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Improving the Quality of Sticker Production in the Use of Printing Machines with the 5W+1H Method Approach and Fish Bone Diagram

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Abstract: This study aims to improve the quality of sticker products in the printing process by optimizing the use of cutting machines at the labeling stage. The main focus of this research is to identify the main causes of defective products (reject) and find effective solutions to reduce the defect rate through improving working methods and machine parameters. The methods used include analysis of production data, measurement of defect levels, and the implementation of evaluation-based continuous improvement. The results show that the adjustment of the cutting speed, cutting angle, and periodic maintenance of the cutting machine significantly reduces the sorting rate. Thus, this research makes a real contribution in improving production efficiency as well as the quality of the final product in the sticker labeling process.

Keywords: *Improving Production Quality and Efficiency.*

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I. INTRODUCTION

The printing industry has an important role in providing high-quality products that meet consumer needs, including stickers that are widely used in product labeling. In this process, the quality of the sticker is often affected by the level of precision and efficiency of the production equipment, such as the cutting machine. An unoptimal cutting process can lead to production defects such as inappropriate sizing, damage to the edges of the sticker, and deterioration in adhesion. This problem not only increases the rate of rejected products but also results in resource waste and higher production costs.

Efforts to improve quality and efficiency in the printing process are the main concern in various sectors. One of the approaches used is optimize machine parameters and working methods to reduce defect rates. For example, research in the printing industry shows that periodic maintenance and speed adjustment on cutting machines can significantly improve production yield and reduce defects. In addition, the study of tool design modification in the manufacturing industry also emphasizes the importance of innovation in the production process to achieve a higher level of efficiency.

This approach is becoming increasingly relevant due to the high consumer demand for high-quality products at competitive prices. This study aims to evaluate the sticker production process in the context of labeling, focusing on the use of cutting machines as one of the critical stages in reducing the level of defects. This research is expected to provide practical solutions that can be applied in the printing industry to achieve more efficient and competitive production targets.

II. LITERATURE STUDY

Research on improving quality and efficiency in the production process, especially in the field of printing, has been carried out a lot. Here are some literature reviews relevant to this study:

A. Improving Product Quality Through Machine Optimization

Hakim's research (2021) shows that design modifications to laser marking machine components are able to reduce the defect rate by up to 98%. In the study, the change in the design of the input driver from solid type to U type succeeded in reducing physical damage to the product during the marking process. This study emphasizes the importance of technical analysis on the tools used to ensure that the production process runs optimally.

B. Defect Management in Production Process

A study on the production of railway bogies by ITS (2016) highlights the importance of reducing waste, especially defects, to improve production efficiency. Using

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the Defect Per Million Opportunities (DPMO) analysis method, this study shows that the defect rate can be reduced by improving the working procedures and periodic maintenance of the machine. This approach is relevant in the context of printing, where the precision of tools such as cutting machines has a significant impact on the final result.

C. Utilization of Cutting Machines in the Printing Industry

Study on PT. Graphic Literature Image shows that the use of modern cutting machines such as Itotec is able to improve cutting precision so as to minimize product dimensional errors. The study highlights the importance of technical parameters such as cutting speed, knife sharpness, and pressure regulation to ensure consistent and quality cutting results.

D. Why Analysis

Why-Why Analysis is a simple technique used to find the root cause of a problem by asking the "why" repeatedly, usually up to five times or until the root cause is found. This method aims to dig deeper than just treating symptoms, so that the solution applied can prevent the problem from recurring. It is usually implemented visually in a tree diagram or table that shows a cause-and-effect relationship. Why-Why analysis is often used to identify the cause of machine failure or product defects.

E. Printing Machine Technology and Maintenance

Other literature highlights the importance of preventive maintenance on cutting and printing machines to reduce downtime and tool breakdown. Studies show that periodic maintenance can extend the life of the tool and improve operational efficiency by up to 20%.

The above study provides a solid basis for designing research on improving sticker quality through optimization of labeling processes. Emphasis on technical aspects and quality management is a key strategy to reduce rejection rates and increase production competitiveness.

