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Joker Connecticut Cigar Product Quality Control Analysis Using Six Sigma Method with Dmaic Stages

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A B S T R A C T

In Jember Regency, CV Dwipa Nusantara Tobacco is a tobacco industry that makes cigars. The company is experiencing problems with the Joker Connecticut cigar product, with defect rates ranging from 7% to 30% of total production. These defects cause the product to be reprocessed or disposed of so that it cannot be sold to consumers. The six-sigma approach was used to conduct this study. The DMAIC (Define, Measure, Analyze, Improve, and Control) stages included the implementation of kaizen during the improvement phase. Three Critical to Quality (CTQ) categories were the focus of the study: hard cigars, wrapper breakage, and body faults. The average industry standard in Indonesia is met by the research's DPMO (Defect Per Million Opportunities) score of 43.922 with a sigma level of 3.2. Redesigning the layout and adjusting the storage process's temperature, educating staff to improve their skills, and putting continuous quality control into place are some suggestions for improvements.

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INTRODUCTION

As an agricultural nation, Indonesia has excellent tobacco products that contribute significantly to state revenue through excise taxes. With excise payments of Rp 104.56 trillion out of the Rp 164.87 trillion national total, East Java is a significant tobacco-producing province that employs over 80,000 people across 425 processing industries. The tobacco processing business accounts for 8.3% of East Java's GDP, despite the tobacco agricultural sector contributing only 0.4%.

With an output of 27,251 tons in 2022, Jember Regency is the biggest producer of tobacco in East Java and has enormous potential for high-quality tobacco processing enterprises. One of four national-scale cigar firms in Jember, CV Dwipa Nusantara Tobacco was founded in 2019 and employs 24 people to produce 550–680 long filler cigars and 135-250 short filler cigars daily.

The Joker Connecticut cigar product has a failure rate of 7–30% of total manufacturing, which is the primary issue. Cracked wrappers, non-round shapes, and harsh cigars from an excessively dense filler arrangement are examples of faults. Systematic quality control is necessary in this situation to preserve both customer happiness and product competitiveness. In order to address the issue of high defect rates, a thorough examination of production stability, quality level (sigma level), and cigar defect-causing elements is required.

LITERATURE REVIEW

Quality Control

Montgomery, D.C. (1995), as cited in Irwan & Haryono (2015), defines quality control as a set of managerial and technical tasks that contribute to assessing the quality of a product, standardizing it in line with relevant provisions and specifications, and adjusting it in the event that there are discrepancies or non-compliance with standards.

Six Sigma

According to Gaspersz (2002), six sigma is a comprehensive and flexible approach that seeks to attain, sustain, and maximize economic success. In order to create more ideal solutions, the Six Sigma methodology leverages real data and focuses on client satisfaction.

Six Sigma Stages

The five short steps of DMAIC (Define, Measure, Analyze, Improve, and Control) are necessary for the use of the six-sigma process. The DMAIC steps are a methodical methodology intended to detect quality issues, assess process performance, examine the underlying causes of flaws, apply enhancements, and regulate procedures to sustain attained outcomes.

Connecticut Tobacco

Because of Indonesia's climate and soil types, Connecticut tobacco grown there can have unique specs and flavor qualities. It also has a brighter color than original Indonesian cigar tobacco (Wardhono et al., 2019).

METHODOLOGY

In order to lower the quantity of product flaws and enhance the performance of Joker Connecticut cigars at CV Dwipa Nusantara Tobacco, this study uses the Six Sigma methodology through the DMAIC (Define, Measure, Analyze, Improve, Control) phases. DPO (Defect Per Opportunity), DPMO (Defect Per Million Opportunity), Sigma Level, and kaizen improvement suggestions are calculated as part of the analysis.

Data on Joker Connecticut cigar goods is gathered by direct observation and interviews using a quantitative descriptive methodology and survey approaches (Sugiyono, 2019). The findings of the study will assess how well the product quality complies with corporate requirements and offer suggestions for enhancements to deal with non-conformity problems.

