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Defects Analysis of Printed Tissue Paper Products using Eight Disciplines Method

(Case Studyof PT IGP Internasional Sleman)

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Abstract

Assuring product quality has been always a main concern of a production process. PT IGP Internasional Sleman is a company that produces Printed Tissue Paper. This company's defect tolerance limit is 2%. Based on early observations, the defect rate reaches 5.2%. The Eight Disciplines (8D) method was used to solve the problem. First, the team was built to engage all related divisions in the project. Then, Failure Mode and Effects Analysis (FMEA) was carried out to sort the problems. Root Cause Analysis using Fishbone diagram was also used to find the causes. Proposed improvements to reduce defects have been implemented. There are adding Rotogravure machine operators, conducting supervision/inspection by production leader, and providing socialization related to the importance of product quality and production. The implementation has successfully reduced the defects to fulfill the company's standard.

Keywords: 8D, defect, FMEA, quality,

1. Introduction

Quality has many definitions. It can be defined as conformance to requirements or production specification limits (Aft, 1998). Implementing quality control will improve product quality, both goods and services that are still below specifications (Kusuma and Guritno, 2020). Products that meet the company's criteria and consumer preferences said to be quality products, sometimes companies can produce defected products where the defective product cannot be sold and causes losses for the company (Fithri 2019). The company's efforts to control product quality are part of the production process where the products produced must be under supervision (Latief et al. 2018).

1.1 Objectives

PT IGP Internasional Sleman is a manufacturing company which one of its products is Printed Tissue Paper. Based on preliminary observations and interviews, some problems have been found. The problems related to product defects cause product reworks and even unable to be sold. This result also adds more costs for the production process. Based on observations in the second period on March 2022, it was found that the percentage of defects was more than 2%, which meant that this exceeded the defects percentage limit set by the company. Therefore, there is a need to identify and find out the causes of defects in order to solve the problem.

The Eight Disciplines (8D) method is one method that can reduce product defects from problems at PT IGP Internasional Sleman because the advantages of this method are that it can solve problems and prevent the recurrence of defects (Krajnc 2012). In its application, there are many ways to solve problems, one of which is regarded manufacturing process deviations and product defects (Chen and Cheng, 2010). The stages in the 8D method in solving problems include using Root Cause Analysis to identify and verify the root cause of the problem by determining the main cause of defect(Kaplík et al. 2013).

2. Literature Review

Elangovan et al. (2021) showed that after applying the 8D method, the percentage of defect rates was reduced even for three months then no quality problems were observed. Prasetyo et al (2021) pointed out, the 8D approach is very helpful in solving problems because it can directly identify problems and provide effective solutions to minimize the occurrence of problems. Likewise Rathi et al. (2021)shows how defects, waste of time, raw materials, worker and customer complaints can be reduced as well as improved service and quality production systems after implementing the 8D method. Moreover, Aichouni et al. (2021) prove that the 8D method is a method with an effective approach to finding the cause of the problem, developing corrective actions to eliminate the root cause.

The tools used in this method can be adapted to the project found so that it can generate a wide range of ideas and further actions using techniques that can narrow the list and generate more data for processing (Zarghami and Benbow 2017). The aim of this method is to improve quality and productivity by reducing costs of manufacturing inefficiencies and making continuous improvements to products and processes which can help identify and correct the causes of nonconformities with a team-based approach (Atigre, 2017).

3. Methods

The 8D methodology involves teams working together in order solve problems, using a structured eight-step approach to help focus on facts, instead of opinions(Riesenberger and Sousa, 2010). The 8D steps are:

D1 – Form the Cross-Functional Team

In this step, a team of selected members with adequate knowledge about the process and product is established. This is because, the team members know about where the problem occurred, why the problem occurred, and they have experience in the technical disciplines needed to solve the problem and taking the action. Therefore, the team have been 4-10 members with all the necessary knowledge and experience (Elangovan et al. 2021).

D2 – Description of The Problem

Describe the problem in measurable terms. Specify clearly and objectively the problems that occurred both internally and outside the company (Broday et al. 2013).Description use 5W+2H Analysis.