F. Fish Bone Diagram

An Ishikawa diagram (also called a fishbone diagram) is a diagram that shows the cause of a specific event. This diagram was first introduced by Kaoru Ishikawa (1968). The most common use of Ishikawa diagrams is to prevent product defects and improve product quality. Ishikawa diagrams can help identify factors that significantly influence an event.

A fishbone diagram will identify the various potential causes of a single effect or problem, and analyze the problem through brainstorming sessions. The problems will be broken down into a number of related categories, including people, materials, machines, procedures, policies, and so on. Each category has a reason that needs to be outlined through a brainstorming session.

III. RESEARCH METHODS

Improving product quality requires a systematic approach that includes problem identification, root cause analysis, solution development, implementation, and evaluation of results. The research methods used can be quantitative and qualitative, experimental, research, action, and Lean or Agile-based approaches.

The choice of method depends on the nature of the product, the type of problem, and the purpose of the research. By integrating analytical techniques such as Fishbone Diagram or Statistical Process Control, companies can understand the root cause of problems, optimize production processes, and meet customer needs. A combination of quantitative and qualitative methods often provides more comprehensive and effective results in improving product quality. Research on SC PW 8K paper focuses on the analysis of the physical and chemical properties of the paper and the influence of the composition of the raw material on its quality. SC PW 8K paper is often used in a variety of applications, including printing and packaging, due to its ability to produce high-quality images.

❖ *Research Description:*

A. Research Objectives

This research aims to:

- Identifying the effect of raw material composition on the physical and chemical properties of SC PW 8K paper.
- Analyze the characteristics of the resulting paper from various material compositions.

B. Methodology

The methods used in this study include:

- *Sample Collection:*

Sampling SC PW 8K paper from various sources for analysis.

- *Characterization:*

Perform laboratory tests to assess physical properties (such as thickness, tensile strength, and porosity) and chemical properties (pH, fiber content, and additives).

- Data Analysis:

Using statistical software to analyze data obtained from testing.

C. Research Results

The results of the study show that:

- *Raw Material Composition:*

Variations in the composition of raw materials, such as fiber types and fillers, have a significant effect on paper quality. For example, the addition of recycled fibers increases porosity but can decrease tensile strength.

- *Physical Properties:*

Paper with a certain composition shows better thickness and optimal ink absorption.

- *Chemical Properties:*

The pH of the paper is within a range suitable for printing applications, ensuring that the paper does not deteriorate quickly when exposed to moisture.

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IV. RESULTS AND DISCUSSION

The process of sticker printing in the printing industry involves several important stages that have a direct effect on the quality of the final result. Research on this process often focuses on printing methods, factors that affect quality, and improvement and quality control efforts. The following is a description of the results of the research discussion related to the sticker printing process.

A. Stage Adjustment

1. *Sticker Design:*
The initial stage of sticker printing is design, which is done using graphic design software such as Adobe Illustrator or CorelDRAW. This design includes imagery, text, and other decorative elements to ensure visual appeal.

2. *Print Preparation:*
Once the design is complete, the print file is prepared with color adjustments and format conversion. The process also includes the application of bleed to ensure accurate prints when cutting.

3. *Printing Process:*
Various technologies are used in sticker printing, including offset, digital, and screen printing. The choice of technology depends on the number of printed stickers and the desired quality.

4. *Lamination:*
After printing, lamination is done to protect the sticker from scratches and UV rays, as well as provide a gloss or matte final effect.

5. *Cutting:*
The stickers are cut to the desired size and shape, either manually or using an automatic cutting machine.

6. *Finishing:*
The final stage includes quality inspection and packaging of stickers to be ready for sale or ship.

Every time you do production, of course, there are standards that must be used as a reference so that the products produced can be consistent, as for the expected product quality criteria have been described in table 1 below.

Table 1 Product Quality

Product Name	Parameter	Average Score
Paper SC PW 8K	Thickness (mm)	0.15
	Tensile strength (N)	50
	Porosity (%)	15
	Ph	7.5

However, as is known, the production of SC PW 8K paper can experience defects for sticker production, as for the details of the types that make defects that occur in SC PW 8K paper are in the following table 2.

