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Quality Control Analysis of Handle Switch Spare Parts Using Statistical Quality Control Methods at PT XYZ

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Abstract
PT XYZ is a manufacturing company that produces motorcycle and car spare parts, during the production process, there is still a level of product defect that needs to be controlled, especially in one of the products with the highest production volume during the period of July–December 2024. This study was conducted to determine the level of damage, identify the factors causing the damage and recommend corrective actions. The method used is the Statistical Quality Control (SQC) method using statistical tools including: checksheet, histogram, pareto diagram, P-Chart, and fishbone diagram. The results of the study showed that the most product defects occurred in the short print defect type (36.61%), followed by appearance (17.42%), movement (16.08%), electric (15.77%), printing feel off (8.45%), and skip printing (5.67%). Actions taken to minimize the level of defects include conducting periodic training for operators in terms of part checking and handling procedures, compiling a visual and final inspection checklist to ensure that no steps are missed, adding a handle to the tray to prevent direct hand contact with the part/material, implementing a part inspection checklist before use including checking the dryness of the cavity, performing surface treatment such as wiping and drying the part/material before the printing process, using a cover on the part.
Keywords: *quality control, statistical quality control, control chart, defective product, spare parts*

Abstrak
PT XYZ merupakan perusahaan manufaktur yang memproduksi spare part motor dan mobil, di mana dalam proses produksinya masih ditemukan tingkat kecacatan produk yang perlu dikendalikan, khususnya pada salah satu produk dengan volume produksi tertinggi selama periode Juli–Desember 2024. Tujuan dari penelitian ini ialah mengidentifikasi kerusakan yang terjadi, menentukan faktor yang menyebabkan kerusakan, serta memberikan rekomendasikan perbaikan yang tepat. Dalam analisis ini metode *Statistical Quality Control* (SQC) digunakan dimana melibatkan alat statistik seperti checksheet, histogram, diagram pareto, P-Chart, dan *fishbone diagram*. Berdasarkan hasil penelitian diketahui bahwa kecacatan produk terbanyak terjadi pada jenis cacat short print (36,61%), dilanjutkan dengan *appearance* (17,42%), movement (16,08%), electric (15,77%), printing feel off (8,45%), dan skip printing (5,67%). Untuk meminimalkan tingkat kecacatan harus dilakukan beberapa tindakan yaitu diantaranya dengan mengadakan pelatihan berkala bagi operator dalam hal prosedur pengecekan dan penanganan part, menyusun checklist pemeriksaan visual dan *final inspection* untuk memastikan tidak ada langkah yang terlewat, menambahkan handle pada tray untuk mencegah terjadinya kontak langsung tangan dengan part/material, mengimplementasikan checklist inspeksi part sebelum digunakan termasuk cek kekeringan cavity, melakukan *surface treatment* seperti pengelapan dan pengeringan pada part/material sebelum dilakukan proses printing, gunakan penutup (cover) pada part.
Kata Kunci: *pengendalian kualitas, statistical quality control, peta kendali, produk cacat, spare part*

1. Introduction

In the face of increasingly competitive competition, companies are required to improve their productivity in order to maintain consumer trust, one of which is by maintaining product quality [1]. Product quality is one of the most important factors in the industrial world [2]. Product quality is no longer a matter of meeting certain requirements, but is considered an outcome that allows consumers to feel satisfied with the product [3]. Product quality plays an important role in influencing consumer interest in a product, so continuous efforts are needed to improve and maximize the quality of the final product [4].

Efforts to maintain the quality of this product require systematic monitoring. In this case, quality control is necessary to ensure that the products produced meet the established standards [5]. Quality control is a series of systems and actions implemented to ensure that products continue to meet established standards and to prevent damage or deviations from specifications [6]. If deviations from these standards

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are found, an analysis is conducted to identify the location of the deviation and the factors causing it [7]. With good corporate quality control, the number of defective products can be reduced, thereby increasing customer satisfaction [8].

PT XYZ is a manufacturing company that produces motorcycle spare parts. In its production process, PT XYZ has strived to maintain product quality. During the period from July 2024 to December 2024, there was a product with the highest production compared to other products. This product is the Handle Switch part. Therefore, an analysis is needed to identify the number of product defects.

The method used in efforts to identify the amount of product damage is Statistical Quality Control (SQC) [9]. This method is a problem-solving approach that analyzes production errors that can cause defective products so that improvements can be made immediately to minimize the occurrence of product defects [10]. Quality control using the Statistical Quality Control (SQC) method serves to monitor every stage of the production process so that the products produced continue to meet the quality standards set by the company [11].