The Joker Connecticut cigar manufacturing results that have aged for around six months and will go through quality control in 2024 make up the study's population. The sampling method employs simple random sampling with a total sample size; the likelihood of a generalization mistake decreases as the sample size gets closer to the population (Sugiyono, 2019).

The analytical techniques used in this research are the DMAIC stages:

1. Define is the first stage in the Six Sigma methodology, which uses CTQ diagrams to identify quality attributes that are significant to consumers and identify issues that need to be improved in business processes.
2. Measures the process using three tools: sigma values as quality benchmarks with a target of 3.4 failures per one million opportunities toward Zero Defect; DPMO calculation for process capability evaluation; and p control charts for process stability analysis.
3. By dissecting cause-and-effect interactions of deviations categorized according to man, machine, environment, material, and technique aspects, the Analyze stage use Ishikawa diagrams to identify the underlying causes of issues (Syukron & Kholil, 2013).
4. The Improve stage involves using the 5W+1H method (What, Why, When, Who, Where, and How) in conjunction with the kaizen methodology to develop improvement recommendations and quality enhancement. The control stage makes sure that gains are maintained and closely watched to avoid process performance regressing

RESULTS AND DISCUSSION

Define

In Six Sigma, the Define stage is the initial step. The Critical to Quality (CTQ) tool is used at this step. Because it directly affects customer demands and satisfaction, Critical to Quality (CTQ) is a quality instrument that requires attention (Gaspersz, 2002).

Table 1. CTQ Characteristics of Joker Connecticut Cigars

CTQ Type	**Specification**	**Description**
Non-round shape	Have a precise/perfectly round body shape and head (upper part of the cigar).	Cigars with irregular shape or incorrect size are categorized as defective products and cannot be distributed, as CV Dwipa Nusantara Tobacco only sells quality products meeting company standards.
wrapper cracking	No outer part/dekblad section that is cracked or torn.	Cigars with torn or punctured outer wrapper (dekblad) are classified as defective products that cannot be distributed due to poor quality and aesthetic appearance not meeting company standards.
hardness	Cigar condition that is not too hard and does not exceed the weight tolerance limit of > 13 grams.	Cigars that are too hard due to excessive tobacco composition or poor draw are defective products that cannot be sold because of low burn rate and difficult inhalation.

Source: Processed Observation Data (2025)

Measure

The second DMAIC stage in the Six Sigma process is called the Measure Stage. In this phase, p-control charts are used to quantify process stability, while DPMO (Defect per Million Opportunity), sigma values, and process capability computations are used to assess process capability.

Process Stability Measurement

Using 23 observations with non-constant sample sizes, process stability measurement was carried out to ascertain the stability level of Joker Connecticut cigar manufacture at CV Dwipa Nusantara Tobacco. Because P-control charts work well with attribute data that has different sample sizes, they were used (Tannady, 2015). The following computations yield the values of Proportion, CL, UCL, and LCL.

1. Calculating non-Conformity Proportion

$$p = \frac{\text{Number of defective products}}{\text{Product quantity}}$$

Calculations are performed from the first to the last observation for each type of defect or attribute

2. Calculating *Central Line (CL)*

$$CL = \frac{\text{Total number of defective products}}{\text{Total production quantity}}$$

3. Calculating Upper Central Line (UCL)

$$\mathrm{UCL} = \mathrm{CL} + 3\left(\sqrt{\frac{\mathrm{CL}(1-\mathrm{CL})}{\mathrm{n}}}\right)$$

Calculations are performed from the first to the last observation for each type of defect or attribute

4. Calculating Lower Central Line (LCL)

$$\mathrm{LCL} = \mathrm{CL} - 3\left(\sqrt{\frac{\mathrm{CL}(1-\mathrm{CL})}{\mathrm{n}}}\right)$$

