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PRODUCT QUALITY CONTROL USING SIX SIGMA (DMAIC) METHODS TO MINIMIZE WAST IN BIMA MANDIRI CIGARETTE COMPANY REMBANG, PASURUAN REGENCY

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ABSTRACT: Quality is a key to be able to compete in the industrial world [16. Quality control is needed to reduce the number of defective products produced by the company, thus reducing losses experienced by the company. The Bima Mandiri Rembang Pasuruan cigarette company is a company that produces cigarettes, one of which is INNO cigarettes. The number of defective products produced by the company so that the company must make an increase in quality by using a method to reduce the number of defects that occur. The number of defective products causes the company to suffer losses. For that, we need a method that can reduce cigarette defective products which in turn can improve the quality of the company's production. Six Sigma with the DMAIC stage (Define, Measure, Analyze, Improve, Control) is a method used in this research. Based on these steps, defects that often occur are less dense cigarettes as many as 289 sticks with a percentage of 25%, tearing on the cigarettes as many as 227 cigarettes with a percentage of 20% and peeling cigarettes as many as 208 sticks with a percentage of 18%. Factors that cause defects include humans, machines, methods and materials. After calculating using the Six Sigma method, before the improvement, the DPMO value is 113988.1 and the Sigma Level value is 2.722. After the improvements were made, the DPMO value decreased to 76488.1 and the Sigma Level was 2.94715. To achieve the six sigma target, the company is expected to be able to carry out improvements with a focus on the factors that cause product defects and always carry out regular control to reduce product defects. The corrective steps taken in the Bima Mandiri Rembang Pasuruan Regency cigarette company are human: regular training for machine operators and employees; methods: inspection of raw materials, blending machines and glue residue in the teat; engine: inspection of engine components; material: reprocessing less refined raw materials and using better quality glue.

Keywords: Quality control, Six Sigma, DMAIC

1. Introduction

The development of the cigarette industry from year to year is increasingly rapid, in line with advances in supporting technology for the increasingly modern cigarette industry[1]. The progress and development of the times is able to change the way consumers look at choosing a desired product[2]. Quality is very important in choosing a product in addition to the competitive price factor. To maintain their products from being competed by other industries, quality standards are needed[3]. Quality quality attracts consumer attention to buy a product. That way to attract consumers. these products must have quality standards in accordance with consumer desires[4]. To achieve a quality product, companies must always control and improve the quality of their products, so that you will get perfect results. For this reason, the company must always make a quality selection of the products produced by reducing the number of defective products[5]

The Bima Mandiri Rembang Pasuruan cigarette company is a company engaged in manufacturing. This company produces several types of cigarettes, one of which is INNO cigarettes. In its production, this company always produces defective products, Disability that occurs is more than one type of disability, including loose ends of cigarettes, length of cigarette not according to standard (cigarette not cut), Broken (loose filter), less dense, torn on cigarette, and peeling. In this case the company must carry out quality control so as to produce a really high quality product so that it is accepted by consumers[6].

This study aims to minimize wast at the Bima Mandiri Cigarette Company Rembang Pasuruan using the six sigmma method with the DMAIC stage[7]. So as to produce products with good quality and continue to increase.

2. Resarch Method

This research is a type of quantitative and observational research. Sampling using random techniques. The types of data used in this study are quantitative data, polymer data and secondary data. while for data collection techniques by means of interviews and observations. The instruments used were interviews and observation. Interviews were conducted with company owners and employees, this method is used to obtain primary data in the form of data on the number of products, the causes of product defects. The next instrument is observation, Observations made are direct observations of the object to be studied, namely in the form of inno cigarette production, as well as checking data and facts in the field, observations are also made on employees to find out firsthand about the employees' work abilities. The data analysis technique uses the six sigma method with DMAIC stages[8].

is not cut), Broken (loose filter), less dense, Tears on the cigarette, Peeling on the cigarette.

3. Results and Discussion

a. Define

The first stage in Six Sigma analysis is the define stage. In the define stage, identification will be carried out related to the problem of damage to Inno cigarette products. From the results of observations during sampling from the production results, the following product defects were found: Lumpy cigarettes, the length of the cigarette does not match the standard (the cigarette is not cut), Broken (loose filter), less dense, Tears on the cigarette, Peeling on the cigarette[9].

b. Measure

In this stage, measurements and calculations are made of the research data. At this stage, the calculation of the number of defective products, the DPMO value and the sigma level is carried out [10].

a. Data calculation of the number of defective products during sampling.

