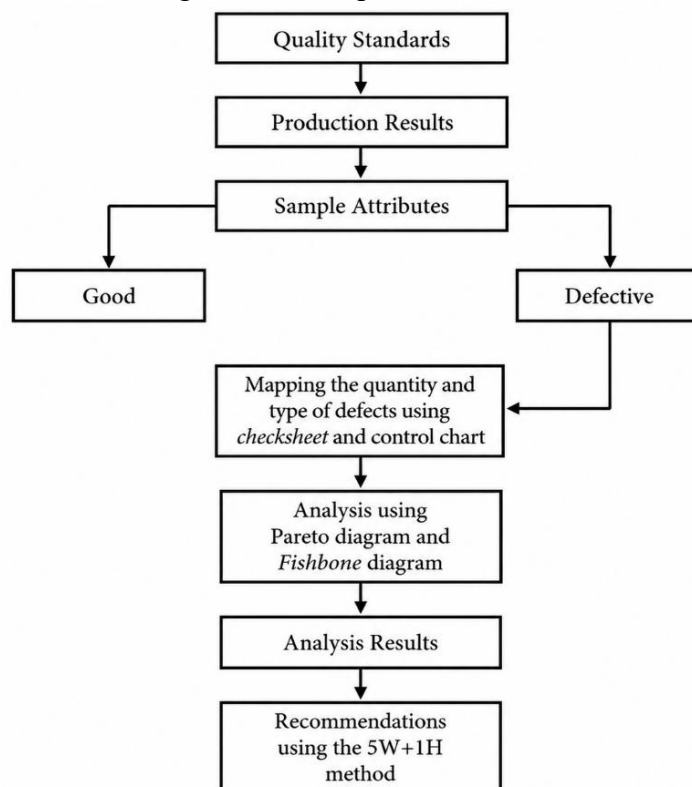
**Action** - making adjustments or standardizing new procedures to prevent problems from recurring and setting targets for subsequent improvement.

### Statistical Quality Control (SQC)

Statistical Quality Control (SQC) is a quality control method that utilizes statistics to collect and analyze data to monitor production results. This technique is used to monitor, control, analyze, and improve products and processes through the application of probability theory in sample testing. Its primary goal is to detect variations or process errors that cause product defects, so that corrective actions can be taken immediately to prevent recurrence (Mulia & Rochmoeljati, 2021).

### Conceptual Framework

Figure 2. Conceptual Framework



Source: Researcher (2025)

## METHOD

### Population and Sample

The population in this study is the entire production output of PT. Bintang Tenaga Multikarya during January-August 2024 with a total production of 628,788 kg and 14,984 kg of defective products. The sample was determined using a purposive sampling method based on certain criteria, namely coin material production data for August 2024 with an output of 32,351 kg and 1,028 kg of reject products, which was chosen because that month recorded the largest number of defects compared to other months in 2024.

### Variable Operationalization

Table 2. Operationalization of Variables

Variable Type	Indicator	Scale
Quality Control	1. There are scratches on the coin material product	Ratio
	2. Suitability of the thickness of the coin material product	
	3. There are oil stains on the coin material product.	
Quality Standards	Maximum limit for defective products is 1.5%	Ratio

Source: Processed by researchers, 2024

### Data Collection Method

Data collection was conducted through interviews with the production manager to obtain information on the types and causes of defects, the production process, and the raw materials used. In addition, direct observations were conducted at PT. Bintang Tenaga Multikarya, observing employee work systems, production flows, and quality control activities. Data was also collected through documentation in the form of production reports and other supporting documents.

### Data Analysis Methods

#### Check Sheet

Production data and product defects are systematically recorded using check sheets. This tool helps identify defect frequency in real time and presents the data in a neat tabular format, facilitating further analysis.

#### Control Chart

Process control is performed using a p-chart to monitor production stability. This chart is used because the data is attribute-based, meaning defective products cannot be repaired and must be rejected. If the data falls outside the control limits, the process is still inconsistent and requires improvement.

#### Pareto Chart

The types of damage found are then arranged in a Pareto diagram to identify and prioritize the most dominant defects so they can be resolved immediately.

**Cause-Effect Diagram (Fishbone Chart)**

After the dominant type of defect is known, a root cause analysis is carried out using a fishbone chart by grouping human, machine, material, method and environmental factors.

**Recommendations for Improvement (5W+1H)**

Based on the analysis results, quality improvement proposals were prepared using the 5W+1H method, namely answering the questions What, Where, Why, Who, When, and How to ensure that improvement actions can be carried out optimally and sustainably.

**RESULTS AND DISCUSSION**

The results and discussion section is a crucial component of a research article. In this section, the author presents the research findings and discusses them based on the methods used in the study.

