QUALITY CONTROL USING SIX SIGMA METHOD TO MINIMIZE PRODUCT DEFECTS (CV. PERCETAKAN BERKAH ANDALAS)

LAPORAN TUGAS AKHIR

Diajukan sebagai Salah Satu Syarat
untuk Memperoleh Gelar Sarjana Teknik
pada Program Studi Teknik Industri

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PEKANBARU
2024

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QUALITY CONTROL USING SIX SIGMA METHOD TO MINIMIZE PRODUCT DEFECTS (CV. PERCETAKAN BERKAH ANDALAS)

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KATA PENGANTAR

بسم الله الرحمن الرحيم

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Quality Control Using Six Sigma Method To Minimize Product Defects (CV. Percetakan Berkah Andalas)

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ARTICLE INFORMATION

INTRODUCTION

Printing is an industry engaged in economics that is involved in making and duplicating a variety of small to large prints, such as stickers, invitations, packaging, posters, billboards, books and other types. However, less than two months after entering mid-2020, businesses in the printing sector experienced significant uncertainty due to the impact of Covid-19. And in 2021, digital print technology is again in demand and even shows an increasing trend. This is evident from the high sales of printed motif cloth masks resulting from changes in business models that occurred during the pandemic (Herfina, et al., 2022).

CV. Percetakan Berkah Andalas operates in the printing industry that produces several products such as food packaging, calendars, paper bags, and stickers. CV. Percetakan Berkah Andalas has an Engineering to Order and Make to Stock production system strategy. Where, the Engineering to Order production system is used for new consumers and consumers who do not place orders continuously then the product will be produced according to the needs and specifications of consumers. While, the Make to Stock production system is used for consumers who do place orders regularly where products will be produced according to estimated demand without waiting for special consumer orders. The raw materials used are Ivory Paper, Ivory PE, Duplex, Crafts, Constructs, Ink, Glue, Plastic Laminating Doff and Laminating Glossy.

In the production process in CV. Percetakan Berkah Andalas there are still many food packaging products that do not meet quality standards or defective products, some of the problems found include dirty mold, unstable mold, wrinkled laminating, bubbly laminating, running pond, broken rails, and glue melts. Based on cost loss data in July 2022, CV. Percetakan Berkah Andalas suffered a loss of Rp. 11,244,100. This situation

has the potential to result in negative financial impacts for the company if left unchecked. Therefore, it is necessary to carry out quality control in CV. Percetakan Berkah Andalas.

Six Sigma is a detailed and flexible framework that aims to achieve, support, and improve business processes by prioritizing understanding customer needs. This approach relies on data, facts, and statistical analysis, and constantly emphasizes control, improvement, and re-evaluation in business processes. The process of implementing Six Sigma quality improvement involves five main stages, known as the DMAIC method (Define, Measure, Analyze, Improve, and Control) (Mabrur and Budiharjo, 2021). DMAIC is one of the commonly used methods in quality improvement and process improvement, and is often used as a problem-solving procedure (Pangastuti, et al., 2022).

Based on the background, this study aims to identify the most impactful types of defects, and measure the level of sigma in the production process. In addition, this study will provide suggestions for improvements in reducing defective products in CV. Percetakan Berkah Andalas uses the Six Sigma method.

LITERATURE REVIEW

Quality

Quality is the match of the characteristics or specifications of a product in accordance with consumer expectations (Mulyono and Heryanto, 2023). Quality is a major responsibility in a company's operations, as it can have a significant impact on the organization as a whole. Quality-related decisions must ensure that quality is considered thoroughly in every aspect of operations, including standard-setting, equipment design, employee training, and supervision of the resulting product or service (Juwito and Al-Faritsy, 2022).

Quality Control

Quality control is a method to maintain the quality of products that have been produced and ensure that the product is in accordance with predetermined specifications. So, quality control is a key factor in ensuring the success of a company in maintaining the quality of the products it produces. So that quality control is one of the main characteristics of the company's success (Sugiantini, et al., 2022).

Six Sigma

Six Sigma is one method in quality management that becomes an alternative to reduce the number of defective products with a focus on quality control (Farid, et al., 2022). Six Sigma has also been proven to provide benefits that include cost reduction, increased productivity, market share growth, reduction of defective products, as well as development in production or service provision (Hidayat and Suseno, 2023). The DMAIC methodology is at the core of Six Sigma problem solving which involves successive corrective steps that are essential in achieving the expected results. DMAIC is a series of stages that must be passed in every improvement project, which stands for Define, Measure, Analyze, Improve, Control (Oktaviani, et al., 2022).

RESEARCH METHOD

Research methodology is a structure or framework that refers to a series of systematically planned steps used in a study to achieve predetermined goals. Research methodology includes the process of preliminary surveys, literature studies, problem

identification, problem formulation, goal setting, data collection, data processing, analysis and conclusions and suggestions.
Data processing is carried out using the Six Sigma method with DMAIC stages as follows:

Define
Define is the first step in the Six Sigma quality improvement method. At this stage, focus on identifying and classifying problems that occur in the company. This stage is also useful for determining the product or process that will be the focus of research using the Six Sigma method (Hidayat and Suseno, 2023). At the define stage, the first thing to do is to determine the project charter, pareto diagram and critical to quality (CTQ).The project charter includes a description of the problem based on predefined priorities, goals, objectives, and project scope.

Diagram is a graphical representation that illustrates the relationship between the problem at hand and its possible causes, as well as the elements that play a role in influencing the problem (Abidin, et al., 2022).

Critical to Quality (CTQ) is a set of main criteria that must be achieved by a product in accordance with the product specification standard. This aims to ensure that consumer wants and needs can be met, thus providing consumer satisfaction (Sylvia, et al., 2023).

Measure
Measure is the stage of measuring the problem to be fixed. This measurement stage has an important role in improving quality, because from here it can be known the condition of the company based on the data collected. This data is the basis for analysis and improvement (Hidajat and Subagyo, 2022).

At this stage, measurements are made of the problem to be corrected. Calculating the DPMO value and sigma level is used to determine the defect level in every one million products produced as well as to assess the sigma level in the CV. Percetakan Berkah Andalas. The P-chart is used to determine whether the production process complies with control limits or not.

Analyze
This analysis is carried out with the aim of being able to analyze the data as a whole so that it is able to find out the root of the problem that occurs (Alfandy, et al., 2023). At this stage, an analysis of the causes of product defects resulting from several existing factors is carried out using Fishbone Diagram and Interrelationship Diagram.