Calculations are performed from the first to the last observation for each type of defect or attribute

a. P-control chart for non-round shape attribute

Table 2. Calculation Data for p-Control Chart of Non-Round Shape Attribute

No.	**Units Inspected (pieces)**	**Number of defects**	**Proporsi**	***UCL***	***CL***	***LCL***
1	306	2	0,007	0,040	0,017	0,000
2	510	3	0,006	0,035	0,017	0,000
3	918	0	0,000	0,030	0,017	0,004
4	663	3	0,005	0,033	0,017	0,002
5	816	0	0,000	0,031	0,017	0,004
6	357	16	0,045	0,038	0,017	0,000
7	765	8	0,010	0,032	0,017	0,003
8	816	22	0,027	0,031	0,017	0,004
9	765	12	0,016	0,032	0,017	0,003
10	918	9	0,010	0,030	0,017	0,004
11	357	3	0,008	0,038	0,017	0,000
12	357	3	0,008	0,038	0,017	0,000
13	408	6	0,015	0,037	0,017	0,000
14	357	10	0,028	0,038	0,017	0,000
15	510	8	0,016	0,035	0,017	0,000
16	357	18	0,050	0,038	0,017	0,000
17	570	5	0,009	0,034	0,017	0,001
18	408	5	0,012	0,037	0,017	0,000
19	510	19	0,037	0,035	0,017	0,000
20	714	17	0,024	0,032	0,017	0,003
21	750	10	0,013	0,032	0,017	0,003
22	612	20	0,033	0,033	0,017	0,002
23	408	30	0,074	0,037	0,017	0,000
∑	13152	229				

Source: Processed Observation Data (2025)

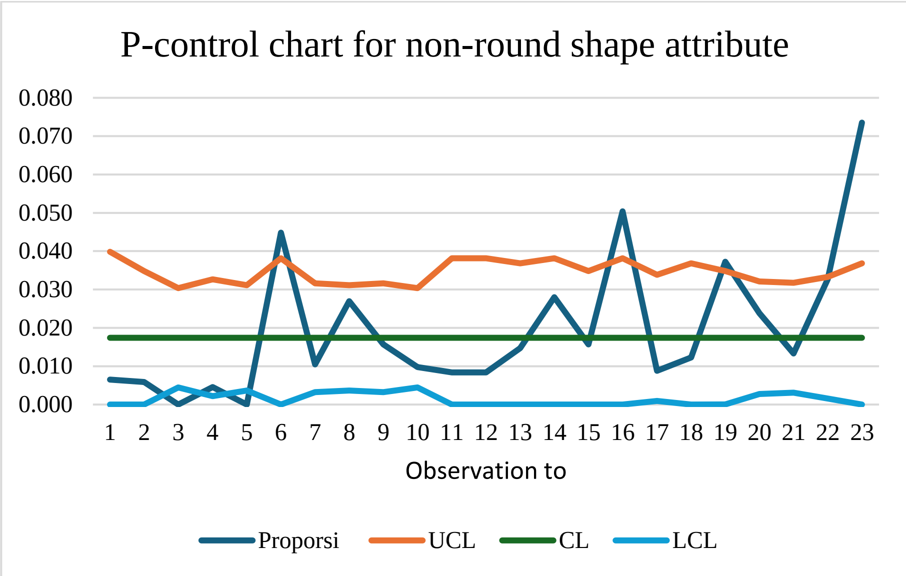

Figure 1. P-Control Chart of Non-Round Shape Attribute
Source: Processed Observation Data (2025)

From 13,152 units inspected, 229 defects were identified. The analysis revealed 5 observation points (3rd, 5th, 6th, 16th, 19th, and 23rd) exceeded control limits, indicating process instability with CL=0.017.

