QUALITY CONTROL ANALYSIS OF BOTTLED DRINKING WATER PRODUCT IN PT.XYZ MINAHASA UTARA

ANALISA PENGENDALIAN KUALITAS PRODUK AIR MINUM DALAM KEMASAN DI PT.XYZ MINAHASA UTARA

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Abstract: Companies in this era of globalization are required to compete with each other. Consumers now prefer the products with good quality. In order to produce better products and mitigate defect in products, every company must implement a quality control system. Company will find means to implement a quality control system that is capable and reliable. One of the methods is using Statistical Process Control (SPC). The case studied in this research was the bottled drinking water product in PT.XYZ in Minahasa Utara. The SPC is including Control Charts, Pareto Diagrams and Fishbone Diagrams (Cause and Effect Diagram). Based on the analysis of control chart indicates that the process is out of control. This can be seen in the graph control where there is still a lot of outlier data. Based on Pareto diagram, repair needs priority is for the dominant type of defect is lid (75%). Based on the analysis of the factors causing defect by fishbone diagram, the types of defects originating from the methods, machines, and labor. Thus the company can take to minimize the prevention and repair of defects and improve product quality

Keywords*: quality control, damaged product, bottled drinking water, contol chart, pareto diagram, cause and effect diagram*

Abstrak: *Perusahaan di era globalisasi ini diharuskan untuk berkompetisi dengan sesama. Konsumen sekarang lebih memperhatikan produk dengan kualitas baik. Untuk menghasilkan produk yang lebih baik dan mengurangi cacat pada produk, setiap perusahaan harus menerapkan system kendali mutu. Perusahaan akan menemukan cara untuk menerapkan system kendali mutu yang mampu dan dapat diandalkan. Salah satu metode menggunakan Statistical Process Control (SPC). Kasus yang diteliti dalam penelitian ini adalah produk air minum dalam kemasan di PT.XYZ Minahasa Utara. SPC yang digunakan di penelitian ini meliputi Control Chart, Diagram Pareto, dan Diagram Sebab Akibat. Berdasarkan analisis diagram control menunjukkan bahwa prosesnya tidak terkendali. Ini dapat dilihat pada Control Chart di mana masih banyak data pencilan. Berdasarkan Diagram Pareto, tipe produk yang paling dominan memerlukan perbaikan adalah tutup gallon atau lid (75%). Berdasarkan analisis factor-faktor penyebab cacat oleh Diagram Sebab Akibat, jenis cacat yang berasal dari mesin, tenaga kerja, dan metode yang dijalankan perusahaan. Dengan demikian perusahaan dapat mengambil langkah untuk meminimalkan cacat pada produk dan meningkatkan kualitas produk.*

Kata kunci*: pengendalian kualitas, produk rusak, air mineral dalam kemasan, control chart, diagram pareto, diagram sebab akiba*

INTRODUCTION

Research Background

Companies in this era of globalization are required to compete with each other. This leads to increasingly intense competition, so companies are competing to produce quality products, therefore the company must maintain the products it produces have a guaranteed quality and can compete in the market.

Companies must carry out various businesses, one of that is by supervising each production process in order to produce quality products. The company also using the technology to maintain and guarantee the quality of the products it produces. The technology applied in the field of manufacturing industry is currently growing very fast. The existence of technology in the industrial world has an impact on competitive competition between companies with one another. There needs to be good planning carried out in several parts such as factory building planning and planning of other production facilities which include machinery, labor, production equipment and other production facilities that support the production activities of a company.

Consumers now prefer the products with good quality. Consumers hope that the products they buy can meet their needs and desires. If the production process had some various kinds of obstacles, it will cause various losses both material and nonmaterial. Quality requires a process of continuous improvement process that can be measured, both individually, organizationally, and company performance objectives. Management, employees and government support for quality improvement is important for the ability to compete effectively in the global market.

The quality of the product is influenced by the basic ingredients of the product, the production process and the end result. So the activities or business of a company directed to provide quality control of the components, ranging from input, then the production process in the form of checks to the packaging and the output or the end result that needs to be checked back and ready to be distributed to consumers, well qualified. Implementation of the quality control activities will reduce the amount of defect products in the production process.

Quality control is required within a company for minimize operational costs in products. Good quality control will assist in the fluency of the production process, so that the production activity will reach its target.

Quality control of the company is to suppress the number of defective or damaged products. Quality control can avoid damaged products into the hands of consumers so it will make the company still have their good name and also in fulfilling the desire of consumers to the desired product the company will not have difficulty because the quality of the product is the basic factor of consumer decisions in choosing and assessing a product.

The quality control analysis process will have an influence on the company's reputation and increase consumer confidence in the company's performance. Companies that are aware of it always carry out quality control activities in every process of producing goods or services.