Table 2 Types of Defects in Sticker Making Paper

Machine	-
Man	Lack of skill and throughness
Material	Paper SC PW 8K
Method	Lack of control and knowledge
Tool	Diecut and Slitting
Environment	Room humidity

Table 3 Types of production defects in sticker manufacturing

Types of Sticker Production Defects		
Erorrs in cutting design	C1	Stains, dust or scratch particles
Problems with the printing press	C2	In accordance with the usage standard
NG slitting process	C3	Paper too stiff

The Seven Tools method is used to identify problems that occur in the sticker production process so that things that are factors that cause defects that can reduce the quality of SC PW 8K paper products can be identified.

➢ *Causal Diagram*
The creation of a causal diagram is intended to show the causal factors (causation) and quality characteristics (causation) caused by those causal factors. To find out the causes of these problems, a thorough identification is needed, starting from the primary cause, secondary cause and tertiary cause. Meanwhile, consequences are the main problem that must be solved. A fishbone diagram is a chart that resembles a fishbone that is used to illustrate the cause and effect factors of a problem. The causal factors are listed in the box on the right side of the paper, while the causal factors are in the "spine" on the left and right sides.

➢ *Errors in Cutting Design (C1):*
Causes of imperfect design or die cut files, such as unclear or misplaced cut lines, can lead to improper cutting. Solution: Make sure the die cut design file is correct, with clear cutting lines and according to specifications. Do some checks and make sure all the design elements are set up correctly. Then it will be more specific to the fishbone image in the following image.

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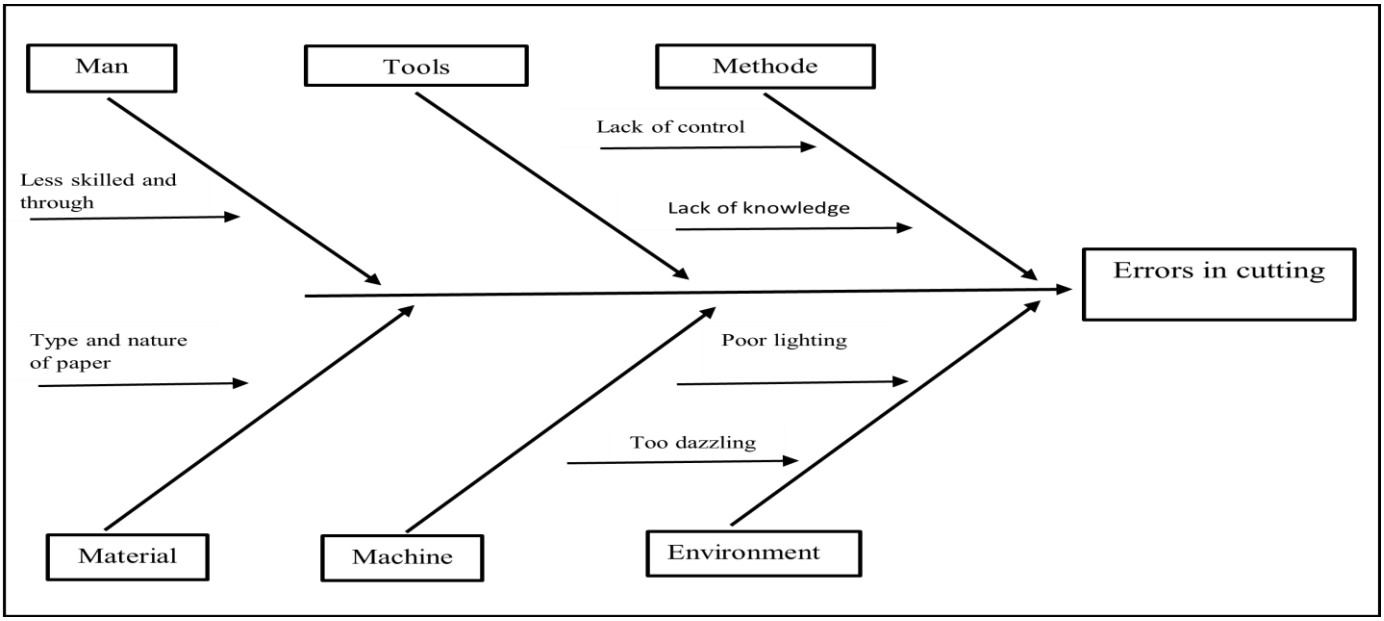