b. P-control chart for wrapper crack attribute

Table 3. Calculation Data for p-Control Chart of Wrapper Cracking Attribute

No.	**Units Inspected (pieces)**	**Number of defects**	**Proporsi**	***UCL***	***CL***	***LCL***
1	306	32	0,105	0,126	0,080	0,033
2	510	58	0,114	0,116	0,080	0,044
3	918	88	0,096	0,107	0,080	0,053
4	663	78	0,118	0,111	0,080	0,048
5	816	74	0,091	0,108	0,080	0,051
6	357	32	0,090	0,123	0,080	0,037
7	765	81	0,106	0,109	0,080	0,050
8	816	56	0,069	0,108	0,080	0,051
9	765	38	0,050	0,109	0,080	0,050
10	918	53	0,058	0,107	0,080	0,053
11	357	22	0,062	0,123	0,080	0,037
12	357	26	0,073	0,123	0,080	0,037
13	408	47	0,115	0,120	0,080	0,040
14	357	23	0,064	0,123	0,080	0,037
15	510	31	0,061	0,116	0,080	0,044
16	357	25	0,070	0,123	0,080	0,037
17	570	57	0,100	0,114	0,080	0,046
18	408	24	0,059	0,120	0,080	0,040
19	510	32	0,063	0,116	0,080	0,044
20	714	51	0,071	0,110	0,080	0,049
21	750	40	0,053	0,109	0,080	0,050

22	612	45	0,074	0,113	0,080	0,047
23	408	36	0,088	0,120	0,080	0,040
∑	13152	1049				

Source: Processed Observation Data (2025)

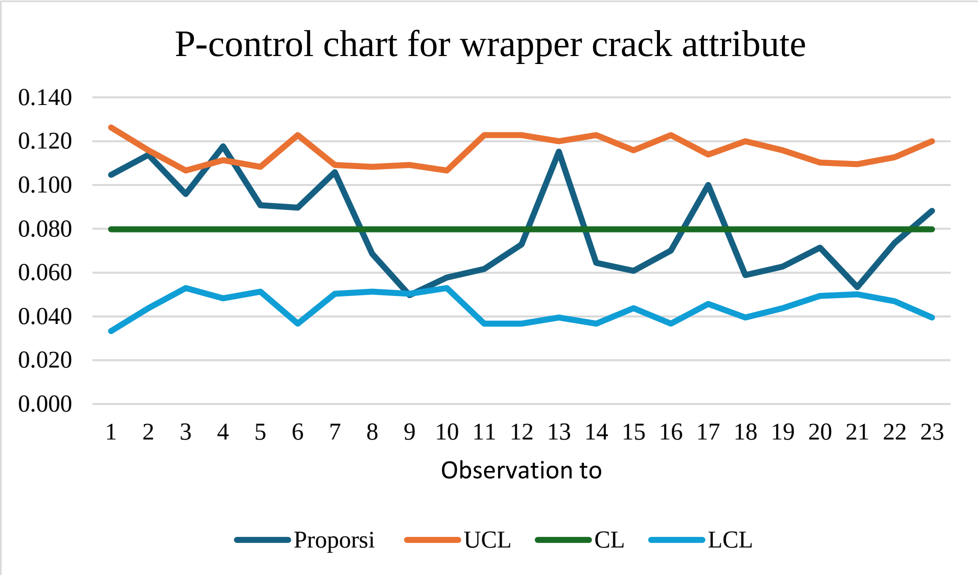

Figure 2. P-Control Chart of Wrapper Cracking Attribute
Source: Processed Observation Data (2025)

From 13,152 units inspected, 1,049 defects were found. Two observation points (4th and 9th) exceeded control limits, showing process instability with CL=0.080.

c. P-Control Chart for Hard Attribute

Table 4. Calculation Data for p-Control Chart of Hardness Attribute

No.	**Units Inspected (pieces)**	**Number of defects**	**Proporsi**	***UCL***	***CL***	***LCL***
1	306	58	0,190	0,066	0,035	0,003
2	510	92	0,180	0,059	0,035	0,010
3	918	51	0,056	0,053	0,035	0,017
4	663	32	0,048	0,056	0,035	0,013
5	816	52	0,064	0,054	0,035	0,015
6	357	0	0,000	0,064	0,035	0,006
7	765	3	0,004	0,054	0,035	0,015
8	816	10	0,012	0,054	0,035	0,015
9	765	10	0,013	0,054	0,035	0,015
10	918	14	0,015	0,053	0,035	0,017
11	357	0	0,000	0,064	0,035	0,006
12	357	3	0,008	0,064	0,035	0,006
13	408	18	0,044	0,062	0,035	0,007
14	357	2	0,006	0,064	0,035	0,006
15	510	0	0,000	0,059	0,035	0,010