Table 1 The number of defective products according to the number of samples examined

Sample	Type of defect						amount
	A1	A2	A3	A4	A5	A6	
336	13	-	-	10	1	7	31
336	7	9	-	7	18	11	52
336	2	5	10	8	22	-	47
336	-	4	-	5	3	21	33
336	11	18	8	3	11	-	51
336		21	2	5	-	3	31
336	2	-	4	13	5	14	38
336	7	-	-	7	13	8	35
336	11	6	-	7	22		46
336	3	3	2	-	5	10	23
336	12	-	7	8	4	7	38
336	-	9	-	11	6	5	31
336	15	11		-	4		30
336	13	-	11	14	10	5	53
336	6	1	1	16	-	3	27
336	-	-	3	8	8	9	28
336	8	8	6	20	11	-	53
336	10	8	-	1	5	17	41
336	5	9		20	-	12	46
336	-	5	11	22	8	5	51
336		-	1	7	4	16	28
336	12	3	5	-	15	7	42
336	8	-	-	8	8	8	32
336		10	6	6	4	-	26
336	3	4	9	17	10	11	54
336		7	-	28	6	10	51
336	13	3	8	13	14	-	51
336		-		7	8	6	21
336	7	2	3	18	-	3	33
336	4	-	10	-	2	10	26
10.080	172	146	107	289	227	208	1.149

b. Calculation of DPMO value and sigma level

Table 2 DPMO values and Sigma levels of inno cigarettes

Observation to	Sample	number of defects	DPO	DPMO	LEVEL SIXMA
1	336	31	0,092262	92261,9	2,827
2	336	52	0,154762	154761,9	2,516
3	336	47	0,139881	139881	2,581
4	336	33	0,098214	98214,29	2,792
5	336	51	0,151786	151785,7	2,529
6	336	31	0,092262	92261,9	2,827
7	336	38	0,113095	113095,2	2,710
8	336	35	0,104167	104166,7	2,758
9	336	46	0,136905	136904,8	2,594
10	336	23	0,068452	68452,38	2,987
11	336	38	0,113095	113095,2	2,710
12	336	31	0,092262	92261,9	2,827
13	336	30	0,089286	89285,71	2,845
14	336	53	0,157738	157738,1	2,504
15	336	27	0,080357	80357,14	2,903
16	336	28	0,083333	83333,33	2,883
17	336	53	0,157738	157738,1	2,504
18	336	41	0,122024	122023,8	2,665
19	336	46	0,136905	136904,8	2,594
20	336	51	0,151786	151785,7	2,529
21	336	28	0,083333	83333,33	2,883
22	336	42	0,125	125000	2,650
23	336	32	0,095238	95238,1	2,809
24	336	26	0,077381	77380,95	2,923
25	336	54	0,160714	160714,3	2,492
26	336	51	0,151786	151785,7	2,529
27	336	51	0,151786	151785,7	2,529
28	336	21	0,0625	62500	3,034
29	336	33	0,098214	98214,29	2,792
30	336	26	0,077381	77380,95	2,923
average	336	38,3	0,11399	113988	2,722