Fishbone Diagram are used to explain the cause of defects in the product. After identifying the type of defect studied, corrective action needs to be taken to prevent similar damage in the future (Ikhsan, et al., 2021).

Interrelationship diagrams are tools used to find solutions to problems involving complex relationships. It helps in solving and identifying logical and interrelated relationships between causes and effects (Aziza and Setiaji, 2020).

Improve
Improve is the preparation of improvement proposals based on the identification of the root of the problem that has been found at the analyze stage (Bernik and Noviyanti, 2019). At this stage, a proposal for improvement is made from the causal factors that have been analyzed previously using Failure Mode and Effect Analysis (FMEA).

This Failure Mode and Effects Analysis (FMEA) method determines the priority of improvement based on the highest value in the Risk Priority Number (RPN), which results from assessing the level of severity, occurrence, and detection at each root cause (Nuraini and Hermanuadi, 2023).

Control

Control is a stage of supervision and control carried out in accordance with the application of the improvement stage that has been carried out. This control aims to provide the best results in reducing the time, trouble, and costs required (Sahelangi and Wulandari, 2023). At this stage, supervision and control are carried out so that problems that have been corrected do not reoccur using the Poka Yoke method and making Standard Operating Procedures (SOP).

Poka Yoke is a strategy and approach to prevent defects directly from the source by conducting continuous inspections aimed at achieving products that are free from defects or commonly referred to as zero defects (Rahmadani, et al., 2023).

The preparation of Standard Operating Procedures (SOP) is essential to maintain product quality and consistency. SOP refers to a set of standard procedures or steps that must be followed to complete a particular task or process. The existence of SOP is very important because they can ensure the quality and consistency of the results of the products and services produced (Ramada and Sandi, 2023).

RESULTS

Define

Define is the initial stage to be able to identify problems that exist during the production process using Project Charter, Pareto Diagram and Critical To Quality (CTQ) as follows:

1. Project Charter

Project charter are used to describe prioritized problems and objectives that have been set in the research. The Project Charter can be seen in Table 1.

Table 1. Project Charter

Project Charter
Company Name : CV. Percetakan Berkah Andalas
Problems
There are still production failures in food packaging, resulting in defects such as dirty mold, unstable mold, wrinkled and bubbly laminating, broken rails, running pond and glue melts. This situation has the potential to result in negative financial impacts for the company if left unchecked.
Purpose
The purpose of this study is to identify the types of defects that most impact the production process and the factors that cause defects, measure sigma levels and provide suggestions for improvements to reduce defects in the production process.
Risk
1. Products have decreased production quality 2. The company suffered financial losses

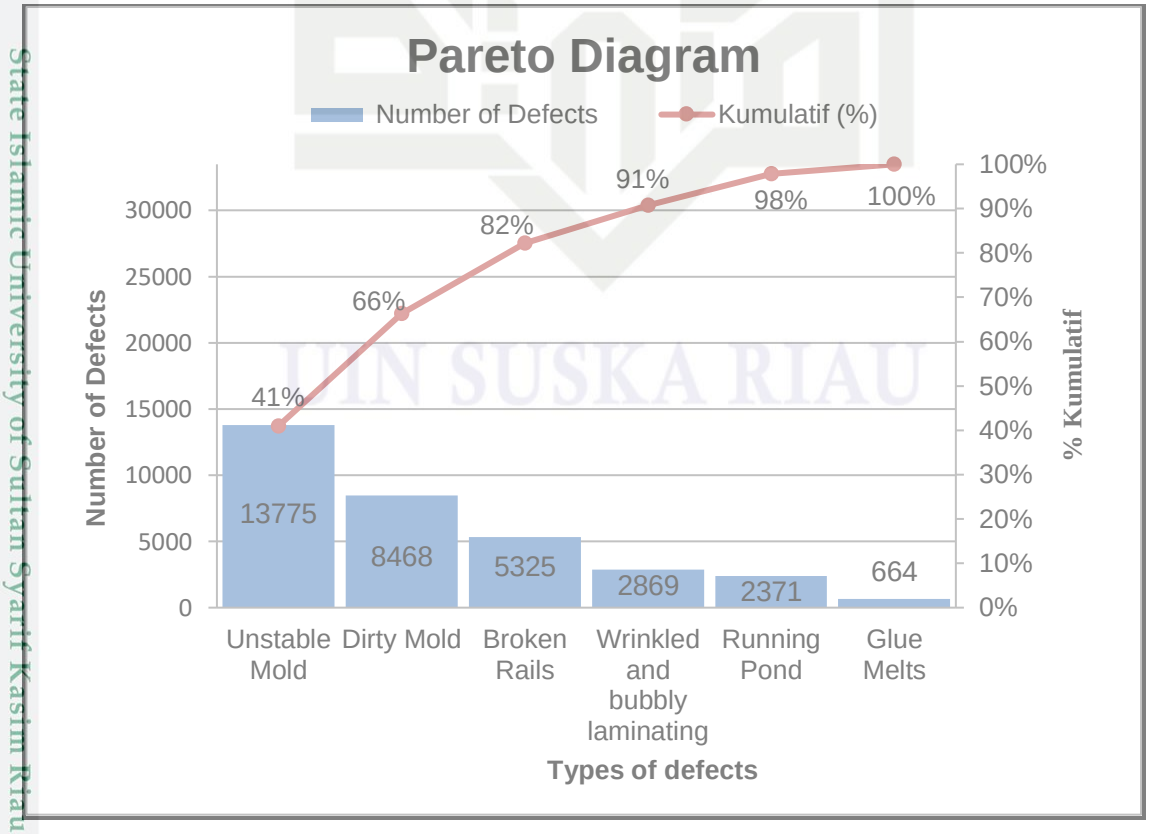
2. Pareto Diagram

Pareto diagrams are used to identify key issues that need to be prioritized in order to improve product quality. The percentage of food packaging defects can be seen in Table 2.

Table 2. Percentage of Food Packaging Defects

Types of defects	Number of Defects	Percentage (%)	Kumulatif (%)
Unstable Mold	13775	41	41
Dirty Mold	8468	25	66
Broken Rails	5325	16	82
Wrinkled and bubbly laminating	2869	9	91
Running Pond	2371	7	98
Glue Melts	664	2	100
Total	33472	100	100

Figure 1. Pareto diagram defects of food packaging



3. Critical To Quality (CTQ)

Critical To Quality (CTQ) is used to determine the quality of products that must be met to match the specified product specifications. The Critical To Quality (CTQ) can be seen in Table 3.

