



ANALYSIS OF EFFORTS TO REDUCE THE NUMBER OF *REJECTED* BEVERAGE PRODUCT BOTTLES IN *THE ASEPTIC PACKAGING DEPARTMENT* AT PT XYZ USING THE SIX SIGMA AND PDCA METHODS

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ABSTRACT

The number of requests for packaged beverage products, especially in the Pasuruan Regency area, is increasing. This is what triggers the growth of manufacturing companies in the beverage industry. One of them is PT XYZ, which is a bottled beverage industry manufacturing company in the Pasuruan Regency area. Meanwhile, PT Six Sigma method with DMAIC and PDCA (plan, do, check, action) is considered capable of overcoming these obstacles. This study aims to improve or repair one part of the machine, namely Scrapper in order to reduce the number of defective bottles. The material used in the repair is Teflon.



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1. Introduction

Industry drinks in the East Java region continue grow . It is can shown from the latest data available at the Central Statistics Agency of Indonesia . In this data , the average growth mark plus industry big and medium according to 2 digit kbli in java east 2012-2015 shows number by 20.31% (BPS, 2018). Growth mark the can triggered by increasing market demand . Demands face the market demand become reason important for industry drinks , especially in the Regency area Pasuruan , for the more increase amount production , quality as well as quality packaging on products processed drinks . With produce product suitable and fulfilling drink market demand , then companies engaged in industry drinks especially in the Regency Pasuruan will still endure .

PT XYZ is one of the company manufacturing located in the Regency area Pasuruan which operates in the field of industry drink packaging bottle . This company classified as new , but his business Keep going experience development . In the production process beverages , PT XYZ produces design bottle the drink myself then bottle the filled by product beverage . Manufacturing process bottle drink through Lots stages . The machines involved with the manufacturing process bottle before Ready filled olen drinks , namely machine maker bottles and also SILO (container) bottle).

Quality good production No off from control and improvement sustainable activities carried out by the parties companies , for example notice every process that exists in every line production , so that can send product in accordance with the quality and quantity desired by the next process (*next process*). One of them The method that is do repair to *Scraper* in the filling process bottle . Problem found that is bottle wedged in *the scraper* so that pile up cause bottle dent even part fall . This is hamper the production process in a way overall .

2. Review Literature

Study related is a study previously the topic The same with writer do moment This . Research related This used as reference writer in do research conducted moment This . Research related This as measure measuring writer in do study This . Research previous can used as base or guidelines writer in do ongoing research carried out (Wijayanti , 2015).

Table 2.1 High data dimension legs in position xxx

Researcher	Title	Objective	Method	Results
Cepi Kurniawan and Hery Hamdi Azwir (2018)	Application of PDCA Method for Reduce Damage Level Machines in the Production Process Coating	Prevent addition coating process time resulting in increasing utilities machine salute	PDCA method	From the results repair replacement hose peristaltic obtained savings of Rp. 4,200,000/ year
Pungky Nor Kusumawardhani (2012)	Design <i>Standard Operating Procedures</i> (SOP) for Post-Harvest Rhizomes Medicinal Plants With PDCA Method (<i>Plan, Do, Check, Act</i>) In Cluster Biopharmaceuticals Karanganyar	Finish reason problem quality experienced by the Cluster Biopharmaceuticals and also produce post-surgery SOPs harvest through PDCA method as <i>continuous improvement</i> in Cluster Biopharmaceuticals Karanganyar	<i>plan , do , check , and act</i> (PDCA).	Produce SOP draft and forms recording post harvest based on PDCA cycle

Figure 1. Number voters
 Source : Data Processing Results

a. Quality

According to (Kusumawati & Fitriyeni , 2017: 55), the definition of quality a product is “ The State of physical , function and properties a product concerned who can fulfill taste and needs consumer with satisfying in accordance the value of money that has been issued ”. Quality No Can viewed as a size narrow that is quality product solely . That thing Can seen

from a number of understanding mentioned above, where quality is not only a quality product but also very complex because involving all over aspect in organization as well as outside organization. In its form, according to (Renaldi et al., 2018:108) the quality is shape and characteristics goods or services that show his ability for satisfying visible needs clear or hidden.