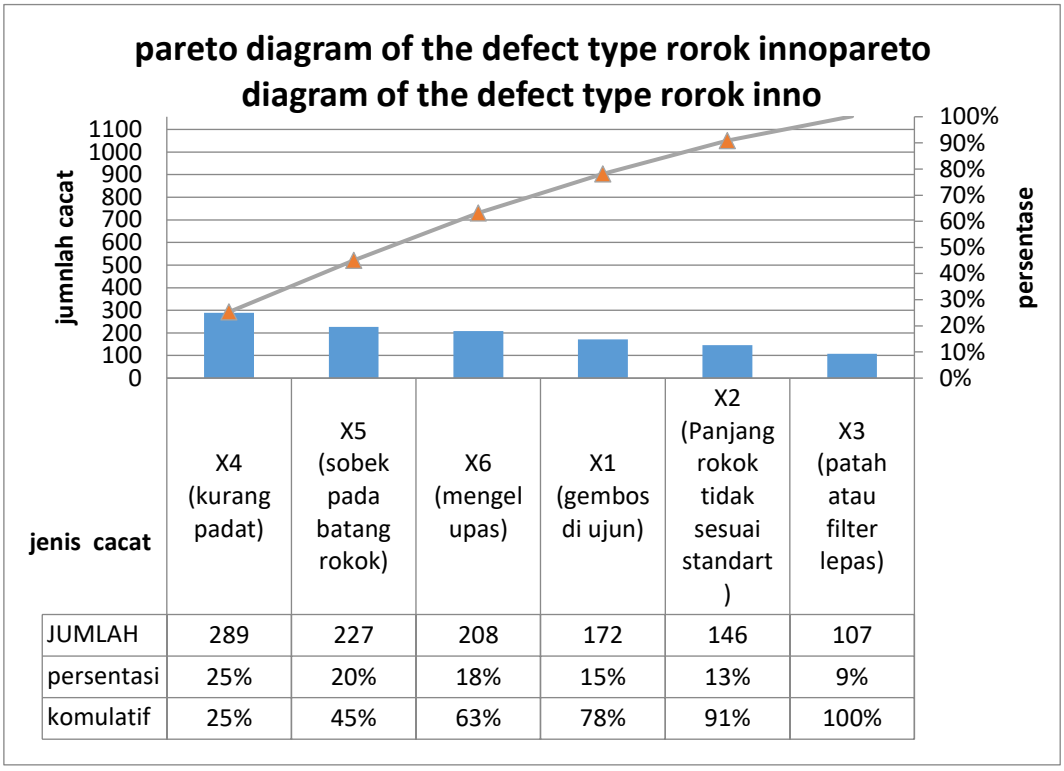
From the results of calculations that have been carried out as in the table above, it is found that the average value of DPMO (Defect Per Million Oppurtunies) is 113,988 and has an average sigma value of 2,722 sigma. 3 sigma,

3.3 Analyze

At this stage 2 analysis tools are used, namely the Pareto diagram and the causal diagram. Analyze Pareto diagram is used to find out the most dominant type of damage and must be treated first. After knowing the most dominant defect, Analyze using the cause and effect diagram, this diagram is used to determine the causal factors for product defects during the production of INNO cigarettes[11].

a. Pareto diagram analysis

After calculating the number of defects, analysis is carried out using the Pareto diagram. The following is a pareto diagram of the number of defects to determine the most dominant defect.



jenis cacat	X4 (kurang padat)	X5 (sobek pada batang rokok)	X6 (mengel upas)	X1 (gembos di ujun)	X2 (Panjang rokok tidak sesuai standart)	X3 (patah atau filter lepas)
JUMLAH	289	227	208	172	146	107
persentasi	25%	20%	18%	15%	13%	9%
komulatif	25%	45%	63%	78%	91%	100%