Table 3. Critical To Quality (CTQ)

Critical To Quality (CTQ)	Information
Unstable Mold	No color/text shifting, printouts are on demand.
Dirty Mold	No ink spots on the print

Measure

Measure is a stage carried out to measure the problem to be corrected by calculating the DPMO value, sigma level and P- Chart as follows:

1. Calculation of DPMO Value and Sigma Level

A recapitulation of the calculation results the DPMO value and sigma level in unstable mold can be seen in Table 4.

Table 4. Recapitulation of DPMO Value and Unstable Mold Sigma Level

No	Month	CTQ	DPU	DPO	DPMO	Sigma Level
1	January	2	0.00169	0.00084	844.482	4.640
2	February	2	0.00168	0.00084	840.323	4.642
3	March	2	0.00143	0.00072	716.783	4.688
4	April	2	0.00154	0.00077	767.952	4.668
5	May	2	0.00156	0.00078	777.922	4.664
6	June	2	0.00156	0.00078	780.822	4.663
7	July	2	0.00144	0.00072	721.165	4.686
8	August	2	0.00167	0.00083	834.127	4.644
9	September	2	0.00151	0.00076	756.552	4.672
10	October	2	0.00157	0.00079	785.714	4.661
11	November	2	0.00145	0.00072	724.832	4.685
12	December	2	0.00147	0.00073	734.607	4.681

A recapitulation of the calculation results of DPMO value and sigma level in dirty mold can be seen in Table 5.

Table 5. Recapitulation of DPMO Value and Dirty Mold Sigma Level

No	Month	CTQ	DPU	DPO	DPMO	Sigma Level
1	January	2	0.00083	0.00042	416.388	4.842
2	February	2	0.00103	0.00051	514.516	4.782
3	March	2	0.00096	0.00048	480.769	4.802

Table 5. Recapitulation of DPMO Value and Dirty Mold Sigma Level Continued

No	Month	CTQ	DPU	DPO	DPMO	Sigma Level
4	April	2	0.00099	0.00050	495.346	4.793
5	May	2	0.00098	0.00049	490.909	4.796
6	June	2	0.00094	0.00047	468.493	4.809
7	July	2	0.00089	0.00044	444.009	4.824
8	August	2	0.00105	0.00052	524.603	4.777
9	September	2	0.00089	0.00044	442.759	4.825
10	October	2	0.00101	0.00051	505.714	4.787
11	November	2	0.00085	0.00042	424.832	4.836
12	December	2	0.00094	0.00047	469.745	4.808

2. P-Chart

The P-chart is used to determine that the production process complies with the established control limits to achieve the desired product quality. The P-chart calculation is as follows:

2.1 Unstable Mold

The calculation of unstable mold P-chart is as follows:

Table 6. Recapitulation of Unstable Mold Defects

No	Month	Production Quantity	Unstable Mold
1	January	598.000	1010
2	February	620.000	1042
3	March	858.000	1230
4	April	752.000	1155
5	May	770.000	1198
6	June	730.000	1140
7	July	893.000	1288
8	August	630.000	1051
9	September	725.000	1097
10	October	700.000	1100
11	November	745.000	1080
12	December	942.000	1384
Total		8.963.000	13775

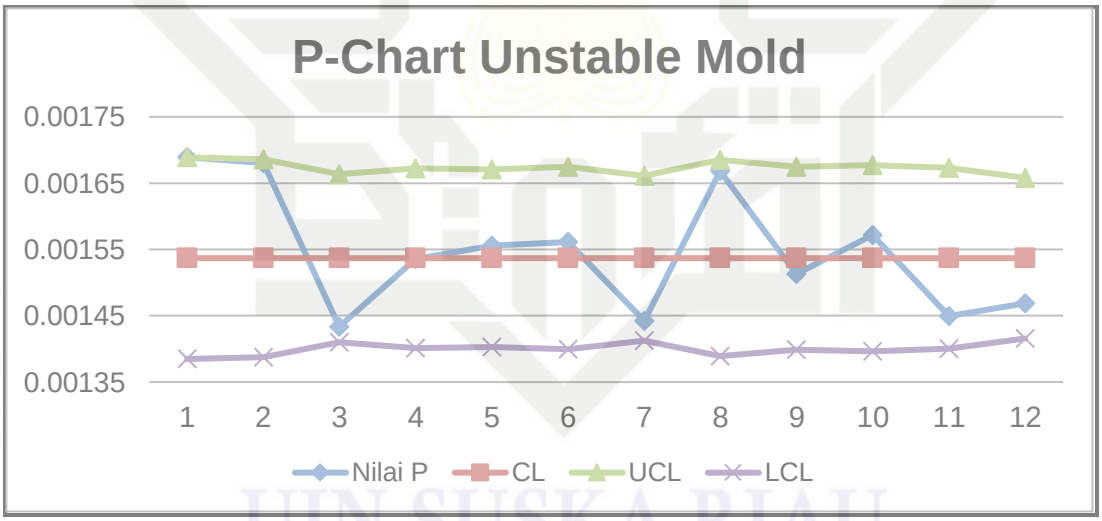
Table 7. Recapitulation of P, CL, UCL, LCL Values Unstable Mold Defects

No	Month	P	CL	UCL	LCL
1	January	0.00169	0.00154	0.00169	0.00138

Table 7. Recapitulation of P, CL, UCL, LCL Values Unstable Mold Defects Continued

No	Month	P	CL	UCL	LCL
2	February	0.00168	0.00154	0.00169	0.00139
3	March	0.00143	0.00154	0.00166	0.00141
4	April	0.00154	0.00154	0.00167	0.00140
5	May	0.00156	0.00154	0.00167	0.00140
6	June	0.00156	0.00154	0.00167	0.00140
7	July	0.00144	0.00154	0.00166	0.00141
8	August	0.00167	0.00154	0.00168	0.00139
9	September	0.00151	0.00154	0.00167	0.00140
10	October	0.00157	0.00154	0.00168	0.00140
11	November	0.00145	0.00154	0.00167	0.00140
12	December	0.00147	0.00154	0.00166	0.00142

Figure 2. P-chart Unstable Mold Defects



2.2 Dirty Mold

The calculation of dirty mold P-chart is as follows:

Table 8. Recapitulation of Dirty Mold Defects

No	Month	Production Quantity	Dirty Mold
1	January	598.000	498
2	February	620.000	638
3	March	858.000	825
4	April	752.000	745
5	May	770.000	756
6	June	730.000	684

