Analysis of the Causes of Printing Defects in Label Products in The Quality Control Section at PT. XYZ with Fishbone Method

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ABSTRACT

This study aims to analyze the factors that cause printing defects in label products in the Quality Control section of PT. XYZ. Data collection is carried out through observation of the production process, operator interviews, and analysis of inspection results. The analysis methods used include fishbone diagrams and the 5 Why approach. The results of the study show that the most dominant print defect in PT. XYZ is the result of blur printing (40%), followed by color mismatch (30%) and register inaccuracy (15%). The main causative factors come from human, machine, material, and inconsistent work methods. Recommendations for improvement at PT. XYZ includes regular engine calibration, improvement of operational standards, and operator training to reduce recurring defects. This research is expected to be a reference for companies in improving the quality of label production in a sustainable manner.

Keywords: Quality Control, Printing Defects, Label Products, Fishbone Diagram, 5 Why Analysis, Printing Industry

INTRODUCTION

The industrial world is now increasingly competitive, both manufacturing and services need to improve the quality of processes. In today's industry, the selling price of products must be competitive to attract customers. Improving the quality of the processes and products produced is one of the approaches used by companies. One of the strategies to win business competition is quality control, but it costs in quality control. Quality is one of the important factors that determine the success of a product or service, so it is important for every business to carry out quality control.

In the manufacturing industry, product quality is an important aspect to maintain customer satisfaction and reduce rework costs. Label products are an important component of the packaging so the slightest defect can affect the aesthetic value and information of the product. In the label production industry, quality is a very important aspect because labels are not just a complementary element, but a major part of a product's identity. The label contains important information such as product name, composition, company logo, and instructions for use. When the quality of the label is not maintained, especially in the event of a printing defect, the overall value of the product can decrease in the eyes of consumers and distributors, so that customers can be interested in our products.

Furthermore, good quality will create consistency. It is this consistency that makes the product easily recognizable and professional-looking. Consumers like familiar and neat things. When labels are always stable in terms of color, print position, and appearance, this builds long-term trust that the product looks more convincing and the company has additional "selling points" even if it's just from the outward appearance.

In the production process, maintaining label quality also means maintaining work efficiency. Abel defects usually result in increased rework, batch rejection, waste of raw materials, and additional inspection time. This condition can hinder production flows, increase operational costs, and decrease productivity. By implementing good quality control, companies can minimize errors from the start, ensuring machines work to standards, and increase operator accuracy in running the printing process.

Label quality is also not only a matter of aesthetics, labels carry brand identity, important information, and an impression of professionalism. If the label is inconsistent, consumers will doubt the overall quality of the product. Distributors can also lose trust, as they rely on products that look neat, clear, and not embarrassing on store shelves. Therefore, label defects should not be underestimated. In the Quality Control section, print defects are often found in the form of inappropriate colors, blurs, and improper registers. This is the basis for the need to conduct an in-depth analysis of the factors that cause print defects.

Small defects such as inconsistent colors, opaque prints, or shifted registers can lead to product rejection, waste of raw materials, increased costs, and a decline in the company's reputation in the eyes of consumers. In contrast, labels printed with high quality standards are able to strengthen brand identity and increase customer satisfaction. Therefore, an in-depth analysis of the factors that cause print defects in the label production process is needed. Based on these conditions, this study aims to identify the main causes of print defects, analyze the most dominant factors affecting the quality of print results, and provide recommendations for improvements that can be implemented by companies to minimize print defects in an ongoing manner.

Overall, quality in the label industry is not only a supporting aspect, but has developed into a strategic element that determines the image and competitiveness of the company. When label quality is not maintained, not only the appearance of the product is affected, but also consumer confidence, the stability of the production process, and the overall operational efficiency. Small defects such as inconsistent colors, blurry prints, or shifted register positions can lead to product rejection, waste of raw materials, increased costs, and the potential loss of the company's reputation in the eyes of the market. On the contrary, labels printed with high quality standards are able to strengthen brand identity, increase customer satisfaction, and provide added value to products even though the core quality of the product is not yet known to consumers.

Based on the formulation of the problem that has been obtained, the objectives of the research are obtained as follows:

a. Identifying the factors that cause printing defects in label products at PT. XYZ.
b. Analyzing the dominant factors in PT. XYZ which affects the quality of print results using quality analysis tools.
c. Providing solutions and recommendations for improvements that can be applied at PT. XYZ.