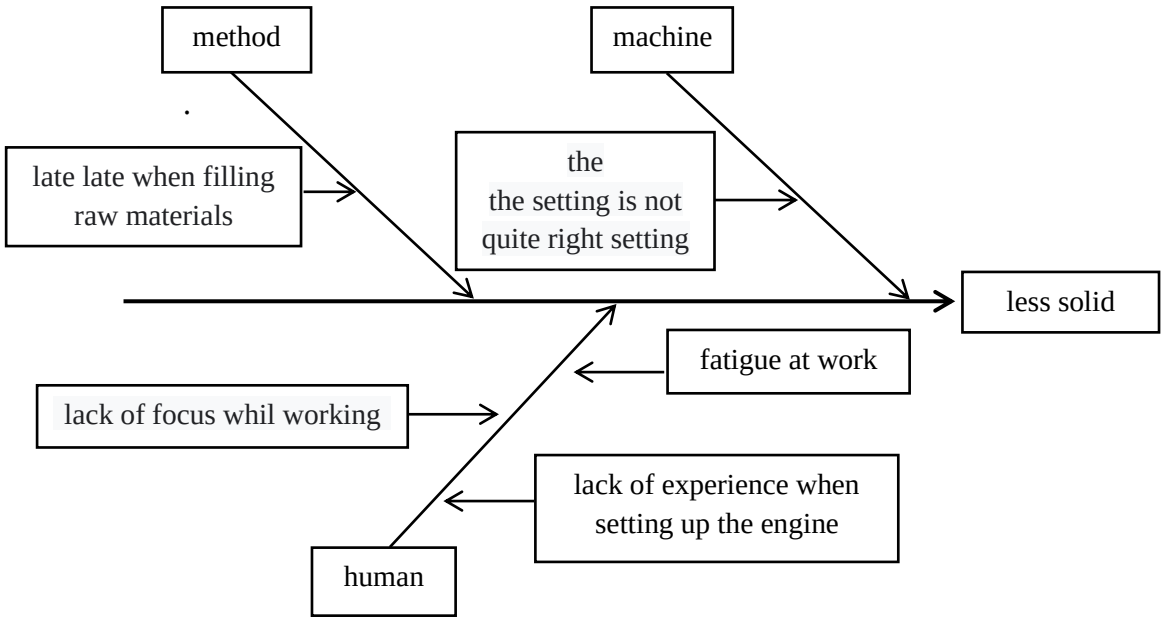
Figure 1 The Pareto diagram

Based on the results of the analysis using the Pareto diagram as shown above, it shows that the defects that are most dominant or that often occur and must be handled first are 289 less dense cigarettes with a percentage of 25%, 227 pieces of torn cigarettes with a percentage of 20% 208 cigarettes peeled off with a percentage of 18%

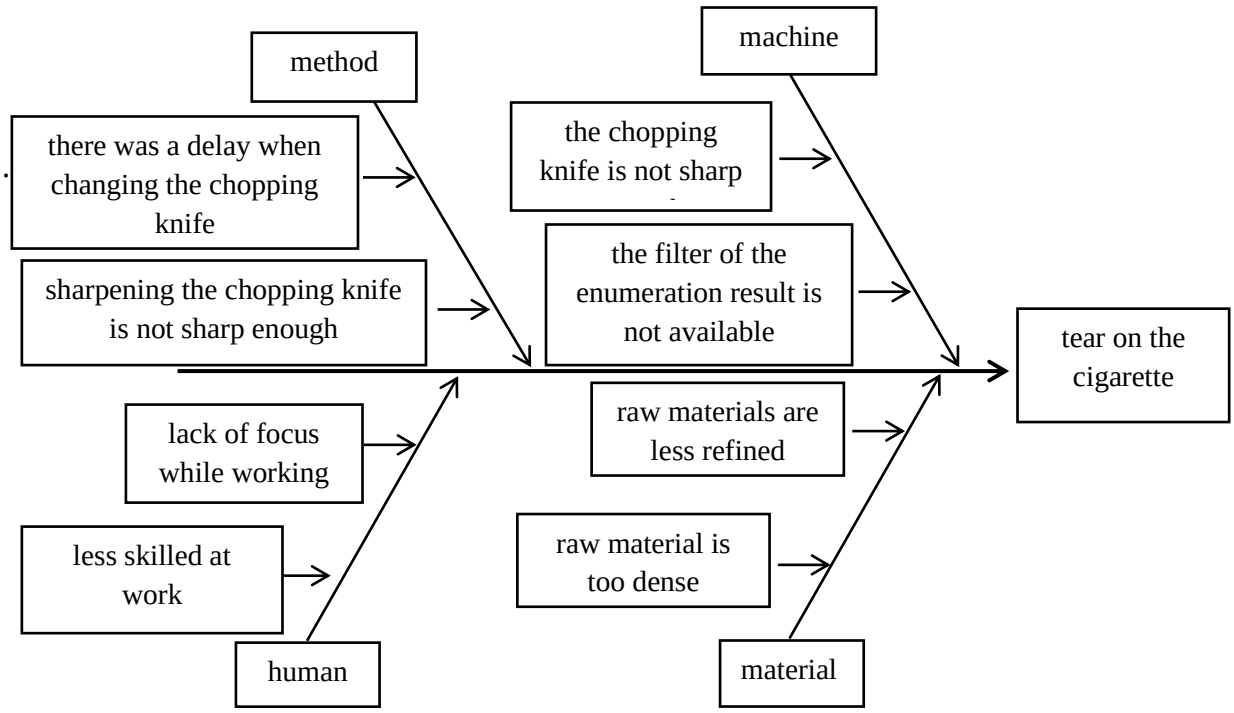
b. Cause and effect diagram analysis

Causal diagrams are made based on observations in the field, interviews with workers and company owners. The following is the presentation of the cause and effect diagram of the most dominant inno cigarette product defects