16	357	0	0,000	0,064	0,035	0,006
17	570	17	0,030	0,058	0,035	0,012
18	408	6	0,015	0,062	0,035	0,007
19	510	11	0,022	0,059	0,035	0,010
20	714	29	0,041	0,055	0,035	0,014
21	750	14	0,019	0,055	0,035	0,015
22	612	29	0,047	0,057	0,035	0,012
23	408	4	0,010	0,062	0,035	0,007
∑	13152	455				

Source: Processed Observation Data (2025)

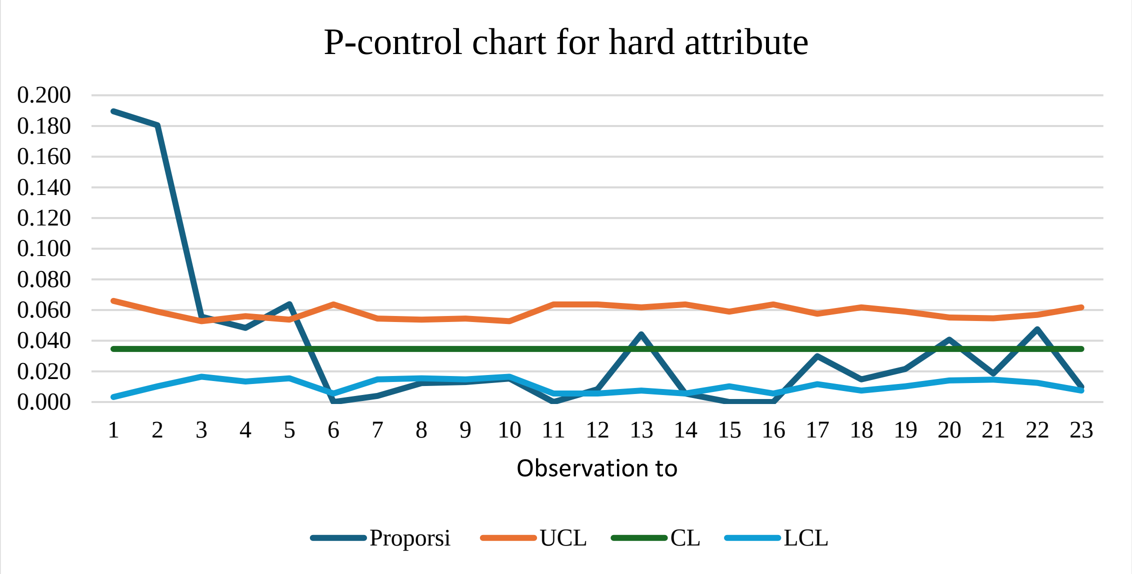

Figure 3. P-Control Chart of Hardness Attribute
Source: Processed Observation Data (2025)

From 13,152 units inspected, 455 defects were detected. Twelve observation points (1st, 2nd, 3rd, 5th, 6th, 7th, 8th, 10th, 11th, 15th, and 16th) exceeded control limits, indicating significant process instability with CL=0.035.