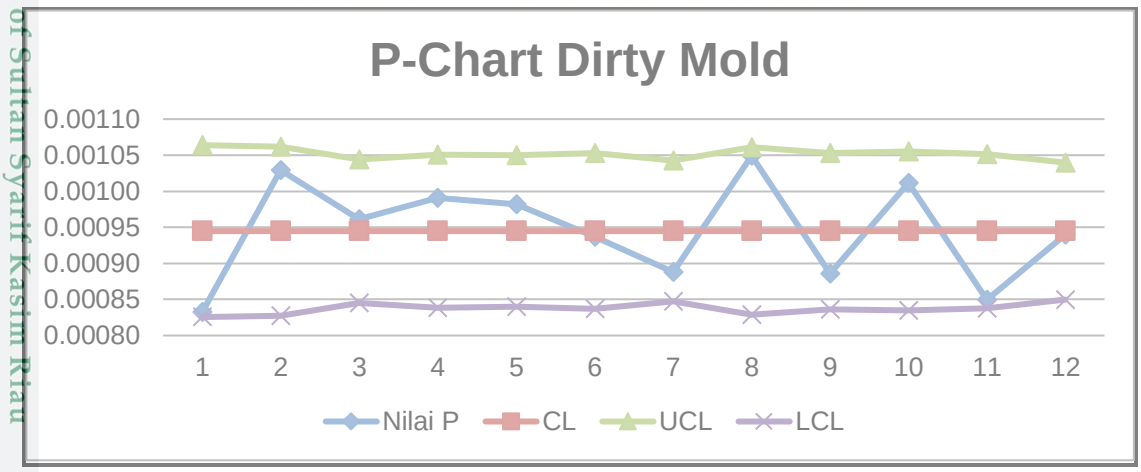
Table 8. Recapitulation of Dirty Mold Defects Continued

No	Month	Production Quantity	Dirty Mold
7	July	893.000	793
8	August	630.000	661
9	September	725.000	642
10	October	700.000	708
11	November	745.000	633
12	December	942.000	885
Total		8.963.000	8468

Table 9. Recapitulation of P, CL, UCL, LCL Values Dirty Mold Defects

No	Month	P	CL	UCL	LCL
1	January	0.00083	0.00094	0.00106	0.00083
2	February	0.00103	0.00094	0.00106	0.00083
3	March	0.00096	0.00094	0.00104	0.00085
4	April	0.00099	0.00094	0.00105	0.00084
5	May	0.00098	0.00094	0.00105	0.00084
6	June	0.00094	0.00094	0.00105	0.00084
7	July	0.00089	0.00094	0.00104	0.00085
8	August	0.00105	0.00094	0.00106	0.00083
9	September	0.00089	0.00094	0.00105	0.00084
10	October	0.00101	0.00094	0.00105	0.00083
11	November	0.00085	0.00094	0.00105	0.00084
12	December	0.00094	0.00094	0.00104	0.00085

Figure 3. P-chart Dirty Mold Defects



Analyze

Analyze is used to analyze the causes of product defects produced by existing factors using Fishbone Diagram and Interrelationship Diagram as follows:

1. Fishbone Diagram

Fishbone Diagrams are used to identify causal relationships that cause defects in the resulting product. The Fishbone Diagram of unstable mold and dirty mold is as follows:

Figure 4. Fishbone Diagram Unstable Mold Defects

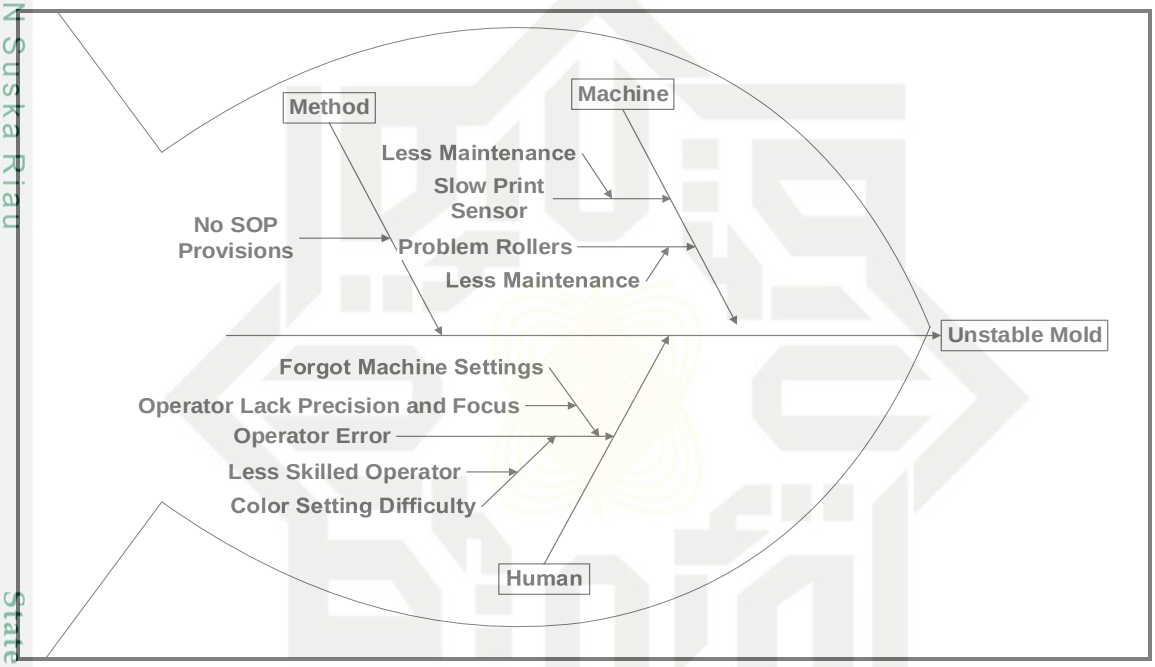
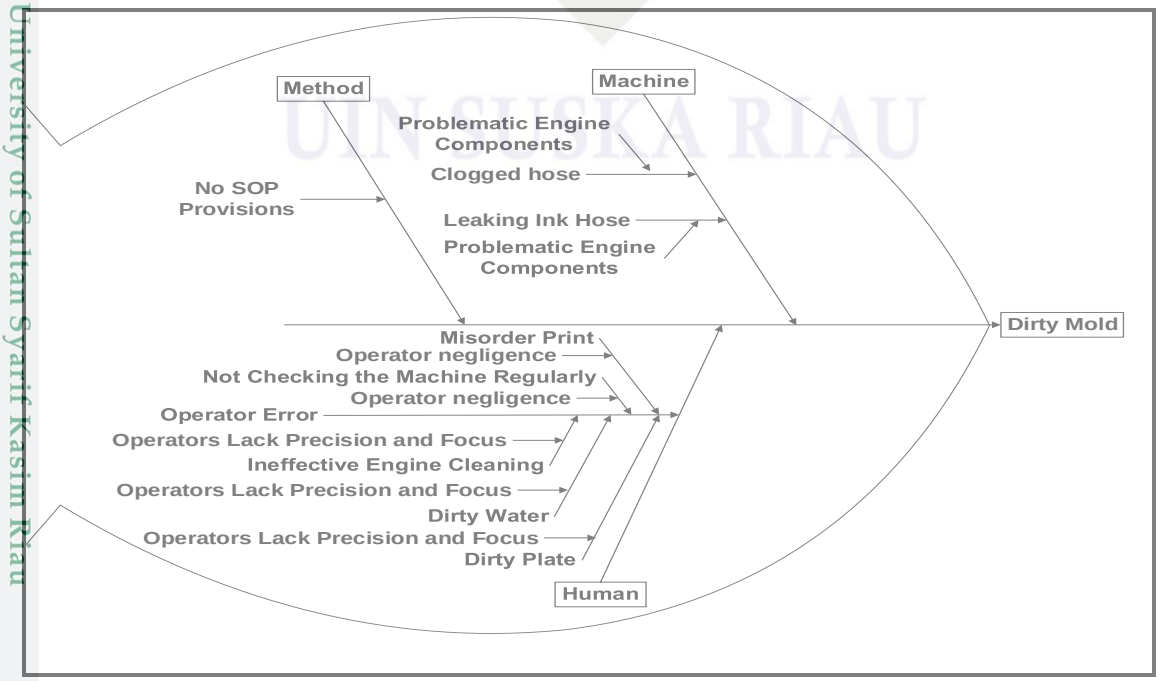