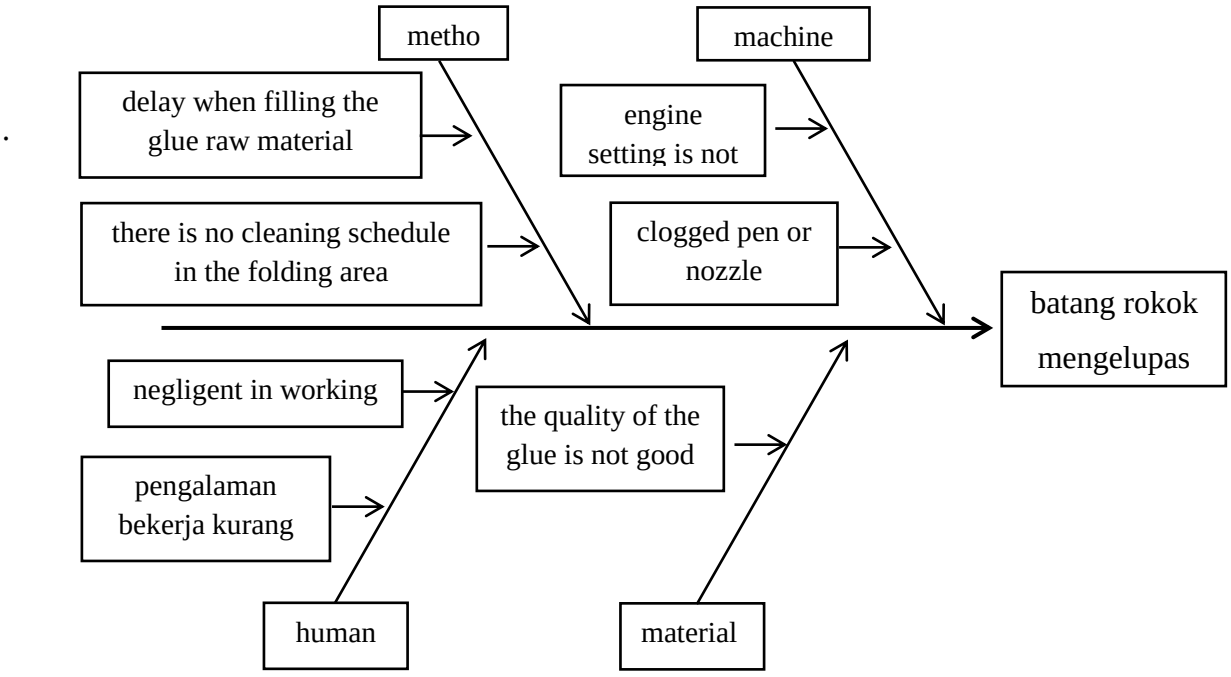
- Cigarettes are less dense



- Tears on the cigarette



- The cigarette is peeling off



3.4 Improve

The improve stage is an action to carry out improvements and improvement of Six sigma quality[12]. After knowing the factors that cause damage to the types of defects in inno cigarette products from the analysis of the cause and effect diagram, then a recommendation or recommendation for general corrective action is drawn up in an effort to reduce the amount of damage that has occurred to INNO cigarette products. The following are suggestions that can

be implemented by the company as an action to improve the quality of inno cigarettes based on the factors causing the defect.[13]

Table 3 Guidelines for Corrective Actions

Factors that cause defective products inno	Proposed action
Human	➢ Provide training to machine operators and employees on a regular basis to increase employee productivity
Method	➢ Check the raw material, chopping machine, and the remaining glue in the teat is still suitable for use or not before starting the production process. ➢ Cleaning scheduling in the folding area must be considered because it greatly affects the nozzle condition, if the nozzle is dirty either due to dust or something else, the gluing process to the cigarette stick will be disturbed
machine	➢ Check and check the engine components, pen or nozzle and raw chopper before the production process starts, and reset the machine if there are inappropriate settings.
material	➢ Reprocessing less refined tobacco Raw materials. ➢ Using good quality glue or Standard.

3.5 Control

The control stage is the last operational stage in improving the quality of Six sigma (DMAIC)[14]. At this stage, observations and recalculation of the results of implementation will be carried out as a comparison of the results before and after implementation. The following is the sampling data after improvement[15].