D3 – Implement and Verify Short-Term Corrective Actions

Define and implement actions that will provide protection for the customer to faulty, not causing a significant loss of the same, until permanent corrective action is implemented. Check on the data of the effectiveness of those actions (Broday et al. 2013).

D4 - Root Cause Analysis

The purpose of this step is to isolate and verify the root cause of the problem defined and to identify the location of leakage in the process. The determination of the problem's root cause should be performed by testing all possible causes based on collected data. There are a number of methods by which it is possible to determine the root cause(Kaplík et al., 2013). Root Cause Analysis use control chart and Fishbone diagram.

D5 –Determination of Permanent Corrective Actions

The essence of this step is to select the best permanent corrective action to eliminate the root cause and the best permanent corrective action for the location of leakage. The place of leakage in the process is seen as the earliest point in the process that is closest to the root cause where the problem should be revealed, but was not. For both of these measures, there should be verified their effectiveness and whether their implementation would not have any adverse effect(Kaplík et al. 2013). Determination uses FMEA and verification based on the highest RPN value.

D6 –Implementation and Validation of Permanent Corrective Actions

The purpose of this step is to plan, implement and validate selected permanent corrective actions. In case of implementation of interim protective measures, it is usually necessary to remove these interim measures before the implementation of permanent corrective actions (Kaplík et al. 2013).

D7 –Prevent the Reoccurrence of the Problem

This step involves updating all the necessary documents, systems, operations and procedures involved with the new permanent corrective action to prevent recurrence for future similar problems (Elangovan et al., 2021)

D8 –Closing Report

This is the last step of the 8D methodology. After solving the problem there should be an acknowledgement or appreciation from the management for the good work done by 8D team (Atigre 2017).Moreover, include a comparison before and after implementating corrective actions

4. Data Collection

The flow of the Printed Tissue Paper production process shown in Figure 1 starts from the entry of raw materials, the initial process is printing with rotogravure machine then cutting stage 1 with sheeter machine and stage 2 with pond-handle machine followed by counting and sort and packing with a conveyor machine.

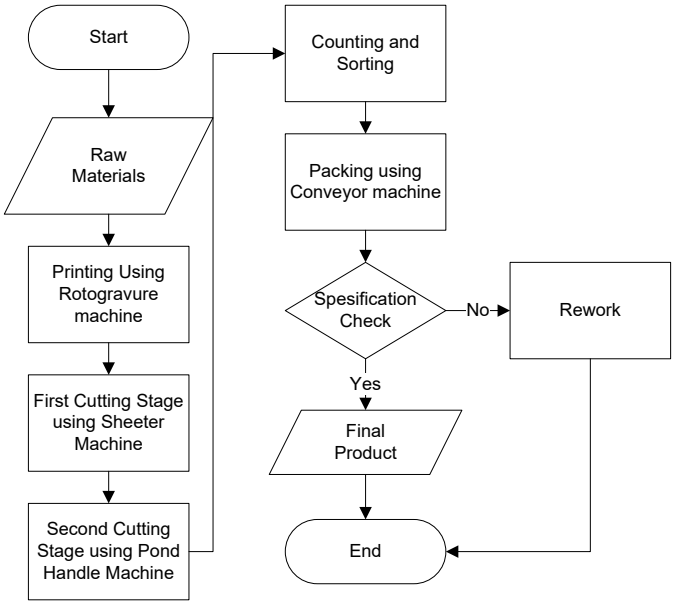

Figure 1.FlowProcess Production of Printed Tissue Paper
Source: PT IGP Internasional Sleman (2022)

Before the product is put into the finished goods warehouse, it is checked by Quality Control to find out whether the quality of all products produced is in accordance with the company's quality standards. If the number of defects exceeds the company's provisions, the product is checked in its entirety and reworked. If the number of defects does not exceed the provisions, then the product is taken to the finished product warehouse.