Based on the explanation of this method, this study also uses the Statistical Quality Control (SQC) method to analyze the level of product damage, minimize defects, and ensure that the damage level remains within the company's control limits. Several researchers have applied the Statistical Quality Control (SQC) approach to ensure and improve product quality. Previous research that applied the Statistical Quality Control (SQC) method was on rubber wheels, which showed that the most dominant defect was porosity with a percentage of 39%. P-Chart control chart analysis showed that the number of defective products was still within control limits. The application of SQC helped the company identify and analyze product defects and their causes [12]. Another study applying Statistical Quality Control (SQC) to iron ladder products revealed that quality inconsistencies were influenced by a lack of operator precision and skill, work methods that did not comply with SOPs, material accumulation, and poorly organized working conditions.

Quality improvement efforts can be made by increasing understanding of SOPs and implementing more structured material storage arrangements [13]. Handle Switch products are the most widely produced products because they are needed by customers. Therefore, the researcher aims to identify the defect rate of Handle Switch parts by identifying the main factors causing defects using the Statistical Quality Control (SQC) method.

2. Materials and Methods

This study uses a descriptive quantitative research design that aims to provide a factual description of the application of Statistical Quality Control (SQC) in analyzing the quality control of Handle Switch spare parts. The data used in this study consisted of primary and secondary data. Primary data was obtained through interviews with the Quality Control department to explore information related to the factors causing product damage. Secondary data was obtained from internal company documentation, which included data on production volume, number of defective products, and types of product defects for the period July–December 2024.

Data collection techniques were carried out through interviews and document studies. Interviews were used to obtain information not contained in company documents, particularly regarding the causes of product damage, while document studies were used to collect quantitative data related to production output and product damage rates. The collected data was then processed using quantitative methods in the form of statistical calculations through the application of Statistical Quality Control (SQC).

Data processing is carried out using SQC tools to evaluate quality control conditions. Checksheets is used as a tool to facilitate the process of collecting and processing data [14], histograms and pareto charts are used to analyze variations in a process and identify types of product defects based on the frequency distribution of classified attribute data [15]. Control chart P is used to assess process stability [16], fish bone diagrams are used to identify the type and cause of each type of damage that occurs [17], The next stages of the research are presented in the form of a flowchart.

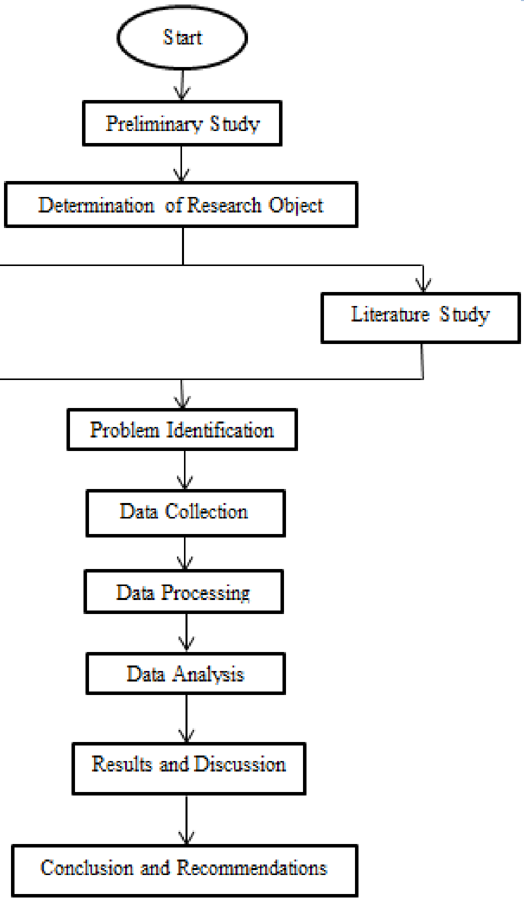

Figure 1. Research Flow

3. Results and Discussion

Check Sheet

Creating a checksheet is the first step in statistical quality control analysis. The production volume and defect data for the product will be used as the data for the checksheet. The production data for the period July–December 2024 is as follows.

Table 1. Check Sheet

Month	Production Quantity (Units)	Type of Defect						Number of Defects (Units)
		Short Print	Print Feel Off	Skip Printing	Electric	Appearance	Movement	
7	783.804	64	14	11	30	33	36	188
8	769.324	66	16	12	26	32	33	185
9	693.531	63	15	13	28	26	21	166
10	762.784	70	16	9	32	30	26	183
11	568.955	51	13	6	19	26	22	137
12	464.111	41	8	4	18	22	18	111
Total	**4.042.509**	**355**	**82**	**55**	**153**	**169**	**156**	**970**

Histogram

After the checklist is created, the next step is to create a histogram. A histogram is a graphical representation that shows the distribution of data and the frequency of each value in a data set. **Table 2** below presents the results of data processing for creating a histogram.