Table 4 Sampling data after repair

Sample	Type of defect						amount
	X1	X2	X3	X4	X5	X6	
336	9	2	8		4	10	33
336	7		2	12	6	3	30
336		9	1	2	8	7	27
336		2			9	13	24
336	6	4	6	17	3	2	38
336		13		4	6		23
336	4		2	7		4	17
336	2	7	5		5	13	32
336	8			9	12		29
336	6	3	7	2		4	22
336	3	6			4	9	22
336	11			6			17
336	5	7	2		9	14	37
336	3		10	11	15		39
336	10	2		7		3	22
336	3	5			8		16
336			9	13		4	26
336			2	1	6	12	21
336	3	3		10		9	25
336	2	7	4	7	11		31
336	4	1		11	2	10	28

336			2	2	11		15
336	6	2			2		10
336	2	5	3	3		2	15
336		2	8	5	4	6	25
336	6	4	2	17	2		31
336	4	9		9		2	24
336	2	2	3	5	4	9	25
336	14		7	12	2		35
336	6	6	4		11	5	32
10.080	**126**	**101**	**87**	**172**	**144**	**141**	**771**

From the Table 4, the number of defects can be as many as 771 defects during sampling. Then, the Table 5 presented the DPMO value and sigma level after improvement

Table 5 calculation of the DPMO value and Sigma Level after improvement

observation to	Sample	Number of defects	DPO	DPMO	LEVEL SIGMA
1	336	33	0,09821429	98214,29	2,79179
2	336	30	0,08928571	89285,71	2,84517
3	336	27	0,08035714	80357,14	2,90267
4	336	24	0,07142857	71428,57	2,96523
5	336	38	0,11309524	113095,2	2,71023
6	336	23	0,06845238	68452,38	2,98742
7	336	17	0,05059524	50595,24	3,13911
8	336	32	0,09523810	95238,1	2,80917
9	336	29	0,08630952	86309,52	2,86384
10	336	22	0,06547619	65476,19	3,01036
11	336	22	0,06547619	65476,19	3,01036
12	336	17	0,05059524	50595,24	3,13911
13	336	37	0,11011905	110119	2,72590
14	336	39	0,11607143	116071,4	2,69486
15	336	22	0,06547619	65476,19	3,01036
16	336	16	0,04761905	47619,05	3,16839
17	336	26	0,07738095	77380,95	2,92291
18	336	21	0,06250000	62500	3,03412
19	336	25	0,07440476	74404,76	2,94375
20	336	31	0,09226190	92261,9	2,82695
21	336	28	0,08333333	83333,33	2,88299
22	336	15	0,04464286	44642,86	3,19918
23	336	10	0,02976190	29761,9	3,38430
24	336	15	0,04464286	44642,86	3,19918
25	336	25	0,07440476	74404,76	2,94375
26	336	31	0,09226190	92261,9	2,82695
27	336	24	0,07142857	71428,57	2,96523
28	336	25	0,07440476	74404,76	2,94375
29	336	35	0,10416667	104166,7	2,75816
30	336	32	0,09523810	95238,1	2,80917
average	**336**	**25,7**	**0,076488095**	**76488,1**	**2,94715**

Based on the results of the above calculations, the DPMO value is 76488.1 and the sigma value is 2.94715[16]. The comparison table of DPMO values and sigma levels before and after the repair can be seen in the Table 6.

Table 6 comparison of DPMO values and Sigma levels before and after improvement

Parameter	Before implementation	After implementation
DPMO Value	113988,1	76488,1
Sigma level	2,722	2,94715

From the comparison table above, it can be seen that the DPMO value has decreased and the Sigma Level has increased. The DPMO value has decreased from 113988.1 to 76488.1. And the sigma level has increased from 2,722 to 2,94715

4. Conclusion

Based on research conducted at the Bima Mandiri Rembang Cigarette Company in Pasuruan Regency in August 2020, in an effort to minimize product defects by applying the six sigma method with the DMAIC stage. Then the following conclusions can be drawn:

After collecting and analyzing the data, it is found that there are several factors that cause the occurrence of defects in cigarette products, namely human factors, machine methods and materials. The application of the six sigma method (DMAIC) in the Bima Mandiri Rembang cigarette company in Pasuruan district can reduce the number of cigarette defects. This can be seen from the decrease in the DPMO value from 113988.1 to 76488.1 and the sigma level has increased from 2.722 to 2.94715[17]. in this case the quality of cigarettes is increasing with the decrease in the DPMO value and the increase in the sigma level.

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