Figure 5. Fishbone Diagram Dirty Mold Defects



2. Interrelationship Diagram

Interrelationship diagrams are used to illustrate and analyze the relationships and interrelationships between the elements present in a problem. The interrelationship diagram of unstable mold and dirty mold is as follows:

Figure 6. Interrelationship Diagram Unstable Mold Defects

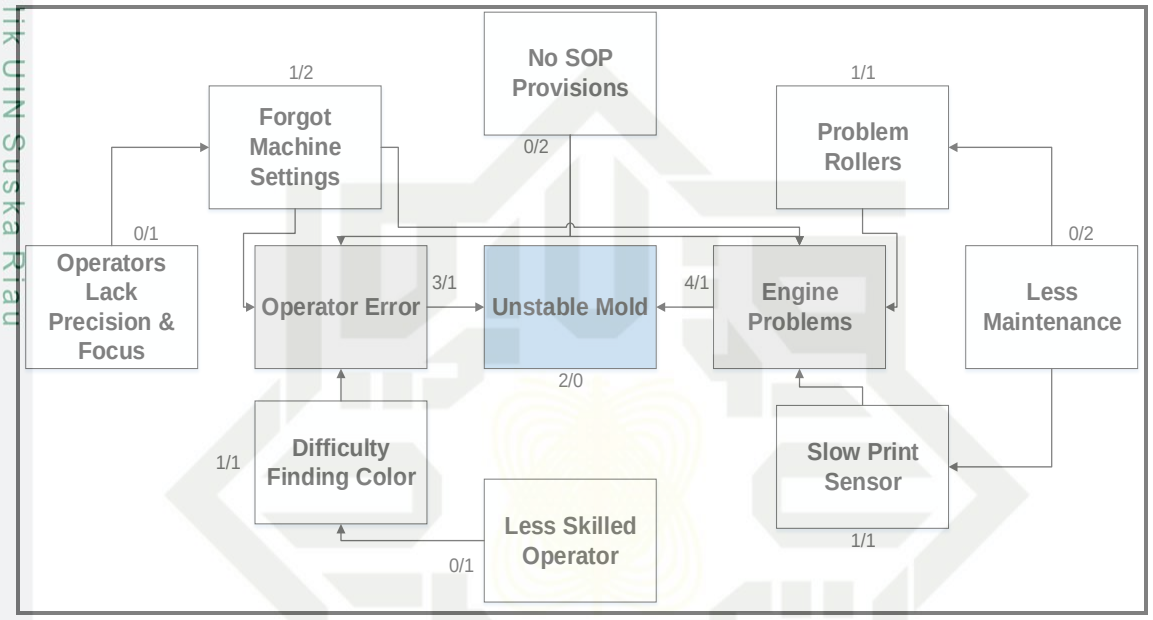
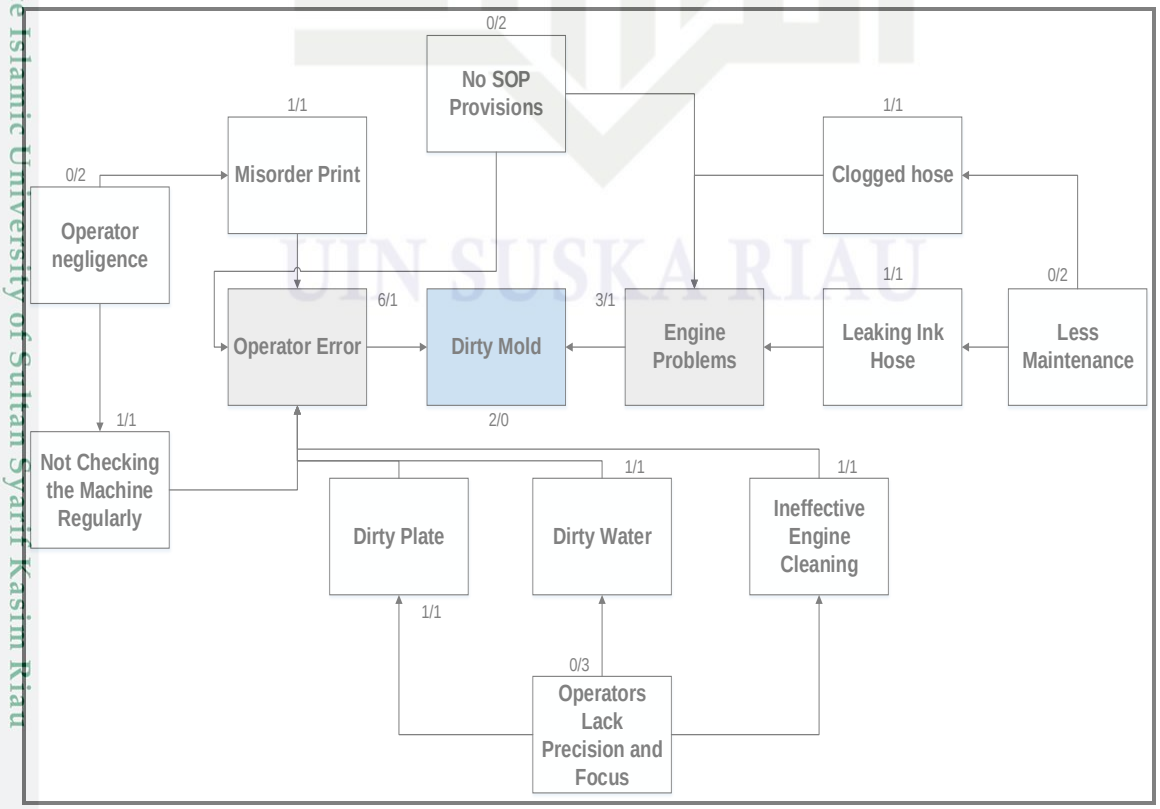