b. *Defect*

(Khaerudin, Dedy, 2020:208) argues that *defect* is products that are not in accordance with specifications. According to Mulyadi (2005:306) *defects* are products that are not own standard the specified quality, but with emit cost workmanship return for fix it, product the in a way economical can perfected. Again become good product. In addition, according to Bastian Bustami and Nurlela (2006: 136) *defects* are products produced from the production process, but No in accordance with specification specified quality.

c. *Six Sigma*

Six Sigma is A philosophy in reduce and prevent *defect* so that reduced costs and customers feel satisfied on expected product. Companies that achieve *Six Sigma* only there is disability in the production process by 3.4 in One million opportunity (DPMO) or 99.999966 percent from what to expect customer will There is in product. With Thus, *Six Sigma* can made into performance target measure production process A product (V, gaspersz, 2002).

d. DMAIC (*Define, Measure, Analyze, Improve, Control*)

DMAIC is steps base in implementation draft *Six Sigma* with method based on data that can called with a settlement basis problem. The DMAIC stages have been proven become method settlement the most effective problem Because force management use data for confirm origin problems and the consequences that arise, find solution problem, establish procedure For look after sustainability solution even though after project the finished (Renaldi et al., 2018)

e. PDCA

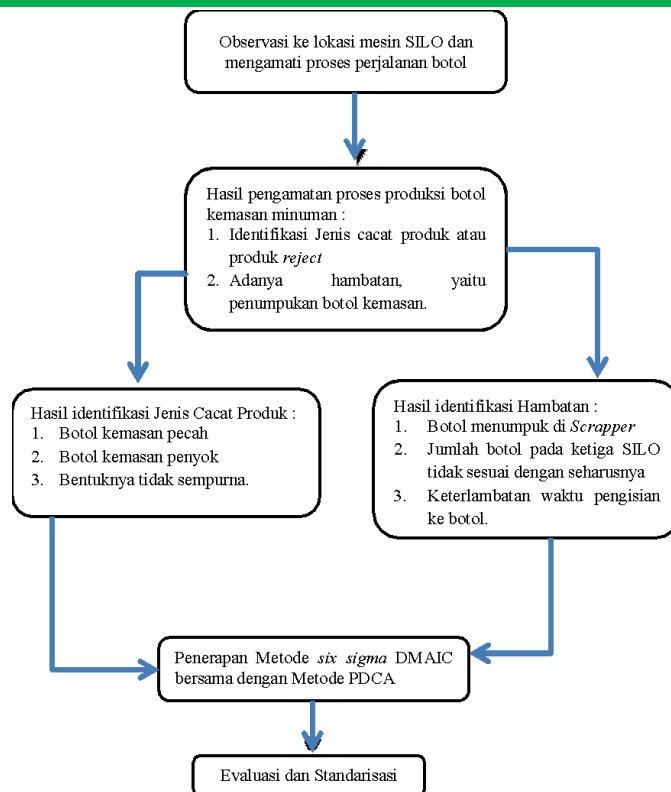
A process of solving problem four common steps used in control quality is PDCA, an abbreviation Language English from " *Plan, Do, Check, Action* " (Plan, Do, Check, Action) continue). PDCA is known as " cycle *Shewhart* ", because first put forward by *Walter Shewhart* several tens last year. However in its development, methodology PDCA analysis more often called the " Deming cycle ". This is because Deming is the person who popularized it its use and expansion its implementation. However, Deming himself always refer to method This as The *Shewhart* cycle, named after *Walter A. Shewhart*, is often considered as father control quality statistics.

f. *Cause and effect diagram (Fishbone Diagram)*

Understanding *Cause and effect diagram (Fishbone Diagram)* according to (Handoko, Andre, 2017) is " a tool that shows systematic relationship between a results or One effect with possible causes. "

3. Methodology

a) Conceptual Framework of Thinking



b) Data collection

Data collection carried out with road observe in a way direct in place research , some the method includes : Observation , Company Documents and Interview .