Table 2. Percentage of Product Defects

No	Type of Defect	Number of Defects (Units)	Percentage
1	Short Print	355	36.61%
2	Print Feel Off	82	8.45%
3	Skip Printing	55	5.67%

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No	Type of Defect	Number of Defects (Units)	Percentage
4	Electric	153	15.77%
5	Appearance	169	17.42%
6	Movement	156	16.08%
	Total	**970**	**100%**

The product defect percentage data presented in the table was then processed and displayed in the form of a histogram to show the frequency distribution of defects. The histogram is presented in **Figure 2**.

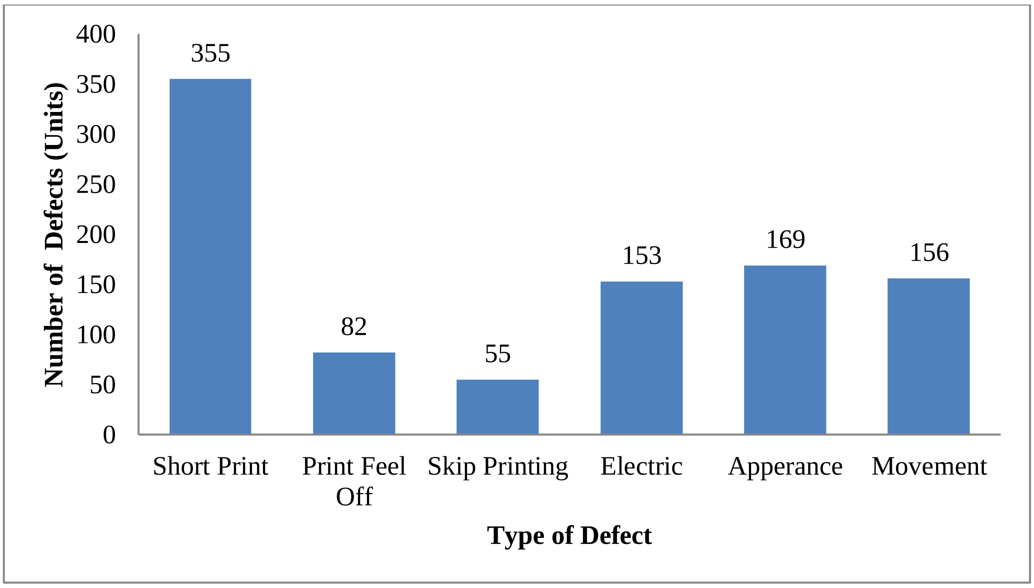

Figure 2. Defective Product Histogram

The type of damage that often occurs based on the histogram for the Handle Switch product in the July-December 2024 period is short print. Therefore, the author's focus is to examine the NG short print type.

Pareto Chart

A Pareto chart is a diagram used to present data in order of largest to smallest contribution, making it easier to identify the most dominant types of defects. **Table 3** below presents the cumulative percentages and types of product defects that occur, as a basis for identifying the contribution of each type of defect to the total defects.

Table 3. Percentage of Defect

No	Type of Defect	Number of Defects (Units)	Percentage	Cumulative Percentage	Priority
1	Short Print	355	36.61%	36.61%	1
2	Appearance	169	17.42%	54.03%	2
3	Movement	156	16.08%	70.11%	3
4	Electric	153	15.77%	85.88%	4
5	Print Feel Off	82	8.45%	94.33%	5
6	Skip Printing	55	5.67%	100%	6
	Total	**970**	**100%**		

Based on the cumulative percentage table, a Pareto chart is used to visualize the contribution of each type of defect from the most dominant to the least, thereby facilitating the identification of improvement priorities. The Pareto chart is presented in **Figure 3**.