Fig 1 Fishbone Diagram Causal Diagram Errors in Cutting

➢ *Problems with the Printing Machine (C2):*

The cause of a dirty, poorly calibrated, or damaged printing machine can cause problems with the print such as scratches, lines, or inaccurate colors. Solution: Perform regular machine maintenance, including cleaning, mold quality checks, and recalibration. Table 4 and figure 2 below show the details of the cause of the printing machine problem.

Table 4 Printing machine problem

Machine	**Errors in the printing process**
Man	Less attention when entering ingredients
Material	Rigid material Damp material Uneven
Method	Lack of control and knowledge
Tool	Settings on the machine Less sharp cuts
Environment	-

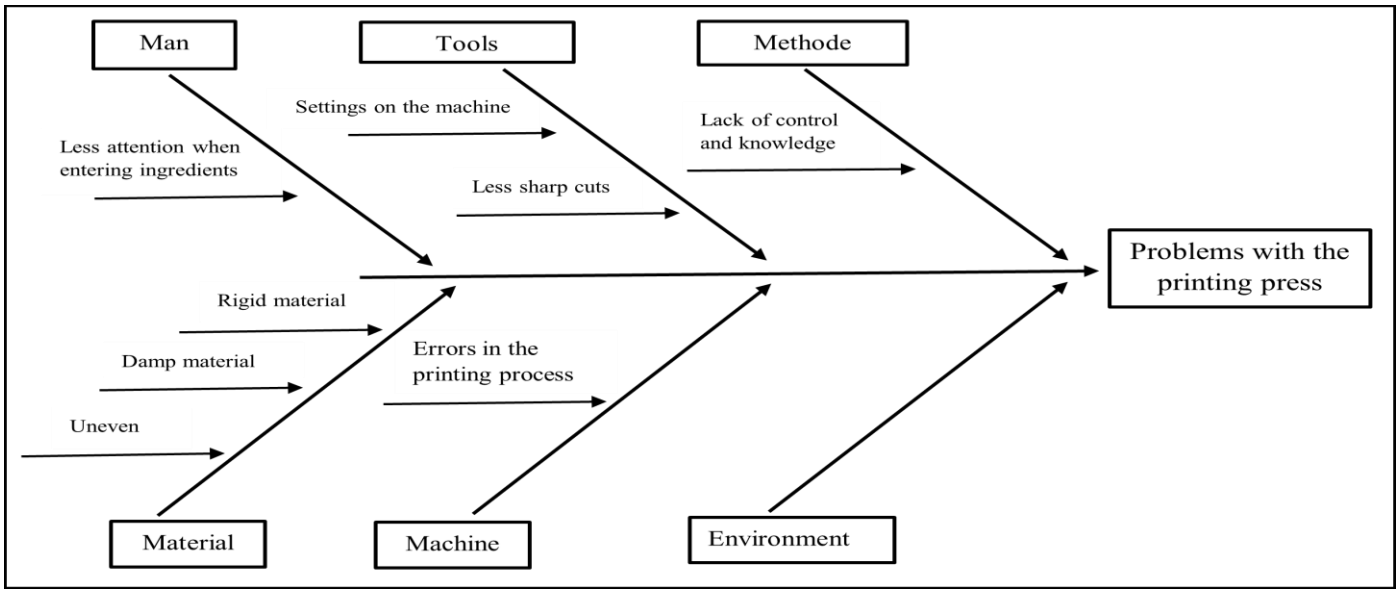

Fig 2 Fishbone Diagram Cause and Effect Problems with Printing Machines

➢ *NG Slitting process (C3):*

Causes Engine speed that is too fast or too slow. The position of the blade is not aligned or does not match the thickness of the material. Inappropriate pressure and spacing between blades. Solution: Adjust the speed of the machine to the characteristics of the label material. Ensure the blade position is precise and in accordance with the thickness of the label. Establish clear engine setup procedures and ensure operators understand the correct settings. The following shows the details of the causes of NG slitting in table 5 and figure 3 below.