LITERATURE REVIEW

Quality Control

Quality Control is a tool for management to improve product quality when necessary, maintain high product quality and reduce the number of damaged products. According to Montgomery (2020), Quality Control is a systematic process to ensure that the products or services produced meet the quality standards that have been set through inspection, measurement, and corrective action activities. Quality Control aims to control process variations so that the products produced are consistent and according to specifications. Feigenbaum (1991) also stated that Quality Control includes all activities that aim to maintain quality from design, production, to post-production. In the industrial world, Quality Control has a role as a quality control so that defects can be detected early so as not to interfere with the next production process.

In the context of the label printing industry, Quality Control includes color checking, register checking, print result check, material check, and visual consistency of products. This is in line with the theory of Statistical Quality Control, which is data-based quality control and visual inspection.

Basic Theory of Print Defects According to Printing Standards (Print Quality Guideline – ISO 12647)

1. Color Deviation

According to ISO 12647-2, color deviation occurs when the value of ΔE (color difference) exceeds the standard tolerance limit. The cause can come from ink instability, changing machine pressure, and room temperature variations. This theory is relevant because the study found color deviations of up to 30%.

2. Smearing / Blur (Blur Print)

According to Kipphan (Print Media Production, 2001), smearing occurs due to inappropriate printing speed, ink has not dried completely, or unstable machine pressure.

3. MisregistrationAccording to the offset printing theory, the register shifts when the sensor register mark is unable to read the mark stably or there is a slip in the paper/film feeding. This is in line with research findings that registers are a frequent flaw.

4. Spotting (Ink Spots)

Printing theory explains that ink spatters appear as a result of excess ink, dirty machine components, or damp media surfaces. This theory is used in research to map the causes of print defects.

The 5 Why Method

The 5W (5 Whys) method has been known since 1930 which was proposed by *Sakichi Toyoda* and in 1970 popularized in *the Toyota Production System.* According to Toyota Production System, the 5 Why method is used to trace the root cause of the problem by asking the question "why?" repeatedly until the real source of the problem is found. This is why this theory is called the 5 Whys Strategy. This 5W strategy is very effective in solving problems with the processes that occur.

Check Sheet, Histogram, & Fishbone Diagram

A check sheet is a simple designed sheet containing a list of things that are needed for data recording purposes so that users can collect data easily, systematically, and regularly at the time the data appears at the scene of the incident. According to Juran (1998), check sheets are used to collect disability data in a structured manner. Histogram is another term used to refer to a frequency chart. This term is more often used in the context of theory or teaching. This diagram presents numerical data in the form of bars arranged close together to illustrate distribution patterns. The Fishbone Diagram was first introduced by Dr. Kaoru Ishikawa in the 1960s. Ishikawa, a quality management expert from Japan, developed this diagram as part of the Total Quality Management (TQM) approach. The goal is to assist the team in identifying the root cause of the problem in a systematic and structured manner. Fishbone Diagram is an effective tool for analyzing and visualizing the cause of a problem.

RESEARCH METHODOLOGY

Types of Research

This research was carried out in a quantitative descriptive manner with a problem cause analysis approach based on calculation, measurement, and numerical data presentation (nimeric). In this method, the presentation can be presented in percentage tables and histograms to see the data easily. This research will describe a situation or a problem by collecting data based on numbers. Then it will answer some questions that will look for the root cause of a problem.

Data Collection Techniques

a. Observation of the production process and Quality Control.
b. Operator and supervisor interviews.
c. Analyze Quality Control inspection results and production results.

Analytical Tools and Techniques

a. Fishbone diagram
b. 5 Why Analysis
c. Historgam
d. Check sheet

RESULTS AND DISCUSSION

Based on the results of observations conducted for one month, it was found that several types of print defects with varying percentages were presented in the table. Based on the data presented in the table, the defect with the highest frequency is register misalignment with a percentage of 40%, which indicates that this problem is a major obstacle in the printing process.

Table 1: Types of Print Defects and Their Percentages

Types of Defects	Percentage
Color deviation	30%
Blur print (smearing/ghosting)	15%
Register misalignment	40%
Ink spots/spots	10%
Other minor defects	5%

Based on the table of the percentage of types of print defects presented in the form of a histogram, it can be seen that the defects with the highest percentage are the result of register misalignment which reaches 40%. With the presentation of the histogram, it visually shows that the register misalignment is the highest among other types of print defects.