c) Data processing

Data processed with use method *six sigma* DMAIC :

1. *Define*, define and select the problem that will be completed .
2. *Measure*, measure problems that have been defined For completed . The measurements were taken is with determine characteristics related quality (CTQ) with the process running . Then next measuring production process the stated bottle in *Defects per Million Opportunities* (DPMO) or converted in size *sigma* .
3. *Analyze*, do determination root reason from key CTQ with use tool help cause-effect diagram (*Fishbone* Diagram). The previous problem explained based on factor *man*, *method*, *machine*, *material* , and *environment*.
4. *Improve*, do repair with use PDCA method as the guidelines .
5. *Control*, standardization and creation of new SOP (*Standard Operational Procedure*) at PT XYZ. This is aiming For adapt with standard from company and also adjustments on change or improvements that have been made done .

d) Repair

Identifying problem , look for alternative solutions , then do design tool help with PDCA method for reach *continuous improvement* (improvement) continuous).

4. Results and Discussion

a) Bottle Reject Data (Defect)

Month	Sunday to -	Reject Scraper
February	1	1985

	2	1604
	3	1050
	4	943
	Total	5582
March	1	862
	2	953
	3	732
	4	0 (HOLIDAY)
	Total	2547
April	1	964
	2	865
	3	859
	4	939
	Total	3627

The table above is reject data from February until April 2020. From the table of rejects of the scrapper bottles can seen amount reject bottle in month February as much as 5582 bottles, month March as much as 2547 bottles and months April amounting to 3627 bottles. It can be concluded that the average bottle reject in the scrapper is of 3919 bottles per month. Furthermore will done identification problems, repairs and analysis after repair.

b) Define Stage

1. Define problems found

Based on data collection, can defined that:

- Packaging bottles piled up at the location *Scrapper*.
- Dented bottle consequence each other collide.
- There is a bottle intact which turned out to be seen scratches on the part his body.
- The way machine hampered consequence existence bottle that is stuck.

2. Define percentage amount reject bottle

Sunday to -	Average amount production bottles per week	Number of scrapper rejects per week	Percentage of bottle rejects scrapper share (%)
1	5,009,592	1985	0.0396
2	5,009,592	1604	0.0320
3	5,009,592	1050	0.0210
4	5,009,592	943	0.0188
5	5,009,592	862	0.0172
6	5,009,592	953	0.0190

7	5,009,592	732	0.0146
8	5,009,592	0	0
9	5,009,592	964	0.0192
10	5,009,592	865	0.0173
11	5,009,592	859	0.0171
12	5,009,592	939	0.0187

From the table above can seen in number percentage at a glance seen small . However for company amount the considered worth it . Only on week only 8th one that doesn't found The same very reject bottle due to engine off.

3. Define the target you want achieved

Research at PT XYZ with use this six sigma method own several targets, namely includes :

- Identifying reason existence *defect* in order to be able to look for solutions and do plan repair .
- Do step repairs as soon as possible Possible problem can resolved .
- Decrease the number of rejected bottles as much as possible Possible attempted level failure more approach mark zero (*zero defect*).

c) **Measure Stage**

At the stage this , is done measurement performance on the production process bottle stated packaging in *Defects per Million Opportunities* (DPMO) or converted in size mark *sigma* . However , before done measurement , must determined characteristics related quality (CTQ) with the process .

1. CTQ Identification

Determining 4 potential CTQs in the travel process bottle packaging at PT XYZ, namely :

- Packaging bottles piled up at the location *Scrapper*.
- Dented bottle consequence each other collide .
- There is a bottle intact which turned out to be seen scratches on the part his body .
- The way machine hampered consequence existence bottle that is stuck .