4.1 Defects Types

There are seven types of defects that occur in printed tissue paper products which are shown in Table 1

Table 1. Defect Types

No.	Defects Types	Description	Figure
1.	Ripped	Product size does not match quality standards	
2.	Pond Machine Problem	The product is not cut according to quality standards	
3.	Printing is not correct	The print is not in the right place	
4.	Dirty	The product struck by inked	
5.	Line problem	There is a line on the product	
6.	*Melet*	The product shifts and is left untidy	

No.	Defects Types	Description	Figure
7.	Wrinkles	Product texture does not meet quality standards	

Source: PT IGP Internasional Sleman (2022)

Types of defects with descriptions and figure, namely: ripped (product size does not match quality standards), Pond machine problem (the product is not cut according to quality standards), printing is not correct (The print is not in the right place), dirty (The product struck by inked), line problem (There is a line on the product), *melet* (The product shifts and is left untidy), wrinkles (Product texture does not meet quality standards).

4.2Data of Defects

Based on the number of samples that have been determined by the company, there are the number of defects listed in Table 2.

Table 2. Data of Defects

No.	Date	Amount of Sample (sheet)	Amount of Defect (sheet)	Percentage of Defects
1	22 March 2022	1600	29	1.8%
2	23 March 2022	1200	32	2.7%
3	23 March 2022	1660	26	1.6%
4	23 March 2022	940	18	1.9%
5	24 March 2022	2000	86	4.3%
6	24 March 2022	1500	34	2.3%
7	25 March 2022	1160	18	1.6%
8	25 March 2022	1800	31	1.7%
9	26 March 2022	1540	25	1.6%
10	26 March 2022	1260	41	3.3%
11	26 March 2022	560	9	1.6%
12	28 March 2022	1600	38	2.4%
13	28 March 2022	1880	41	2.2%
14	29 March 2022	1160	29	2.5%
15	30 March 2022	1560	26	1.7%
16	30 March 2022	1140	17	1.5%
17	30 March 2022	660	15	2.3%
18	30 March 2022	1060	39	3.7%
19	31 March 2022	1740	28	1.6%
20	31 March 2022	1280	67	5.2%

No.	Date	Amount of Sample (sheet)	Amount of Defect (sheet)	Percentage of Defects
21	31 March 2022	1160	28	2.4%
22	31 March 2022	1000	17	1.7%
23	01 April 2022	1200	18	1.5%
Sum			712	

Source: Analysis (2022)

The lowest defect sheet is 1.5 % and the highest defect sheet is 5.2%.

5. Results and Discussion

5.1. Form the Cross-Functional Team

The team consists of 11 members. There are supervisor of quality control, leader of quality control, quality control outgoing section, quality control in-line intern, quality control primary, leader of rotogravure machine, leader of sheeter machine, back-up leader of pond-handle machine, leader of line, counter/sorter, and packer.

5.2. Description of The Problem

The description is carried out by knowing the product quality standards, namely, product size 19”x25” with a half-circle cut shape, clean product, neat arrangement and folds and smooth product texture. Therefore, unsuitable products are defected products.

5W+2H		**Response**
What	What is the product with problem?	Printed Tissue Paper
	What is the specific problem?	Ripped
		Pond machine problem
		Printing is not correct
		Dirty
		Line problem
		Melet
		Wrinkles
Where	Where was the problem detected?	Process Counting until Packing
When	When did the problem occur?	When product is processing
Who	Who detected the problem	Quality Control, Counterand Packer
Why	Why is this a problem?	causes station delay
		the production output does not reach the target
		the production process will be longer
		it can increase production costs
		the company can suffer losses
How	How is the problem measured?	With direct observations and calculations
How many	How many products are defect?	712 from 30660 sample until 10 days
	how many percentages of product?	Average 2.3% per production

Figure 2. 5W+2H Analysis

Source: Analysis (2020)

Figure 2 shows how 5W+2H analysis to identify problems.

5.3. Implement and Verify Short-Term Corrective Actions

Short-term corrective action is carried out by holding the product before it is placed in the finished product warehouse.

Figure 3. Implement and Verify Short-Term Corrective Actions

Figure 3 is a temporary prevention by outgoing quality control by checking the number of samples according to company regulations

5.4. Root Cause Analysis

The root cause analysis of the problem is carried out by calculating the control chart according to the defects data in table 2. The calculation starts from the proportion of defects, center line, UCL, and LCL so as to produce data as shown in Figure 4.