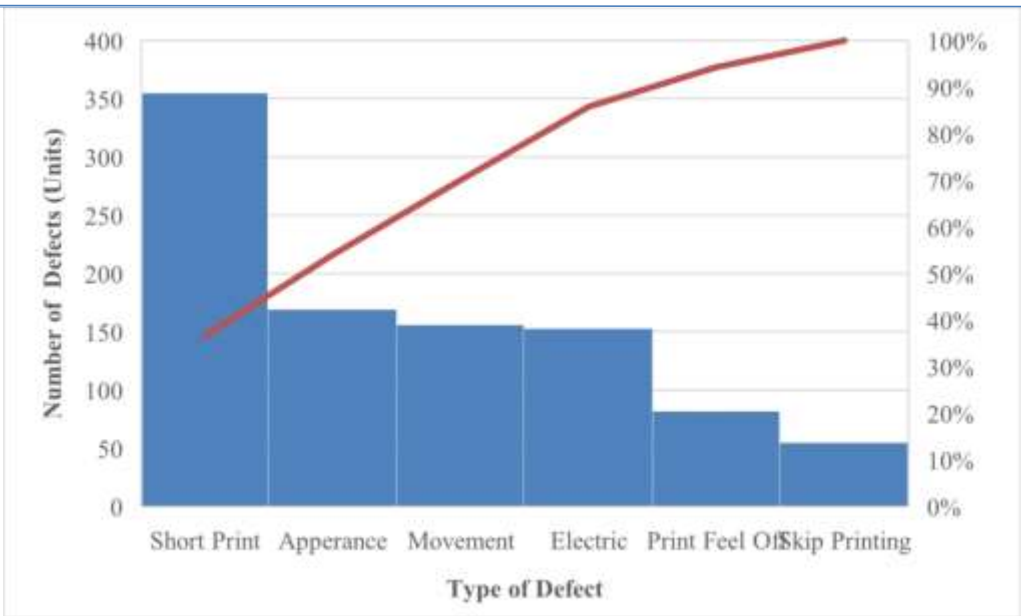

Figure 3. Pareto Diagram of Defective Product

The Pareto chart shows that short print defects have the highest percentage, at 36.61% making them the top priority for improvement.

Control Chart

Control charts are used to determine whether the level of product defects is still within control limits or has deviated from normal production process conditions. Therefore, a proportion control chart (P-Chart) is prepared based on data on the number of defects and the number of product outputs. Table 4 below presents the results of the P-Chart calculation, which includes the defect proportion value, center line (CL), upper control limit (UCL), and lower control limit (LCL).

Table 4. Control Chart (P-Chart)

Month	Production Quantity	Number of Defects	Proportion	CL	UCL	LCL
7	783.804	188	0,000240	0,000240	0,000263	0,000217
8	769.324	185	0,000240	0,000240	0,000263	0,000217
9	693.531	166	0,000239	0,000240	0,000263	0,000217
10	762.784	183	0,000240	0,000240	0,000263	0,000217
11	568.955	137	0,000241	0,000240	0,000263	0,000217
12	464.111	111	0,000239	0,000240	0,000263	0,000217
Total	**4.042.509**	**970**				

Based on the calculations in the table, the data is then displayed in a P-Chart graph to facilitate process control analysis. **Figure 4** shows the P-Chart for the number of defective products.

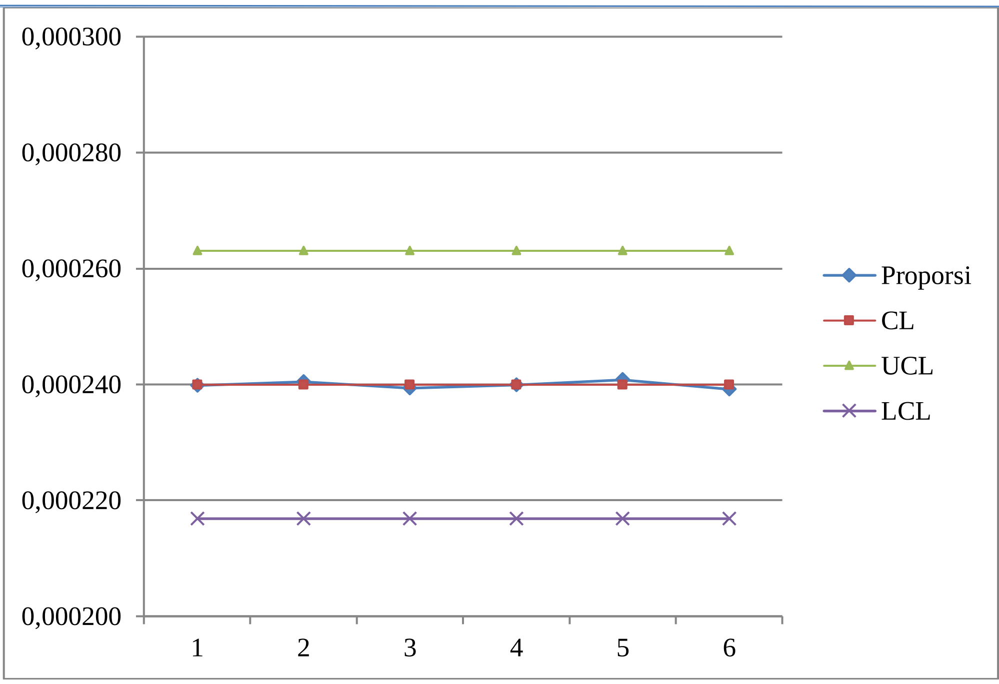

Figure 4. Control Chart (P-Chart)

Based on the P-Chart graph generated, all observation points are within the specified control limits, so it can be concluded that the production process is statistically under control.