Seeing the importance of quality control for the company, especially for bottled drinking water company that is in food industry in North Celebes, the company needs to pay attention to the quality of its products, because the products are still defective and not in accordance with product quality standards, this is because companies are less strict in quality control on raw materials production, at the time of the production process and at the end of production.

Viewed from the current conditions where bottled drinking water products are an important product for the people. Water is a basic need for life, as well as humans during their life always needs water. For humans, mineral water is one of the main needs, humans use water for various purposes including household, industry, agriculture, and so on.

The quality of the bottled drinking water products has now decreasing. Currently there are a lot of complaints from the people, such as dirty water, bad taste of water, etc. towards bottled drinking water products (Sutrisno, 2010), therefore there is a need for quality control so that bottled drinking water products at PT.XYZ has good quality so that the company can produce effectively and efficiently, besides that it can give orders to consumers as expected.

PT.XYZ produces bottled drinking water that packaged in various forms consisting of 240ml cup, 600ml bottle, 1500ml bottle, and 19 liter gallon. Production data and the damages of PT.XYZ products can be seen at this table:

Table 1. Total Production and Total Damage of PT.XYZ Products in 2017

No.	Product	Total Unit Production	Total Unit Damage
1	240ml cup	178,288,320	213,259
2	600ml bottle	91,732,584	431,560
3	1500ml bottle	26,098,296	148,593
4	19 liter gallon	6,491,853	45,166

Source: PT.XYZ, 2017

Table 1 shows that the highest product produced is 240ml cup with 178,288,320 total unit productions, but the highest percentage of damage product is the 19 liter gallon with 45,166 total unit damage. The researcher focusing the highest percentage of damage product in this research which is the 19 liter gallon.

There are some mineral water companies in North Celebes, but the researcher pick one of them and the company that became the object of research did not want the researcher to publish their name so the researcher named it PT.XYZ. This company always supervises the production of bottled drinking water, but based on table 1 there are still errors that occur in the product. From the background above, the researcher takes the Quality Control Analysis of Damaged Bottled Drinking Water Production in PT.XYZ Minahasa Utara as a research.

Research Objectives

The objective of this research is to find out whether the damage in bottled drinking water product is still in the statistical control limits or not and to know the factors that cause the damage in bottled drinking water product.

THEORETICAL FRAMEWORK

Production and Operation Management

Production and operation management is an area of management concerned with designing and controlling the process of production and redesigning business operations in the production of goods or services. Heizer and Render (2006) note that production and operations management is the set of activities that creates value in the form of goods and services by transforming inputs into outputs.

Product Damage

Damaged products are products that are damaged, or do not meet established quality standards, and cannot be repaired, but will result in higher repair costs compared to the increase in value or benefits or repair of damaged products there are two types, damaged products which are normal and not normal. Damaged product is a product that is produced in the production process where the resulting product is not in accordance with the quality standards applied, but economically the product can be improved by spending certain costs, but the costs incurred tend to be greater than the value sell after the product is repaired (Bastian, 2006).

Quality Control

Quality control is a system of maintaining standards in manufactured products by testing a sample of the output against the specification. Prawirasentono (2007) quoted that quality control is the integrated activities ranging from standard quality control materials, standard production process, intermediate goods, finished goods, up to the standard delivery of the final product to the consumer, in order for goods (services) are produced in accordance with the planned quality specifications.

Previous Research

Ramphal (2016) is studied about A Quality Tool box for the Hospitality Industry. The objective of this research is to provide a description of quality in services, methods of evaluation and the use of Ishikawa's basic quality tools for diagnosing quality related problems specifically for the hospitality sector. The tools explained were process maps, check-sheets, Pareto table, cause and effect diagram and scatter-sheets

Subbulakshmi et al (2017) are studied about An Essential Role of Statistical Process Control in Industries. This paper represents an understanding report on defining and carrying out a systematic review on SPC, which is well known in industrialized contexts. Implementation of SPC tools at the company is expected to develop its processes and condense variability or waste because it may not be possible to completely eliminate variability

Muhammad (2015) is studied about Quality Improvement Of Fan Manufacturing Industry By Using Basic Seven Tools Of Quality: A Case Study. This research was carried out in "Fecto Fan Company". Who are specialized in manufacturing all type of ceiling fans. There were two sections in plant, manufacturing and assembling. Research was carried out in a Fan manufacturing industry to address the quality related problems and improve their quality level by implementing basic seven tools of quality.

Conceptual Framework

In the production process, quality control has to be conducted to the product. The quality control has a huge impact to the product, wether it has damage or not. The damaged product has to be fixed by using some tools, in this research the researcher used three tools of the Statistical Process Control (SPC): C-Chart Analysis, Pareto Chart Analysis, Cause and Effect Diagram Analysis.