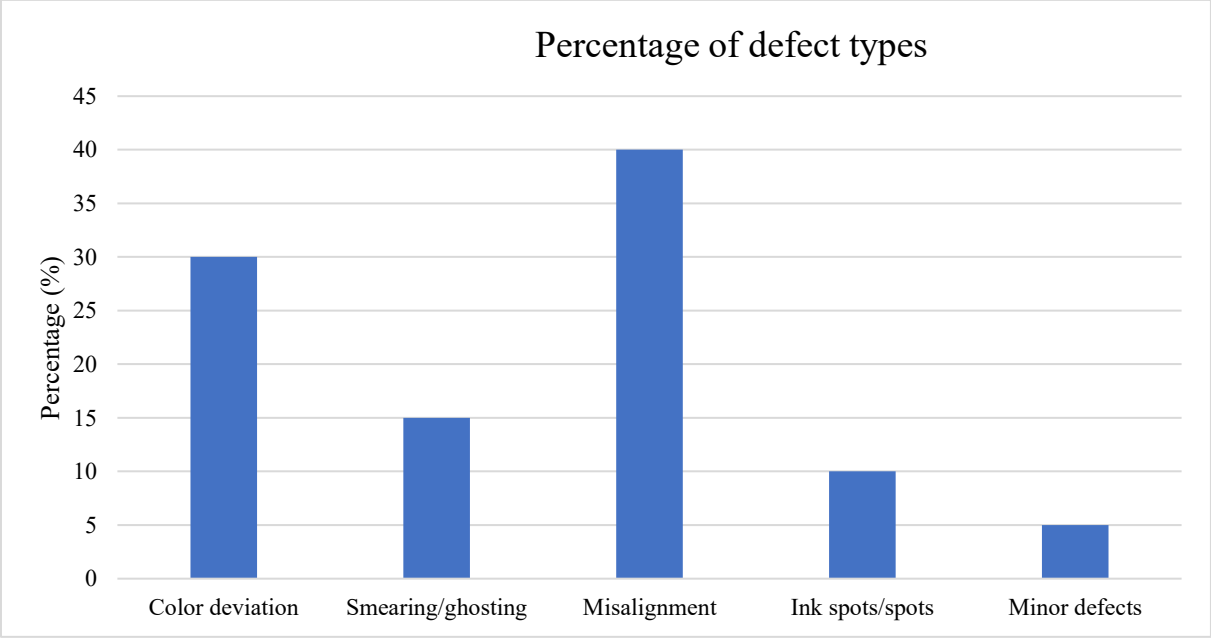

Figure 1. Percentage of defect types

Identification of Types of Print Defects

The following are the results of the identification of the types of print defects found during the inspection process in the production process:

a. Color deviation

is a visual element that has an important role in the packaging industry, especially in attracting consumer attention and strengthening brand image and identity. Color is a visual perception that is captured by the eye due

to the reflection of light from an object. Controlling the color quality of printed products is a very important aspect in maintaining visual quality and product perception. In the labeling industry, color stability between products is needed to get a visualization that is one understanding. Color measurement is generally done with the help of color bars, which are standard color segments printed simultaneously with the main design for the purpose of color calibration and evaluation. However, in large-scale commercial printed products such as packaging, color bars are often not included. This condition requires color measurement to be carried out directly in the product design area, so an alternative measurement approach is needed so that the measurement results remain valid and able to represent the color quality of the print as a whole. One of the main causes of color inconsistency is the absence of a standard color reference standard. In many cases, the printer operator must rely on the visual eye to assess whether the colors are in accordance with the design or not, without using measuring instruments such as spectrodensitometers or spectrophotometers. Although the human eye can be used as an observer tool, the resulting judgment is subjective. Therefore, a special measuring tool is needed to objectively assess the quality of printed products and ensure the quality of printed results. This causes the consistency of the print color to make it difficult to process quality control, so methods must be used to achieve color stability.

b. Blur printing results (smearing/ghosting)

In the world of printing or printing, often experience blur printing, this is caused by several factors. First is that the printer's dirty print head or paper residue that accumulates on the heating element in the print head can block the evenly transfer of heat to the paper, resulting in faded or streaked prints. Then there is the improper hot temperature factor (too hot or too cold) on the print head can affect the clarity of the print. Draft or low-quality mode settings can also lead to faded prints. There are many factors that will affect the blur print, this can be prevented with several treatments either from the printer factor or from the design draft factor.