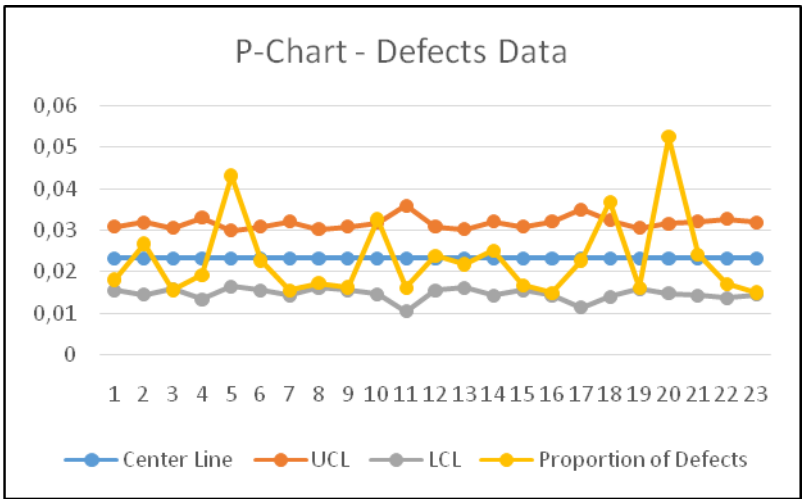

Figure 4. P-Chart Defect Data

There is data coming out of UCL, this indicates a problem at the time of retrieving the data. Next, the root cause analysis of the problem is carried out using Fishbone diagram for each type of defect.

5.5. Determination of Permanent Corrective Actions

The selection of corrective actions is analyzed using FMEA then the RPN calculation appropriate Table 3 is carried out where the three highest RPN values become verification of actions that will be analyzed further to reduce defects.

Table 3. Determination of Permanent Corrective Actions

No.	Failure Mode	RPN	Root Cause Analysis	Permanent Corrective Action
1.	Printing is not correct	392	• Lack of quantity Rotogravure operators • Lack of awareness Rotogravure operators about importance of Printed Tissue Paper quality • Lack of training • Lack of socialization about SOP • Lack of supervision	• Added Rotogravure operator • Providing socialization about importance of Printed Tissue Paper quality • Added Intense training • Providing socialization about SOP • Added supervision
2.	Pond Machine Problem	216	• Sheeter operators communicate with each other • Lack of awareness of Sheeter and Pond Handle operators on the importance of Printed Tissue Paper quality • Chase production targets	• Added supervision • Providing socialization about importance of Printed Tissue Paper quality • The existence of updating work procedures such as the process of picking up the stack is not too much
3.	*Melet*	135	• Lack of awareness of Counter and Sorter about importance of Printed Tissue Paper quality • chase production targets • Lack of supervision	• Providing socialization about the importance of Printed Tissue Paper quality • splitting of defects Melet for use in the next step • Added supervision

Proposed corrective actions based on root cause analysis and brainstorming to get effective improvement proposals.

5.6. Implementation and Validation of Permanent Corrective Action

The proposed improvement is carried out by implementing simulations with the addition of operators from the production process of other operators, supervision and socialization is carried out by in-line quality control, and experiments on updating work procedures.

Table 4. Implementation

No.	Date	Amount of sample (sheet)	Amount of defect	Percentage of defects
1	04 April 2022	940	11	1.2%
2	05 April 2022	1200	10	0.8%
3	05 April 2022	1260	8	0.6%
4	05 April 2022	1280	4	0.3%
5	06 April 2022	1160	11	0.9%
6	06 April 2022	1240	23	1.9%
7	07 April 2022	1200	9	0.8%
8	13 April 2022	520	7	1.3%
9	14 April 2022	1000	18	1.8%
10	14 April 2022	800	2	0.3%

The percentage of defects has decreased according to Table 4. Defect percentages are below the company's standard, which is 2 %. This indicates that corrective action is quite effective.

5.7. Prevent the Reoccurrence of the Problem

More effective reduction of defects and in the long term, corrective actions need to be carried out continuously.