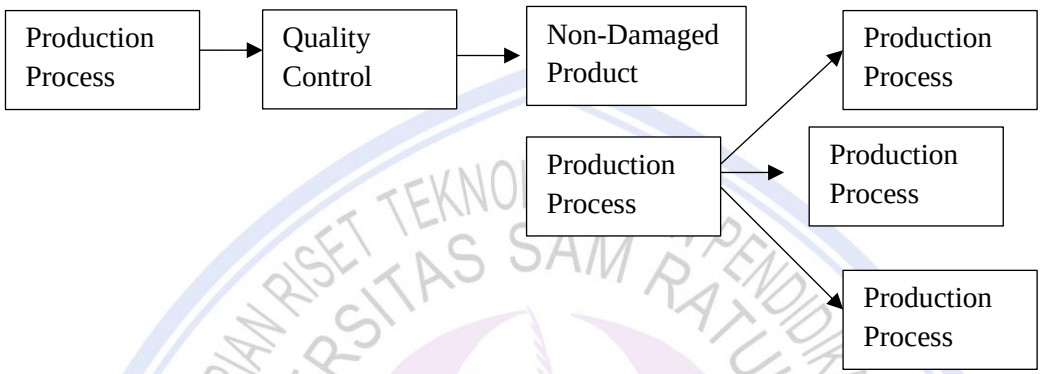

Figure 1. Conceptual Framework
Source: Theoretical Review, 2018

RESEARCH METHOD

Research Approach

This research is used qualitative research methodology to analyze the production process of bottled drinking water in PT.XYZ Minahasa Utara. According to Miles and Huberman (1994), qualitative research is method used to examine complex phenomenon where researcher is the key instrument. The most common sources of qualitative data include interviews, observations, and documents (Patton in Miles and Huberman, 1994). Qualitative research is much more subjective and uses very different methods of collecting information, mainly individual, in-depth interviews and focus groups.

Population, Sample and Sampling Technique

A research population is also known as a well-defined collection of individuals or objects known to have similar characteristic. According to Sugiyono (2006), population is the generalization of the object or the subject has certain qualities and characteristics set by the researchers to learn and then drawn the conclusion. The population in this research is the bottled drinking waterproduct that produced by the PT.XYZ which has damage or defects.

Sampling was constituted to choose some of individual process in research so they or individual as a voluntary. While as quoted from Sugiyono (2006), sample in qualitative research is not called as respondent instead as a sources, participant, informant, friend and teacher in research process. Sample in qualitative research also is not statistical sample but a theoretical and constructive sample because the purpose is to gain theory and the source data is the source of constructed phenomenon that was previously unclear before.

Snowball sampling may simply be defined as a technique for finding research subjects. One subject gives the researcher the name of another subject, who in turn provides the name of a third, and so on (Vogt, 1999).

Data Collection Method

The data used in this research consist of two types of data, which is primary and secondary data. Primary data are gained from in-depth interview and secondary data are taken from several books, journals, previous research and company profile.

Operational Definition of Research Variables

There are two main variables in this research that consists of five indicator, which is Quality Control and Product Damage (raw materials, labor, machine, method and environment).

Instrument Testing

The instrument testing are the tools that the researchers prepare for measurement while conducting the research. In an interview the instrument can be interview schedules, performance checklist, observation forms, attitude scales, and so on.In this research, the key instrument or research tool is the researcher itself.

Data Analysis Method, Validity and Reliability

The data analysis method in this research is a guide in the process of analyzing data to find the final result of the research. Miles and Huberman in Sugiyono (2017) stated that qualitative data analysis is done interactively and continuously until complete, so the data is saturated. While, according to Miles and Huberman in Sondakh (2017) there are generally steps in qualitative data analysis: Data Collection, data reduction, data display, drawing and verifying conclusion. Test the validity of data in research is often only emphasized on the validity and reliability test. According to Sugiyono (2017), In testing the validity of data, qualitative research methods include credibility test, transferability test, dependability and confirmability test.

RESULT AND DISCUSSION

Result

This result use qualitative research and use in-depth interview as the tool to gain information, the informant was the quality manager and production manager. Quality control is an effort to maintain product quality with the quality standards set by the company and to suppress damaged products. Research activities on an object required analytical actions from the data that has been obtained. The technique used is the C-Chart as a first step to find out whether quality control in this company has been controlled or not. From the data obtained from PT.XYZ, then the quality control analysis will carry out using the Control Chart (C-Chart) method.