Figure 7. Interrelationship Diagram Dirty Mold Defects



Improve

Improve is used to provide suggestions for improvements to the factors causing problems that have been analyzed using Failure Mode and Effect Analysis (FMEA). Failure Mode and Effect Analysis (FMEA) is used to correct the causative factors of the problem by providing proposed improvements. The Failure Mode and Effect Analysis (FMEA) of unstable mold and dirty mold are as follows:

Table 10. Failure Mode and Effect Analysis (FMEA)

No	Types of defects	*Potential Failure Mode*	*Potential Causes of Failure*	*Potential Effects of Failure*	S	O	D	RPN	Recommended Action
1	Unstable Mold	No SOP provisions	The company does not make SOP	The operator is not working optimally	8	8	7	448	Making SOP provisions
		Slow print sensor	Less maintenance	Degraded engine performance	8	4	7	168	Perform regular machine maintenance
		Problem rollers	Less maintenance	Deterioration in print quality	8	7	7	392	Perform regular machine maintenance
		Forgot machine settings	Operator lack precision and focus	Print results are not up to standard	7	4	7	196	Supervise and brief before the production process
		Color setting difficulty	Less skilled operators	Print results do not match laser print	8	8	6	384	Provide operator training
2	Dirty Mold	Clogged hose	Problematic engine components	Print results are not clean	8	3	8	192	Perform regular maintenance
		Leaking ink hose	Problematic engine components	The printout has ink spots	8	4	8	256	Perform periodic maintenance and replace hoses
		Misorder Print	Operator negligence	The print results are not optimal and there is dirt	5	2	5	50	Provide operator training

Table 10. Failure Mode and Effect Analysis (FMEA) Continued

No	Types of defects	*Potential Failure Mode*	*Potential Causes of Failure*	*Potential Effects of Failure*	S	O	D	RPN	Recommended Action
2	Dirty Mold	Do not check the machine regularly	Operator negligence	Decreased performance and accumulation of dirt on the engine	7	8	7	392	Check the machine periodically before starting the production process
		Dirty Plate	Lack of material quality control	There are stains and spots on the print	8	3	6	144	Conduct quality control on materials periodically before the production process
		Dirty Water	Lack of material quality control	Ink contamination and stained prints and spots	7	3	6	126	Conduct quality control on materials periodically before the production process
		Ineffective engine cleaning	Operators lack accuracy and lack of SOP provisions	The accumulation of dirt on the machine	8	7	7	336	Provide operator training on machine cleaning

Control

Control is the last stage carried out to improve quality control in Six Sigma using the Poka Yoke method and making SOP as follows:

1. Poka Yoke

Poka Yoke is used to prevent failures stemming from human error in the work process. In the process of food packaging production there are still several errors that need to be given the following solutions:

1.1 Solutions that can be done in the production room

a. Clean and tidy up the production room before and after the production process
b. Providing posters is mandatory to maintain the cleanliness of production rooms and machines

Figure 8. Poster Must Maintain Cleanliness

c. Providing posters must use Personal Protective Equipment (PPE)

Figure 9. Poster Must Use PPE

d. Providing posters must follow Standard Operating Procedures (SOP)

Figure 10. Poster Must Follow SOP

1.2 Solutions that can be done on production machines
a. Perform regular maintenance
b. Replacing damaged and old components
c. Checking and cleaning the machine before and after the production process

1.3 Solutions that can be done on working method
a. Create Standard Operating Procedures (SOP)
b. Provide operators with specialized training on production processes

2. Creation of Standard Operating Procedures (SOP)

Making Standard Operating Procedures is important in a company to maintain product quality and consistency. Standard Operating Procedures contain structured work steps that are used as guidelines in running the production process consistently. The standard operating procedures are as follows:

Table 11. Standard Operating Procedures (SOP)

Kemasan Berkah Andalas	**CV. PERCETAKAN BERKAH ANDALAS** Jl. Garuda RT.01 RW.04 Dusun IV Kasang Kulim, Kubang Jaya, Siak Hulu, Kampar, Riau.	
Standard Operating Procedures	Number	:
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	Page	: 01

1. Purpose
To ensure the production process runs in a structured and consistent manner

2. Scope
Standard Operating Procedures covering the production process of food packaging

3. Definition
Food packaging: products used to protect food
Design: The process of creating a graphic design that is ready to be printed according to the brief
Printing: The process of transferring designs to food packaging materials
Laminating: The process of coating food packaging with a protective layer of plastic
Pond: The process of making patterns on food packaging according to design
Gluing: The process of forming food packaging
Packing: The process of packaging food packaging with plastic to safely reach consumers

Created By	Checked By	Approved By
Production Coordinator	QC Coordinator	Head of Production

Table 11. Standard Operating Procedures (SOP) Continued

Kemasan Berkah Andalas	**CV. PERCETAKAN BERKAH ANDALAS** Jl. Garuda RT.01 RW.04 Dusun IV Kasang Kulim, Kubang Jaya, Siak Hulu, Kampar, Riau.	
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4. Responsibility

Operator : Carry out and monitor the production process
Quality Control: Ensuring product quality in accordance with established standards
Production Coordinator: Oversees the entire production process and ensures SOP are followed correctly

5. Procedure

The procedure to be carried out is as follows:

5.1 Security and Safety

1. Use of PPE: Ensure all operators wear designated Personal Protective Equipment (PPE)
2. Security Training: Conduct regular training on safety procedures for all operators