c. Register misalignment

In color printing, registration means making sure different colors align correctly when printed in layers. Each color is printed individually, and proper registration ensures that the colors overlap appropriately, creating a clear and accurate image.

d. Ink spots/spots

Ink is very important in the world of printing, as it is an essential component for shaping writing or drawings. Because the ink is liquid and prone to leaks or splashes on other parts, it is very important to maintain the components that are related to the ink. Inaccuracies in the installation or in the maintenance of these components will result in leaks or even dirty other components, so that small dots will appear, either on the image or on the machine due to ink sticking to the engine parts that are not cleaned. This will certainly affect the printing results, where because there is a machine that is stained by the ink, so that the result will appear bitnik or spots that cause a decrease in the quality of the product.

e. Other minor defects

Printing defects have a wide variety of causes, apart from the urian above, there are many more printing defects in the printing world, including dotted lines in the printing process due to instability of the ink output, then unexpected small impurities, or even impurities that come after printing is finished so that they stick to products that are still relatively wet in ink. Or maybe it could even be a light variation that is still within the limit of quality tolerance.

Analysis of the causes of defects using fishbone

Fishbone diagrams are one of the problem solving methods. This diagram is in the shape of a fishbone by reflecting many factors and aspects that are condensed into a single problem. The following is a fishbone diagram in the problem of printing defects in printing.

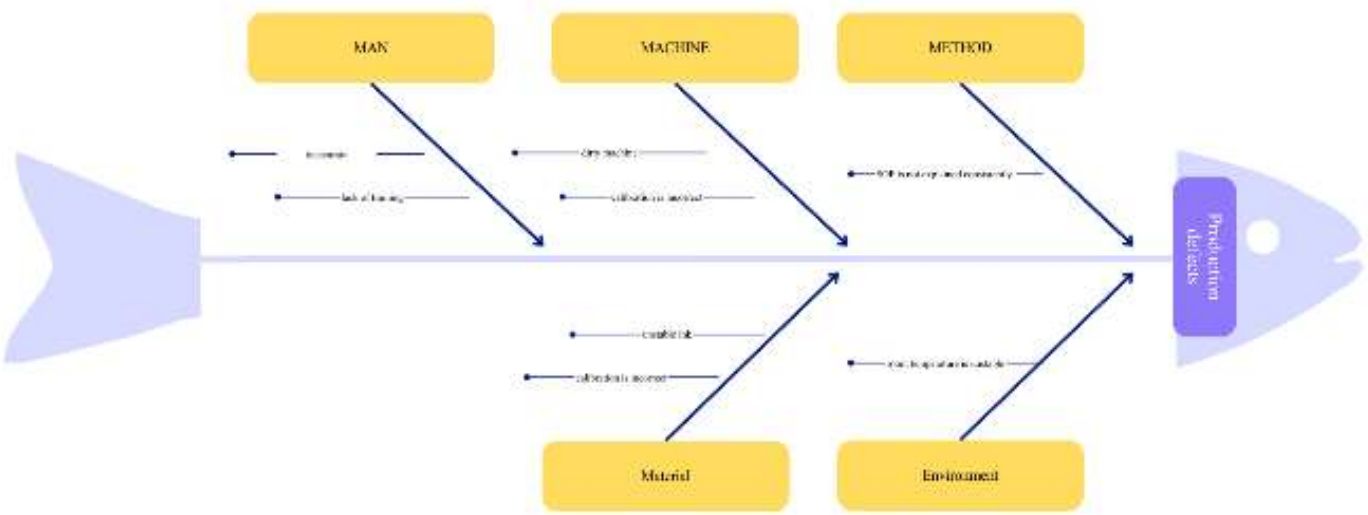

Figure 2. Fishbone diagram

1. Lack of training, lack of training.
2. Machine: dirty machine, improper calibration.
3. Method: SOP is not carried out consistently.
4. Material: unstable ink, damp paper.
5. Environment: room temperature is unstable.

Analysis Of The 5 Whys

The following is a root cause analysis for dominant defects, namely incorrect registers through 5 Whys analysis:

1. Why is the register incorrect?
   Incorrect registers can occur because the position of the print shifts during the production process, causing a shadow to form on the print result.

2. Why can the print position shift?
   The print position can shift due to the factor of the machine, namely from the sensor of the register mark reader that is unstable in reading the mark.