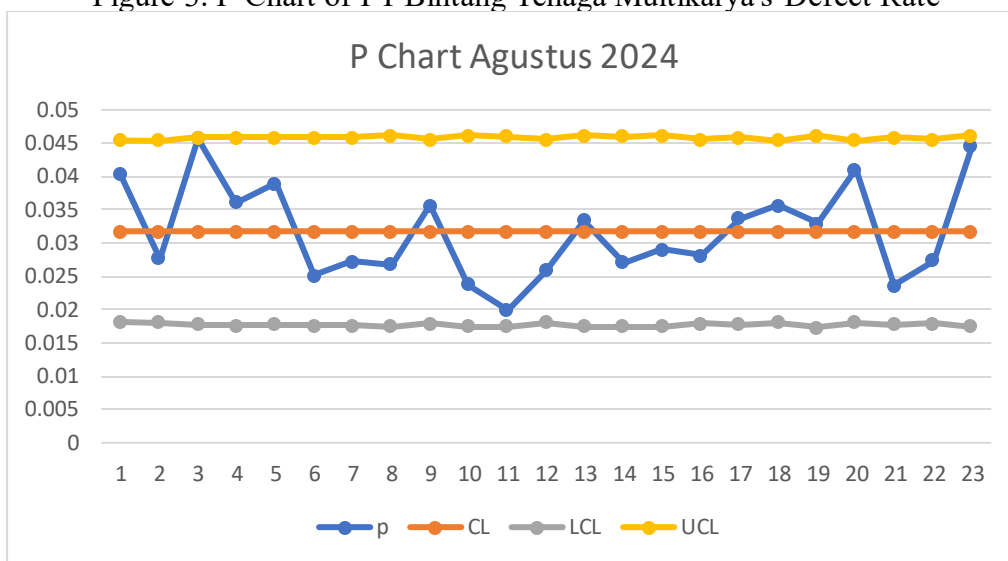
Table 3. Defect Observation Results Data for the August 2024 Periode

Date	Engine Output (kg)	Reject (Kg)			Total
		Scratch	Staining Oil	Under/Over Thick	
1	1.491	34	8	18	60
2	1.482	25	4	12	41
3					
4					
5	1.401	40	10	14	64
6	1.383	24	12	14	50
7	1.410	31	13	11	55
8	1.395	19	7	9	35
9	1.395	18	6	14	38
10					
11					
12	1.345	17	5	14	36
13	1.456	28	9	15	52
14	1.342	13	6	13	32
15	1.356	9	8	10	27
16	1.467	23	6	9	38
17					
18					
19	1.346	26	9	10	45
20	1.365	19	7	11	37
21	1.345	18	8	13	39
22	1.456	23	4	14	41
23	1.398	24	9	14	47
24					
25					
26	1.488	26	11	16	53
27	1.338	23	7	14	44
28	1.488	34	12	15	61
29	1.398	16	3	14	33
30	1.457	23	7	10	40
31	1.349	30	12	18	60
<b>Total:</b>	<b>32.351</b>	<b>543</b>	<b>183</b>	<b>302</b>	<b>1.028</b>

Source: Internal Company Data, 2024

Based on production data for August 2024, PT. Bintang Tenaga Multikarya produced 32,351 kg of output with 1,028 kg of rejects, or approximately 3.18%, exceeding the company's maximum tolerance of 1.5%. The largest type of defect was scratches (543 kg), followed by under/over thickness (302 kg), and oil staining (183 kg). These findings indicate that scratches are the dominant problem that needs to be prioritized for handling, followed by improvements in thickness control and oil stain prevention, so that production quality meets contract standards and cost losses can be minimized.

Figure 3. P-Chart of PT Bintang Tenaga Multikarya's Defect Rate



Source: Internal Company Data, 2024

Based on the results of the p-chart analysis in August 2024, the product defect rate was within the statistical control limits with an average defect rate (CL) of 3.1%. All observation data for 23 working days fell between the average lower control limit (LCL) of 1.8% and the average upper control limit (UCL) of 4.6%. Although there were fluctuations in the 3rd and 23rd observations that approached the upper control limit, the variation in defects that appeared was still considered common cause variation, so there was no indication of special cause variation. Thus, the production process can be said to be statistically stable. However, the defect rate still exceeded the company standard of 1.5%, so continuous improvement efforts are needed to ensure product quality meets the established standards.

Table 4. Pareto Chart Percentage Calculation Data

Type of Defect	Number of Defects	Percentage (%)	Cumulative Percentage
Scratch	543	53%	53%
Under/Over Thickness	302	29%	82%
Staining Oil	183	18%	100%
<b>Total number</b>	<b>1,028</b>	<b>100%</b>	

Source: Internal Company Data, 2024

Based on the defect percentage calculation, scratches occupy the highest position with a total of 543 kg or approximately 53% of the total defects. Under/over thickness defects are in second place with 302 kg or 29%, bringing the cumulative percentage to 82%. Meanwhile, oil staining defects contribute 183 kg or 18%, which when combined produces a cumulative

percentage of 100%. These results indicate that scratches are the dominant defect and should be the main priority for repair, considering their largest contribution to the total defects.