5.2 Design Process

1. Acceptance of Design Briefs: Receive and Clarify briefs from consumers
2. Design Concept Development: Do research, ideation, sketching then do internal discussion and feedback
3. Digital Design Creation: Create digital designs using design software and templates and grids for accuracy
4. Design Revision and Development: Presenting the design to consumers and making revisions based on consumer feedback
5. Design Approval: Finalize design and documentation of consumer approval
6. File Storage : Stores the final design file in an archive

5.3 Preparation

1. Material Preparation: Make sure all ingredients are ready and in accordance with the specified specifications
2. Machine Preparation: Check the condition of the machine to make sure all components are functioning properly and in a clean state. Calibrate if needed

Created By	Checked By	Approved By
Production Coordinator	QC Coordinator	Head of Production

Table 11. Standard Operating Procedures (SOP) Continued

Kemasan Berkah Andalas	**CV. PERCETAKAN BERKAH ANDALAS** Jl. Garuda RT.01 RW.04 Dusun IV Kasang Kulim, Kubang Jaya, Siak Hulu, Kampar, Riau.	
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5.3.1 Print Process

1. Design Settings: Design input to be printed into the printing machine system
2. Parameter Settings: Set machine parameters (pressure, temperature, speed) according to the type of material and design used
3. Color Settings: Set the printing machine to the CYMK base color, make sure each color unit is filled with the appropriate ink and use preset or pre-set color profiles for color consistency
4. Place the printing material in the right position on the machine
5. Start the press and run production
6. Monitor print quality regularly
7. Make adjustments if there are quality deviations
8. Evaluate the final result and record any adjustments that have been made
9. Document the color settings used for reference on subsequent print jobs

5.3.2 Coating Process

The coating process is the process of adding a special layer to the surface of the product in the following ways:

A. Laminating Process

1. Parameter Settings: Set machine parameters (temperature, pressure) according to material thickness and laminating film
2. Place the printing material in the right position on the machine
3. Start the machine and run production
4. Make sure the production process runs smoothly without being folded, squeezed or stuck
5. Monitor laminating quality regularly
6. Make adjustments if there are deviations
7. Evaluate the final result and record any adjustments that have been made

B. UV Spot Process

1. Set the UV spot machine according to the specifications of the printing material and UV varnish
2. Make sure the UV plate is properly attached to the machine
3. Place the printing material in the right position on the machine

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Production Coordinator	QC Coordinator	Head of Production

Table 11. Standard Operating Procedures (SOP) Continued

Kemasan Berkah Andalas	**CV. PERCETAKAN BERKAH ANDALAS** Jl. Garuda RT.01 RW.04 Dusun IV Kasang Kulim, Kubang Jaya, Siak Hulu, Kampar, Riau.	
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4. Start the machine and run production
5. Use a UV dryer to dry UV varnish quickly and efficiently
6. Monitor spot UV quality regularly
7. Make adjustments if there are deviations
8. Allow the product to dry completely before further handling
9. Evaluate the final result and record any adjustments that have been made

5.3.3 Process Pond

1. Make sure the cutting knife matches the desired design
2. Check the sharpness of the knife and make sure there is no damage
3. Parameter settings: set machine parameters (pressure, speed) according to the type of material and production needs
4. Place the printing material in the right position under the cutting knife
5. Make sure the printing material is flat and not shifted
6. Monitor the quality of the pond periodically
7. Make adjustments if there are irregularities
8. Clean the remnants of material from the machine and work area
9. Store the cutting knife properly and correctly for subsequent use
10. Evaluate the final result and record any adjustments that have been made

5.3.4 Glue Process

1. Fill the machine with glue according to the instructions or user manual
2. Make sure the glue is filled sufficiently and there are no leaks
3. Parameter Settings: Set machine parameters (temperature, pressure, speed) according to glue specifications, materials and production needs
4. Place the printing material in the right position on the machine
5. Start the machine and run production
6. Supervise the glue application process to ensure precise and consistent results
7. Monitor the quality of glue application results periodically
8. Make adjustments if There are deviations

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Production Coordinator	QC Coordinator	Head of Production

Table 11. Standard Operating Procedures (SOP) Continued

Kemasan Berkah Andalas	**CV. PERCETAKAN BERKAH ANDALAS** Jl. Garuda RT.01 RW.04 Dusun IV Kasang Kulim, Kubang Jaya, Siak Hulu, Kampar, Riau.	
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9. Carry out the product assembly process according to the design after the glue is applied
10. Make sure all parts of the product are installed properly and firmly
11. Clean the remnants of glue from the machine and work area
12. Perform a final quality check of the installed product with glue
13. Store the finished product in a clean and neat place for packing
14. Label the product with appropriate information (owner, design, quantity, date of production)
15. Evaluate the final result and record any adjustments that have been made

5.4 *Quality Control*

1. Visual Inspection : Check each batch of product to ensure there are no visual defects
2. Functional Testing :Test the durability and durability of food packaging to ensure compliance with established standards
3. Documentation :Record inspection and test results in daily quality control reports

5.5 Settlement

1. Machine Cleaning: After production is complete, do machine cleaning to maintain machine cleanliness and production quality
2. Production Area Cleaning: After machine cleaning is complete, clean the production area for operator comfort and safety
3. Product Storage: Store finished products in a safe place and according to established storage standards

5.6 *Packing*

1. Make sure all products have passed the quality inspection process and are ready for packing
2. Make sure the quantity and product specifications are in accordance with consumer orders
3. Prepare protective materials to protect products during shipping

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Table 11. Standard Operating Procedures (SOP) Continued

Kemasan Berkah Andalas	**CV. PERCETAKAN BERKAH ANDALAS** Jl. Garuda RT.01 RW.04 Dusun IV Kasang Kulim, Kubang Jaya, Siak Hulu, Kampar, Riau.	
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4. Wrap each product with plastic protective material to prevent damage during shipping
5. Make sure all products are well protected
6. Put a shipping label on the packaging box with clear and complete information
7. Include the required shipping documents inside or outside the box according to the company's shipping procedures
8. Store products that have been packed regularly and are easy to access in a clean and safe temporary storage area
9. Do a final inspection to make sure the product is packed properly and the shipping label is installed correctly
10. Make sure there is no damaged or open packing before shipping
11. Record all products that have been packed, including quantity, specifications and shipping details in the diary
12. Document any problems or breakdowns that occur during the process Packing

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DISCUSSION

Define

Project charter are used to facilitate researchers in identifying and formulating problems faced by the company, along with the risks arising from these problems. In addition, the purpose of the project charter is that research on the problems faced and to be researched becomes more structured, so that the research process can be carried out more focused.