Measuring Process Capability

Process capability measurement is conducted to determine the level of CV Dwipa Nusantara Tobacco's ability in producing Joker Connecticut cigars, whether it can be considered appropriate or not. DPMO calculation and Sigma Value can be calculated using the following formulas:

1. Defect per Million Opportunity Calculation

$$\mathrm{DPMO} = \frac{\text{Total defective products}}{\text{Total production } \times \mathrm{CTQ}} \times 1000000$$

$$\mathrm{DPMO} = \frac{1733}{13152 \ \times 3} \times 1000000$$

$$\mathrm{DPMO} = \ 43.922$$

2. Sigma Value Calculation

Nilai Sigma (Excel) = NORMSINV (1-DPMO/1.0000) +SHIFT
= 3,21

The DPMO and sigma value calculations show that Joker Connecticut cigar production is at level 3.2 with an average DPMO of 43,922 per 1,000,000 production. According to Gaspersz (2002), achieving 2-3 sigma aligns with average Indonesian industry performance, but can still be improved

Analyze

The fishbone diagram, often known as the Ishikawa diagram, is used to determine the underlying causes of issues. Three forms of CTQ (Critical to Quality) were analyzed: hardness, wrapper cracking, and non-round shape.

a. Non-Round Shape

Figure 4. Ishikawa Diagram for Non-Round Shape
Source: Processed Observation Data (2025)

According to the Ishikawa diagram analysis, there are three primary causes that contribute to flaws in Joker Connecticut cigar goods. Employee skill gaps and inconsistent binding methods are the root causes of human factors (man). Non-standard binding and pressing techniques, as well as an untidy layout and a limited room capacity, are all causes of method factors. Wear on molding equipment results in products with inaccurate forms, which is a machine issue.

b. Wrapper Cracking

Figure 5. Ishikawa Diagram for Wrapper Cracking
Source: Processed Observation Data (2025)

Three primary variables contribute to wrapper cracking flaws in Joker Connecticut cigars, according to the Ishikawa diagram analysis. Employee skill gaps and inattention brought on by a hasty deadline are examples of human factors (man). Inadequate storage facilities, messy layouts, and incorrect storage practices (aging) are the causes of method factors. Because Connecticut tobacco leaves are thin and prone to tearing, material issues are the cause.

c. Hardness

Figure 6. Ishikawa Diagram for Hardness
Source: Processed Observation Data (2025)

Three primary elements are responsible for the hardness flaws in Joker Connecticut cigars, according to the Ishikawa diagram study. Employee inattention during weighing and binding and competence disparities are human factors (man). Uneven distribution of tobacco leaves, non-standard production processes, and imprecise raw material measurements are all examples of method factors. Scales' deteriorating performance leads to machine factors, which produce imprecise measurements.

Improve

The next stage is the improve phase where improvement recommendations will be implemented for frequently occurring defects that become priorities. This improvement stage employs 5W+1H analysis for improvement analysis and Pareto diagram tools to discover the highest flaws.

Table 5. Calculation Results of Pareto Diagram for Joker Connecticut Cigar Defects

No.	Defect Type	Frequency i	Cumulative Frequency	Total Percentage (%)	Cumulative Percentage (%)
1	Non-round shape	229	229	13%	13%
2	Wrapper cracking	1049	1278	61%	74%
3	Hardness	455	1733	26%	100%
∑		1733		100%	

Source: Processed Observation Data (2025)