Table 5. Proposed Improvements Using the 5W + 1H Method for scratch defects

Disability Factors	Dominant Cause	Countermeasures					
		What	Why	Where	When	Who	How
Machine (main factor)	Friction between the product and the conveyor belt and the conveyor surface is rough	Belt conveyor maintenance and coating	Reduces product scratches	Line conveyor belt all machines	Immediately when the conveyor belt is damaged / when a massive defect is found	Maintenance team and machine operators	Replace the belt when damage is found, clean it regularly
Material	Raw materials are exposed to friction	Provides a smooth base for coil storage	Reduce friction on each side of the raw material	Storage area	Every time you store or move raw materials	Forklift drivers	Using a base such as styrofoam or plastic
	The surface of the raw material is not good	Conduct raw material inspection upon receipt	Prevent raw materials of poor quality from being processed	Goods reception area	When receiving goods	Head of QC	Conduct a visual inspection of the raw materials (if they are not good, immediately return them to the supplier)

Source: Processed by researchers, 2024

Table 6. Proposed Improvements Using the 5W + 1H Method for Oil Staining Defects

Disability Factors	Dominant Cause	Countermeasures					
		What	Why	Where	When	Who	How
Material (main factor)	Raw materials contain too much oil	Complain to the supplier regarding the defect	Avoid raw materials that contain too much oil	Supplier factory	When it was discovered that many raw materials had been found with these defects	Head of QC	SLA (service level agreement) with suppliers, and regular inspections
Method	The cleaning method is not optimal	Using a new cloth or special liquid	Avoid oil residue remaining on raw materials	Production area	During the production process	Machine operator	Using MEK liquid as a cleaner
Machine	Dirty	Cleaning	Avoid raw	Machine	Before	Machine	Clean using

Disability Factors	Dominant Cause	What	Why	Countermeasures			
				Where	When	Who	How
	dies/molds	the mold before production	materials entering the mold being exposed to oil	area	production	operator	a new cloth and MEK fluid.

Source: Processed by researchers, 2024

Table 7. Proposed Repairs Using the 5W + 1H Method for Under/Over Thickness Defects

Disability Factors	Dominant Cause	What	Why	Countermeasures			
				Where	When	Who	How
Man	Inconsistent production	Conduct audits of suppliers	So that raw material production is stable and consistent	Supplier factory	once every 3 months	Production manager and head of QC	SLA (service level agreement) with suppliers, Ask the supplier to attach the CoA (certificate of analysis) results
	Lack of quality control	Tighten quality control when raw materials are incoming	Avoid poor quality raw materials	Goods reception area	When receiving raw materials	QC Inspector	Ask the supplier to attach the CoA (certificate of analysis) results
Material (main factor)	Thickness varies	Set tolerance standards for customer-agreed thicknesses	Prevent defective products from being sent to customers	N/A	Before the contract begins	Sales team and production manager	Make an agreement regarding the agreed thickness tolerance
	Poor quality of raw materials	Setting quality standards for suppliers	Maintaining the quality of the final product	Supplier factory	Before ordering raw materials	Production manager and QC head	Create an SLA (service level agreement) and return goods if the raw materials are very bad

Source: Processed by researchers, 2024

## CONCLUSION

Based on the results of the research "Analysis of Quality Control in Efforts to Reduce Product Defects in the Production of Coin Materials at PT. Bintang Tenaga Multikarya", the following conclusions can be drawn:

### 1. Implementation of Quality Control

PT. Bintang Tenaga Multikarya has implemented quality control through SOPs and statistical tools such as checksheets, control charts (p-charts), Pareto diagrams, and

fishbone diagrams. The control chart results indicate that the production process remains within statistical control limits. The fluctuations that occur are close to the UCL but are still classified as natural variation (common cause variation).

## 2. Factors Causing Product Defects

Pareto and Fishbone analysis identified three main defects, namely:

- **Scratch:** due to friction between raw materials and coins during production and packaging.
- **Staining oil:** due to residual lubricant from raw materials or the printing process..
- **Under/over thickness:** due to improper rolling of raw materials and changes in supplier machine settings.

Of the three defects, **scratch** is the dominant defect with the main causal factors coming from the machine, material and work method.

## 3. Improvements That Can Be Made

Through the 5W+1H method, improvements focus on: strict selection and inspection of raw materials, routine machine maintenance, operator skill enhancement, and increased oversight of the production line. These measures are expected to reduce the defect rate to below the company's target tolerance of 1.5%.

### Suggestion

Based on the research results, discussion, and conclusions, the author recommends that PT. Bintang Tenaga Multikarya conduct routine preventive maintenance on machines and belt conveyors and improve forklift operator training to reduce scratch defects. The company also needs to establish standard procedures for lubricant use that include the type, amount, and replacement intervals to prevent stains on the product, and make agreements with suppliers regarding the consistency of raw material thickness according to specifications. For the Quality Control department, it is recommended to maximize the use of statistical tools on an ongoing basis and follow up on the results of defect analysis with documented corrective actions. As for future researchers, the research can be expanded by considering additional variables such as the work environment and SOP compliance, and using a combination of quantitative and qualitative methods to obtain a more comprehensive picture.

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