Pareto charts are used to find out the types of defects that will be a top priority for improving product quality. The types of defects that are prioritized are unstable molds and dirty molds because two types of defects out of six types of defects account for as much as 66% of the total types of defects. Therefore, the efforts made have obtained significant results.

Based on the results of the pareto diagram, it is determined that unstable mold and dirty mold are the top priorities for the type of defect to be corrected. Therefore, the critical to

quality setting for unstable prints is that there are no shifted, striped colors / writings and prints according to demand. As for dirty prints, there are no ink spots on the print. By setting critical to quality, the quality of the product that must be met must be in accordance with the specifications that have been set.

Measure

Based on the calculation of DPMO value and sigma level on unstable mold and dirty mold, it can be seen that the average value of sigma level obtained for unstable mold is 4.6 and gross mold is 4.8. Therefore, the sigma level can be said to be at the sigma level of 4 because it produces a significant defective product that requires repair. This sigma 4 level still needs to be improved to reach sigma 6 which is the highest standard in process quality, very low defect rate and very high reliability.

On the unstable mold P-chart, it can be seen that there is one data that is right at the upper control limit (UCL) which is in January and eleven data is within the control limit, which is in February-December with the upper control limit (UCL) which is 0.00169 and the lower control limit (LCL) which is 0.00138. Therefore, the production process is still within the established control limits.

On the dirty mold P-chart, it can be seen that there is one data that is right at the lower control limit (LCL) which is in January and eleven data is within the control limit, namely in February-December with the upper control limit (UCL) which is 0.00106 and the lower control limit (LCL) which is 0.00083. Therefore, the production process is still within the established control limits.

Analyze

In the fishbone diagram of unstable mold, it can be seen that there are three factors that cause unstable molds, including humans, machines and methods. The human factor has several causes including operator errors caused by forgetting machine settings due to the operator not being careful and focused, difficulty setting colors due to unskilled operators. The method factor is caused by the absence of SOP provisions. And the Machine factor is caused by slow print sensors and roller problems due to lack of maintenance.

In the fishbone diagram of dirty mold, it can be seen that there are three factors that cause unstable mold including humans, machines and methods. The human factor has several causes including operator errors caused by ineffective engine cleaning, dirty water and dirty plates due to the operator not being careful and focused, incorrect print order and not checking the machine regularly due to operator negligence. The method factor is caused by the absence of SOP provisions. And the engine factor is caused by clogged hoses and leaking ink hoses due to problematic machine components.

In unstable mold it can be seen that operator errors are caused by difficulty finding colors due to unskilled operators causing unstable prints, and so on how to see the relationship between the elements so on. In the interrelationship diagram of unstable prints, it can be stated that the basic cause of unstable prints is that there is no SOP provision and lack of maintenance because it does not have an entry arrow and has two exit arrows. The main cause of unstable prints is a problematic machine because it has four entry and one exit arrows.

In dirty mold, it can be seen that operator errors are caused by not checking the machine periodically due to operator negligence which causes dirty molds, and so for how to see the relationship between the next elements. In the interrelationship diagram of dirty mold, it can be stated that the basic cause of dirty mold is that the operator is less precise and

focused because it does not have an entry arrow and has three exit arrows. The main cause of dirty prints is operator error because it has six entry and one exit arrows.

Improve

Based on the results of the predetermined value of each factor causing defective products, it can be seen that there is no SOP provision has the highest RPN value with a value of 448 which means that no SOP provision is a factor causing priority failure that needs to be immediately corrected by making Standard Operating Procedures (SOP). While the second highest RPN value is not checking the engine periodically with a value of 392, then an improvement proposal is given by checking the engine periodically before starting the production process for 30 minutes. The third highest RPN value is a problem roller with a value of 392, so a proposal for improvement is given by carrying out periodic engine maintenance every 1 month. No periodic machine check is placed in the second order because it has a higher occurrence value than problem rollers.

Control

Poka Yoke is used to prevent errors before they occur and reduce failures in production. The solutions provided to overcome errors that occur include cleaning and tidying up the production room before and after carrying out the production process because the production room that is not clean and tidy can cause operator discomfort so that the operator does not focus. Providing posters must maintain the cleanliness of production rooms and machines so that operators always pay attention to the cleanliness of production rooms and machines before and after the production process. Providing posters is mandatory to use Personal Protective Equipment (PPE) to avoid work accidents during the production process. Providing posters must follow Standard Operating Procedures (SOP) so that operators work according to structured steps so as to maintain product quality and consistency. Perform maintenance periodically 1 time a month so that machines and equipment work optimally. Replacing damaged and old machine components to maintain smooth operations and production efficiency. Checking and cleaning the machine before and after the production process aims to maintain machine performance, efficiency, and safety. Create Standard Operating Procedures (SOP) so that operators have a reference in carrying out the food packaging production process. Provide special training on the production process to operators aimed at increasing the insight and skills of operators in the production process.

Standard Operating Procedures (SOP) are made with the aim that operators can make SOP as a reference in carrying out the production process, because SOP have structured production process steps in order to maintain product quality and consistency.

CONCLUSION

The types of defects that have the most impact in the food packaging production process are unstable mold and dirty mold because these 2 types of defects account for as much as 66% of the total types of defects.

The average value of sigma level on unstable mold and dirty mold is 4.6 and dirty mold is 4.8. Therefore, the sigma level can be said to be at the sigma level of 4 because it produces a significant defective product that requires repair.

The main factor causing product defects is that there are no SOP provisions, the second is not checking the machine regularly and the last is roller problems. This factor is obtained from the results of the highest RPN value.

The proposal for quality control of food packaging to reduce product defects is to apply the Poka Yoke method by providing solutions such as cleaning and tidying up the production room before and after the production process, providing posters that must maintain the cleanliness of production rooms and machines, providing posters that must use PPE, providing posters that must follow SOP, carrying out periodic maintenance, replacing damaged and old machine components, check and clean machines before and after the production process, make SOP and provide special training on the production process to operators.

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International Journal of Engineering Business and International Management
(IJEBIM)

Subject: **Letter of Acceptance**
ID 770: **Quality Control Using Six Sigma Method To Minimize Product Defects in CV. Percetakan Berkah Andalas**

Lindri Rahayu Agesti, Nazaruddin, Muhammad Nur, Fitriani Surayya Lubis, Suherman
Universitas Islam Negeri Sultan Syarif Kasim

Dear Authors:

On behalf of Editors, we are delighted to inform you that your article has been accepted, to be publishing through the periodical International Journal of Engineering Business and International Management (IJEBIM) Volume 10 Number 1.

Thank you for submitted and registration.

Editors

Abdu Muthalib, Ph.D