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Table 5 NG Processes Slitting

Machine	Roll is not aligned
Man	Less control before entering the machine
Material	Sticker paper Label
Method	No re-checking
Tool	Blade is not sharp Settings on the machine
Environment	-

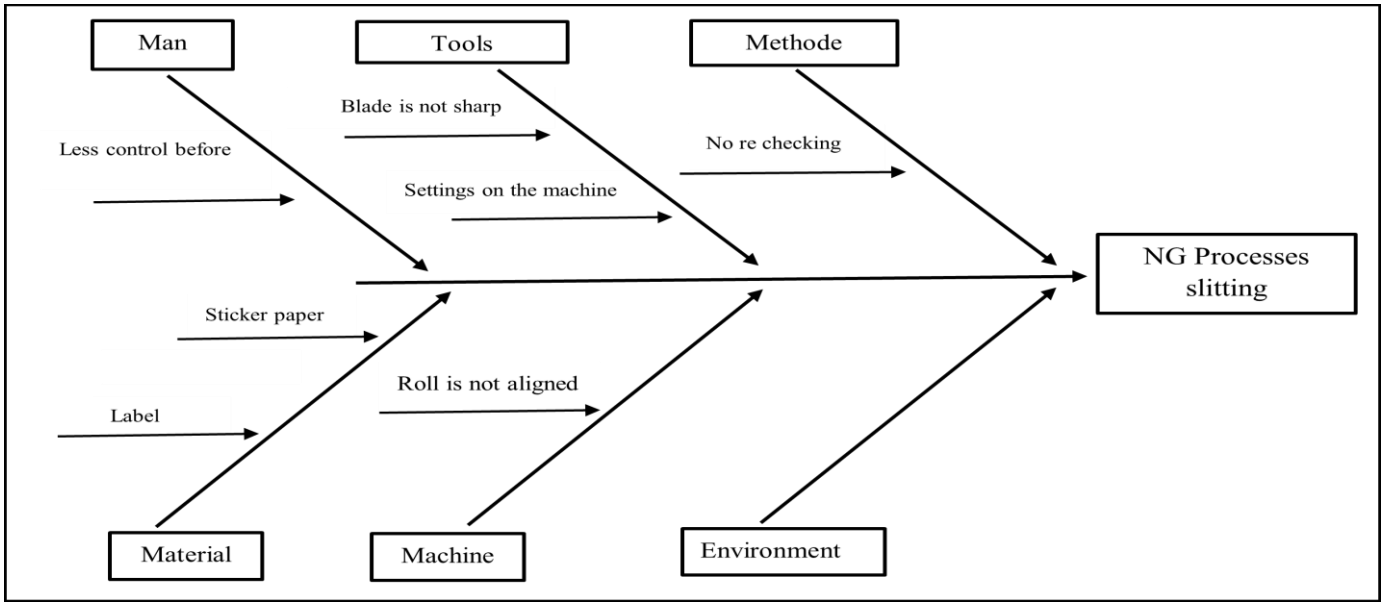

Fig 3 Fishbone Diagram Cause and Effect NG Slitting Process

➢ *Diagram Pareto*

After completing the diagram and all the details of the cause and effect diagram, the next step is to make a pareto diagram based on the number of defects of each type that has been explained earlier, while table 6 below shows the percentage of the number of defects of each type of the total and the percentage of cumulative defects.

Table 6 Defect Percentage

Types of Defects	Frequency	Percentage	Cumulative Percentage
C1	250	38,46%	38,46%
C2	220	33,85%	72,31%
C3	180	27,69%	100,00%
Total	650	100,00%	100,00%

Based on the type of defects as in Table 6, if made in the form of a Pareto diagram as shown in figure 4 below, this Pareto diagram image is sorted by the number of the most types of defects.