3. Why is the sensor unstable?
   The stability of the sensor will cause the stability of the printing results. Unstable sensors can be caused by dirt caused by ink splashes and dust during production.

4. Why can the sensor get dirty?
   Periodic maintenance of the appliance is necessary, especially on tools or machines that are often running or used. Dirty sensors are often caused by not doing regular cleaning before shift changes or no periodic cleaning of the sensor.

5. Why is regular cleaning not done?
   Routine cleaning must be carried out, of course, to maintain the cleanliness and integrity of the machine used. Routine or periodic cleaning is not carried out, often ignoring maintenance SOPs that are not followed and there is no daily checking checklist, so that the checking or maintenance of the machine is missed.

Check Sheet

The check sheet in this study functions as a tool for recording quality inspection data systematically. This form contains a list of critical, major, and minor parameters that must be met by label products at PT. XYZ. Each parameter is checked using visual standards as well as physical tests such as rubbing, scratch test, and barcode verification. Quality Control marks the appropriate columns to record the actual condition of the product. The

data from the check sheet is then used to analyze the dominant type of defect and identify the causative factors through methods such as fishbone diagram and 5 Why Analysis.

Example of Check Sheet Inspection at PT. XYZ

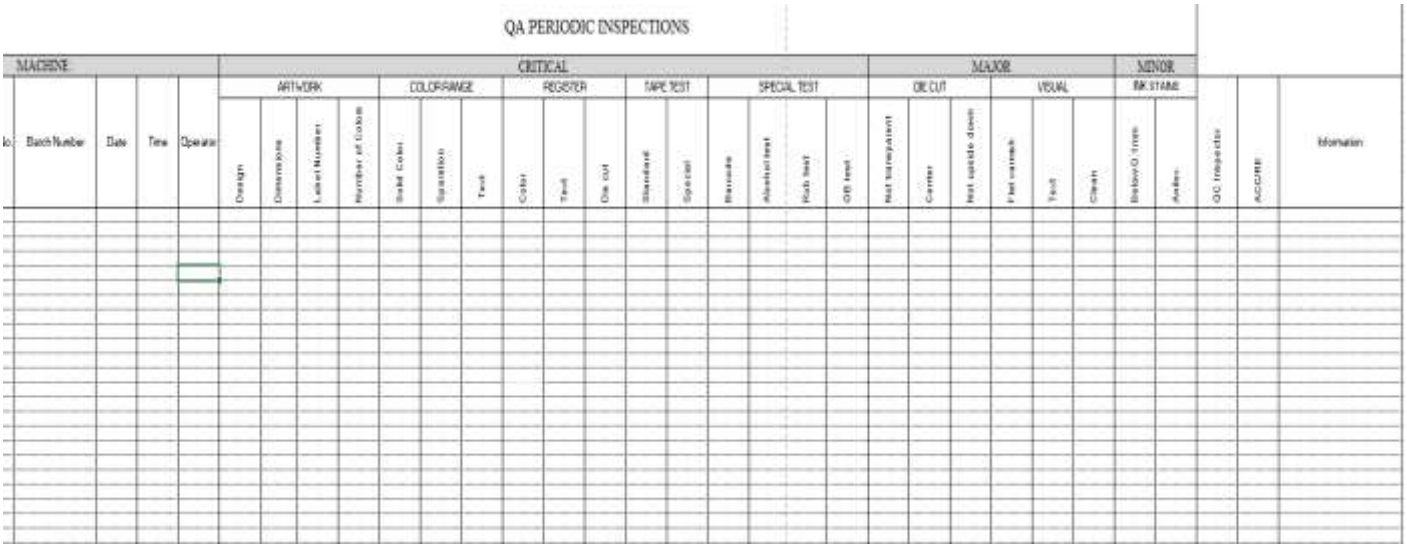

Figure 3. Checksheet

CONCLUSIONS

Conclusion

This study shows that print defects that appear in the label production process include color inappropriateness, blurry print results, register inaccuracy, ink spots, and other minor defects, with the dominant defects coming from blur printing results and register inaccuracy. The main causes come from human, machine, method, material, and environmental aspects, especially unstable machines, dirty register sensors, and SOPs that are not executed consistently. The 5 Why analysis confirms that the root of the problem stems from a lack of regular maintenance and cleaning of the machine. To reduce defects in a sustainable manner, companies need to carry out periodic calibration and maintenance, improve operator training, improve SOPs, and conduct material checks before the production process takes place.

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