Fishbone Diagram

To identify the factors causing product damage, a fishbone diagram was used. The results of the fishbone diagram were used as a reference to determine the appropriate solution for the level of damage occurring to the Handle Switch product. The most common type of damage was short printI. The results of mapping the causes of damage using a fishbone diagram are shown in **Figure 5**.

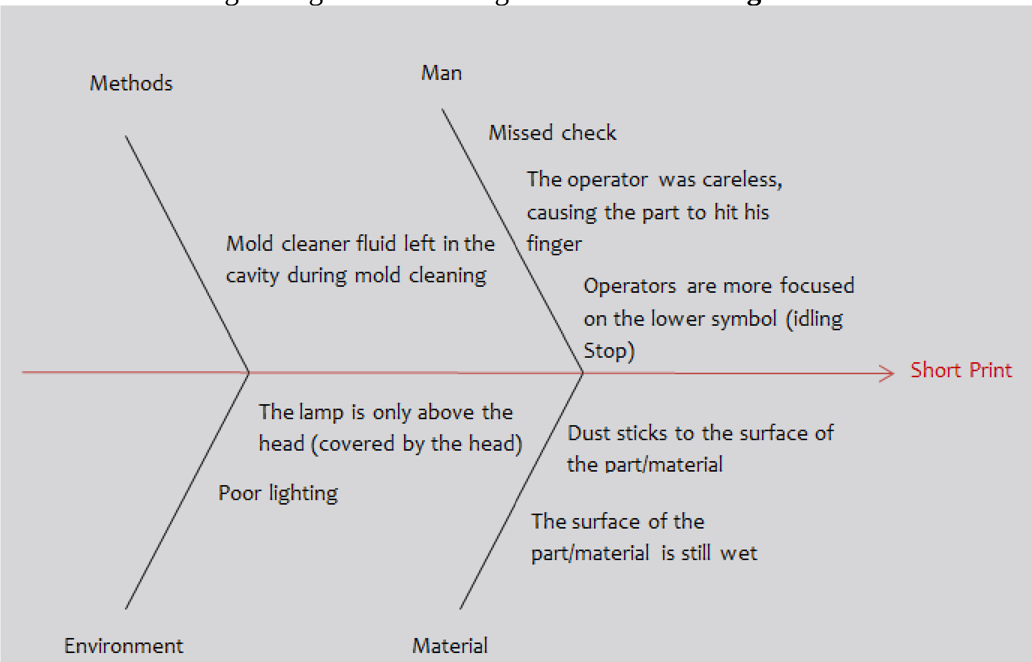

Figure 5. Fishbone Diagram

Improvement Proposals

There are improvement suggestions that companies can implement to minimize damage levels, namely the following improvements. Regarding human factors, provide regular training for operators on checking and handling procedures for parts, compile a visual inspection checklist and final inspection checklist to ensure that no steps are missed, and add handles to trays so that operators' hands do not touch parts/materials during the handling process when the parts/materials are still wet. Method factors include implementing a part inspection checklist before use, including checking the dryness of the cavity. Material factors include performing surface treatments such as wiping and drying parts/materials before the printing process and using covers on parts to prevent dust from sticking. Environmental factors include arranging the lighting so that it is not obstructed by the operator's head, which can be done with diagonal lighting or spotlights, and adding lights on the right and left sides or under the work table so that the part area is brighter and does not only rely on overhead lighting.

4. Conclusion

Based on the results of data collection and analysis, it can be concluded that the damage rate of Handle Switch spare parts during the period of July –December 2024 period is still within the company's control limits, as indicated by an average damage value of 0.00024 with an upper control limit (UCL) of 0.000263 and a lower control limit (LCL) of 0.000217 on the P-Chart control chart. The results of the histogram and Pareto diagram analysis show that the most dominant type of defect is short print with a percentage of 36.61% making it the main focus of quality issues. The fishbone diagram analysis shows that the causes of defects originate from three main factors, namely human factors, methods, and materials, which include negligence in the checking process, non-compliance with work procedures, and suboptimal surface conditions of parts or materials. The application of Statistical Quality Control methods provides a clear picture of quality control conditions and the factors causing defects in accordance with the actual conditions in the company.

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