2. DPMO and *Sigma*

Defects per unit or *Defect per Unit* (DPU) is number evaluation capability product . The concept refers to the amount average defects per sample unit product .

$$DPU = \text{Defects amount production}$$

Defects Per Opportunity , is size failure in Six Sigma which shows the amount disabled or failure by one chance .

$$DPO = \text{Defects amount production} \times \text{number of CTQs}$$

DPMO (*Defects Per Million Opportunities*) in implementation *Six Sigma* is ratio amount Defects in 1 million opportunity when a goods can contain more from One disabled .

$$DPMO = DPO \times 1,000,000$$

DPU, DPO, DPMO, and Sigma value calculation table

Minggu ke -	Rata-rata jumlah produksi botol per minggu	Defects	CTQ	DPU	DPO	DPMO	Sigma
1	5009592	1985	4	0.00039624	0.001584959	1584.959414	4.45
2	5009592	1604	4	0.000320186	0.001280743	1280.743023	4.52
3	5009592	1050	4	0.000209598	0.000838392	838.3916295	4.64
4	5009592	943	4	0.000188239	0.000752956	752.9555301	4.67
5	5009592	862	4	0.00017207	0.00068828	688.2796044	4.70
6	5009592	953	4	0.000190235	0.00076094	760.9402123	4.67
7	5009592	732	4	0.00014612	0.000584479	584.478736	4.75
8	5009592	0	4	0	0	0	0
9	5009592	964	4	0.000192431	0.000769723	769.7233627	4.67
10	5009592	865	4	0.000172669	0.000690675	690.6750091	4.70
11	5009592	859	4	0.000171471	0.000685884	685.8841998	4.70
12	5009592	939	4	0.00018744	0.000749762	749.7616572	4.68

The sigma value is obtained from table DPMO to sigma conversion based on Motorola concept . Sigma values based on nearest DPMO value in accordance in table conversion . Take advantage of rounding numbers so that numbers Can found with fast and easy .

5. Conclusion

a) Conclusion

conclusion from method six *sigma* applied and added with PDCA method is as following :

Results of Six Sigma Method Analysis with DMAIC and PDCA Methods

- 1) At the stage *Define* done definition problems and targets you want to achieve achieved . The problem is defined is bottle pile up , bottles dented , bottle scratched as well as bottle concerning . Then defined percentage amount products that experience rejection for 12 weeks with an average of 980 bottles per week or The same with 0.000195625 % of amount production bottles per week . The target you want achieved is the numbers are close zero (*zero defect*) .
- 2) At the stage *Measure* identified a total of 4 CTQs or characteristics quality namely : Packaging bottles pile up in *the scrapper*, bottles collide so that dented , bottle seen Good However there are scratches and bottle hooked into *the scrapper* . Then measure which sigma value is found that the average result known sigma values based on DPMO calculation is of 4.27.
- 3) At the stage *Analysis* is done search root reason problem . This is can using a fishbone diagram . From *the fishbone diagram* we can known that :
 - a. *Man*, considered not enough agile Because miscommunication between the operator and the leader as well lack of focus worker .
 - b. *Material*, SILO *over volume* so that bottle pile up cause dent .
 - c. *Machine*, known that *scrapper* has corner by 90° so that bottle difficult turn and get stuck .
 - d. *Environment*, bottle very sensitive to change temperature . Temperature space on site feel hot Because circulation bad air .
 - e. *Method*, the existence of damage to part *pneumatic scrapper* and also *photocell sensor*.

- 4) At the stage *Improve* be implemented repair. The method used is PDCA (*Plan, Do, Check, Action*)
- 5) At the stage *Control* an SOP will be created which will complete or update the previous SOP.

Decrease Rate Amount Reject Post Repair

Decrease rate number of rejects can be seen clearly in the picture graph 4.10 which shows decline amount enough significant from Sunday to 13 to week 20. For percentage decline amount before and after is with compare the average number of rejects before improvements and average number of rejects after experience repair. Here are results the calculation.

Average number of rejects before repair = amount disability per week amount the amount week = 980 pcs

Average number of rejects after repair = amount defects per week amount the amount week = 163 pcs

Percentage decrease (%) = (before-after) before $\times$ 100 % = $(980-163)/980 \times 100 \% = 83.37 \%$

So, it can be concluded that mark its decline is by 83.37%.

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