Table 5. Prevent the Reoccurrence of the Problem

No.	Failure Mode	Permanent Corrective Actions	Prevent the Reoccurrence
1.	Printing is not correct	• Added Rotogravure operator • Added Intense training • Providing socialization about the importance of Printed Tissue Paper quality • Added supervision • Providing socialization about SOP	• added operators by opening job vacancies and give intensive training • Providing socialization about the importance of Printed Tissue Paper quality and SOP
2.	Pond Machine Problem	• Added supervision • Providing socialization about the importance of Printed Tissue Paper quality • The existence of updating work procedures such as the process of picking up the stack is not too much	• Providing socialization about the importance of the quality of Tissue Paper Printed products • The existence of updating new procedures of work such as the process of picking up the stack is not too much
3.	*Melet*	• Providing socialization about importance of Printed Tissue Paper quality • Added supervision • splitting of defects Melet for use in the next step	• Providing socialization about the importance Printed Tissue Paper quality • The existence of updating new procedures of work with the splitting of defect melet for use in the next step

Table 5 shows the prevention of reoccurrence of problems that companies can take to effect corrective actions in the long term. Analysis of preventing reoccurrence of problems based on permanent corrective actions taken and with the help of brainstorming.

5.8. Closing Report

The comparison before and after implementation shown in Table 6 shows a decrease in the percentage of defects.

Table 6. Comparison before-after implementation

No.	Proportion					
	Before implementation			After Implementation		
	Date	Amount of Sample (sheet)	Percentage of defects	Date	Amount of sample (sheet)	Percentage of defects
1.	23 March 2022	940	1.9%	4 April 2022	940	1.2%
2.	23 March 2022	1200	2.7%	5 April 2022	1200	0.8%
3.	26 March 2022	1260	3.3%	5 April 2022	1260	0.6%
4.	31 March 2022	1280	5.2%	5 April 2022	1280	0.3%
5.	29 March 2022	1160	2.5%	6 April 2022	1160	0.9%

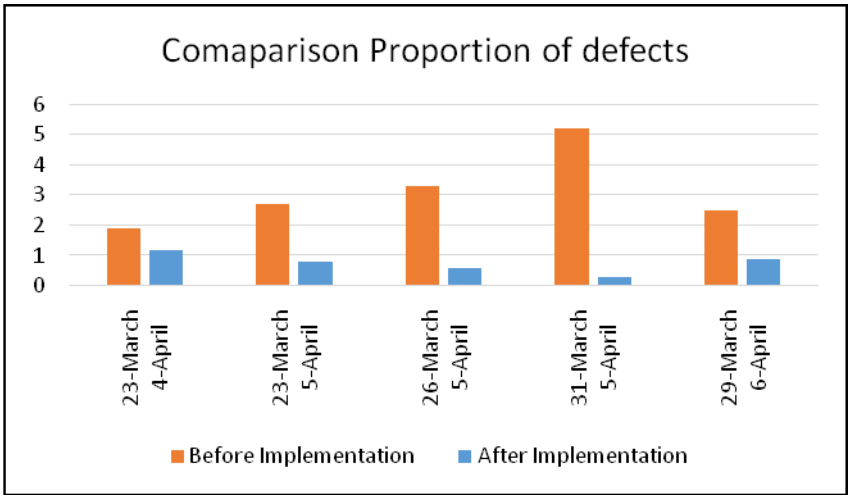

Figure 5 Comparison before-after implementation

Figure 5 clearly shows the difference and decrease in the percentage of defects before and after implementation. Implementation has been carried out and the percentage of defects has decreased comply the company's standard.

6. Conclusion

There are some causes of defects. First problem is lack of concern for rotogravure machine operators, sheeters and pond-handles. In addition, the rotogravure machine also lacks operators and existing operators also lack sufficient expertise. Sheeter operators are often found communicating with each other about outside work. The product failed because the stack was not neat in the counting and sorting process, the cause was the operator being careless in the process. To solve the problem, this research recommended adding operators accompanied by intensive training for more optimal workmanship and also conducting socialization about the importance of product quality in production process according to standard operating procedure. Implementation has been carried out and the percentage of defects has decreased comply the company's standard (less than 2%).

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