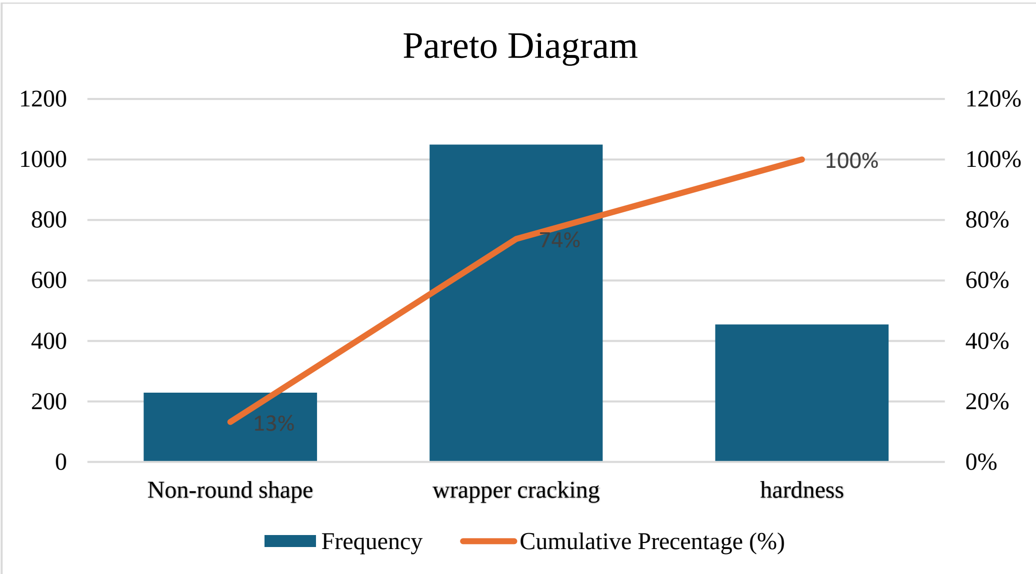

Figure 7. Pareto Diagram of Joker Connecticut Cigar Defects
Source: Processed Observation Data (2025)

From the Pareto diagram results, it can be concluded that wrapper cracking defects experience very high defect rates and become the priority for improvement using Kaizen 5W+1H methodology.

Table 6. Improvement 5W+1H for Wrapper Cracking Defects

No	5W+1H	Description
1	*What*	The outer leaf layer of cigars experiences cracking or tearing.

	(What is the problem)	
2	*Why* (Why does this problem need to be fixed?)	Cigars with cracked wrappers will cause cigars to not reach consumers, production costs increase due to raw material waste, and this will also affect productivity because re-wrapping is required.
3	*Where* (Where does improvement need to be done?)	Improvement needs to be done in the storage area, cigar wrapping section, and quality control section.
4	*When* (When does improvement need to be done?)	Improvement can begin immediately at the start of the next production cycle and be carried out continuously with weekly evaluations.
5	*Who* (Who is responsible?)	Production manager as the main person in charge, production supervisor and quality control.
6	*How* (How to fix it?)	1. Regulate the temperature and humidity of the storage room for Connecticut cigars below other cigars. Different leaf characteristics may also require different handling. 2. Conduct quality inspection and condition assessment of tobacco leaves before the wrapping process. 3. Connecticut tobacco has high elasticity, so it requires special techniques during the wrapping process. When wrapping cigars, employees must be careful not to pull the wrapper leaf too tightly. Excessive pulling can cause the leaf to stretch or expand, which can potentially damage the structure and quality of the cigar. 4. Storage layout redesign can be implemented through three key approaches: installing multi-level shelving systems with appropriate spacing between cigars to prevent contact damage, changing the storage technique from bundling to protective box systems to prevent excessive stacking that causes deformation of bottom cigars, and considering space expansion or additional storage room construction to accommodate proper storage capacity and reduce overcrowding issues

CONCLUSIONS AND RECOMMENDATIONS

1. According to the Defect per Million Opportunities (DPMO) estimate, there is a 43,922 chance that 43,922 defective items will occur for every million production units. The Joker Connecticut cigar production method satisfies the average industry requirements in Indonesia, according to the sigma level result of 3.2.
2. Improvement of wrapper cracking defects in Joker Connecticut cigars must be done thoroughly in storage areas, wrapping sections, and quality control, according to the Kaizen 5W+1H analysis. Production managers, production supervisors, and quality control teams will be given responsibility for this, and weekly evaluations will be conducted beginning with the start of the next production cycle. The four main components of the improvement strategy are: adjusting storage room temperature and humidity in accordance with Connecticut tobacco characteristics; inspecting tobacco leaves for quality before wrapping; using unique wrapping techniques that take into account Connecticut tobacco's high elasticity; and redesigning storage layout using multi-level shelving systems, switching from bundle to protective box systems, and increasing storage space to address overcrowding issues in order to significantly reduce defects and improve product quality, production efficiency, and customer satisfaction.

FURTHER STUDY

This study still has limitations so that further research is still needed on the topic "Joker Connecticut Cigar Product Quality Control Analysis Using Six Sigma Method with Dmaic Stages".

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