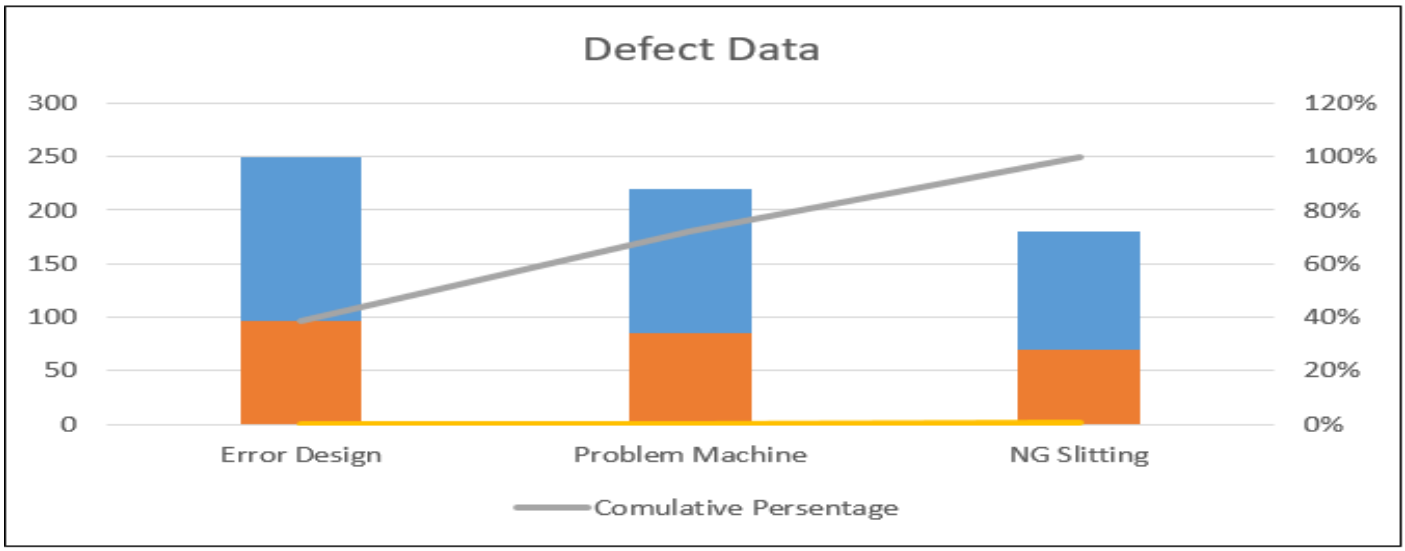

Fig 4 Pareto Diagram

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➢ *5W+1H*

After analyzing the type of defect in the sticker manufacturing process, it can be found that cutting errors are the most common type of defect, therefore the author will propose improvements using the 5W+1H method as shown in tables 7 to 9 below.

Table 7 What and Where

Problem	What	Where
Material	Bent Damp material Rigid material	Ingredients
Man	Less attention when entering material	Filling stage
Machine	Settings on the machine	System on the machine
Tool	Knife setting	Printing machine
Method	Escape control	Before entering the machine

Table 8 Who and When

Problem	Who	When
Material	Material production	Before entering the printing machine
Man	Production operators	Before you begin production
Machine	Mechanic	Before the machine is operated
Tool	Mechanic	When setting the blade
Method	Quality control	Before entering the printing machine

Table 9 Why and How

Problem	Why	How
Material	To find out the cutting error	Checking raw materials
Man	To be more thorough and skilled	Upskilling and training
Machine	Minimizes damage at the printing stage	Setting on the machine
Tool	Sharpness on the blade	Ensuring knife sharpness
Method	Reduce dropouts	Implementing SOPs

V. CONCLUSION

From the research conducted, it can be concluded that the application of the analysis of the causes of production defects through the Why Why method and Ishikawa diagram is very effective in identifying problems in the sticker production process. Adjustment of machine parameters and the application of routine maintenance have proven to be significant in reducing the defect rate. In addition, better quality management not only improves efficiency but also strengthens the company's competitive position in the market. Therefore, recommendations for the implementation of this procedure in other printing industries are highly recommended in order to achieve optimal and high-quality production results. In addition, further exploration of the use of automation technology and artificial intelligence in quality management could provide valuable new insights for innovation in the printing industry. Thus, this research not only provides a practical solution to the problem of sticker production but also paves the way for further research that can strengthen the overall competitiveness of the printing industry.

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