C-Chart

The C-chart analysis is used to know and determine the level and type of damage to the final product such damage if it still be in tolerance or not and still meet the criteria control limit or not. To analyze the magnitude of the level and type of damage with the using the C-chart analysis with regard to the data used production during the period 2017.

Table 2. Total Production and Total Damage of 19 liter gallon Product of PT.XYZ in 2017

Month	Production per unit	Defect/damage product
January	512,938	3,628
February	493,727	2,911
March	636,936	3,605
April	506,270	4,666
May	555,126	3,848
June	614,335	4,878
July	609,011	3,519
August	537,683	3,812
September	517,761	3,583
October	523,872	3,401
November	443,592	3,636
December	540,602	3,679
Total	6,491,853	45,166

Source: PT.XYZ Quality Control Department, 2018.

a. Determine the Average of Damage

$$\bar{C} = \frac{\sum c}{n}$$

$$\frac{45,166}{12} = 3,763.83$$

Average product in C-Chart is the establishment of the line of the center line (CL). Average product failureof 3,763.83 is ideal damage for the company due to amount of damage between the lines of the center line. This is reasonable if the condition is above orunder the line of center line.

b. Standard Deviation

$\sigma = \sqrt{\bar{c}} = \sqrt{3,763.83}$ = 61.35

c. Upper Control Limit (UCL)

UCL = C $+ 3\sqrt{\bar{c}}$
= 3.763,83 + 3 (61,35)
= 3.763,83 + 184,05
= 3,947.88

d. Lower Control Limit (LCL)

LCL = C $- 3\sqrt{\bar{c}}$
= 3.763,83 – 3 (61,356)
= 3.763,83 – 184,05
= 3,579.78

The Upper Control Limit (UCL) is a limit of tolerance the Lower Control Limit (LCL) is a maximum and the limits of tolerance minimum for damage to products used for limiting conditions are ideal for product failure period 2017. The limits of control over at the company amounted lower control limit 3,947.88 and 3,579.78. In PT.XYZ product damage of 19 liter gallon in 2017 is no bigger than 3,947.88 when exceeding 3,763.88 will be created in the out of control condition and in the damage does not exceed the product of 3,947.88 and not less than 3,579.78 it can be said that the product failure is still is considered reasonable.
After doing the calculation then can be drawn up the C-chart to display damage products that are still within the boundary lines of supervision and who still are out of line supervision.

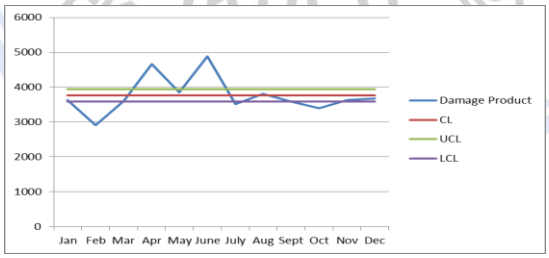

Figure 2. Grafik C-Chart Total Damage Product
Source: Data Processed, 2018

Based from the calculation above, it is known that the UCLis 3,947.88, the LCL is 3,579.78 with standard deviation 61.35 and the average damage 3,763.83. Based on the image above, it can be seen that there is still damage products be in the condition of out of control that occurred on the February, April, June, July, and October.

Pareto Diagram

During observing the product process the cup notes problems regarding the types of damage that become cause of product damage. To analyze problems regarding the types of damage, researcher uses Pareto Diagram.

Table 3. Types of Damage Product

Month	Lid	Body	Label	Dirty	Total Damage
January	2,377	886	220	145	3,628
February	2,075	628	195	43	2,911
March	2,671	812	83	39	3,605
April	3,667	967	9	27	4,666
May	2,879	899	72	0	3,848
June	3,515	1252	91	39	4,878
July	2,579	606	291	4	3,519
August	2,967	739	98	8	3,812
September	2,877	610	96	0	3,583
October	2,696	438	267	0	3,401
November	2,817	679	192	0	3,636
December	2,930	634	115	0	3,679
TOTAL	34,050	9,150	1,726	305	45,166
Percentage	75.38%	20.25%	3.82%	0.65%	100%

Source: Data Processed, 2018

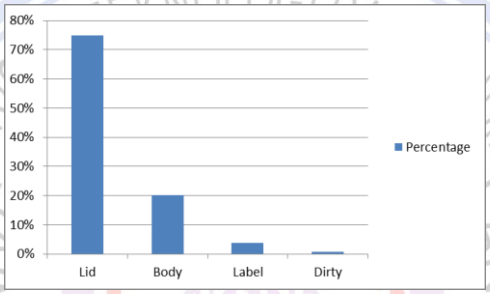

Figure 3 Pareto diagram Types of Cup Product damage
Source: Data Processed, 2018

From the calculation of the percentage of damage from the image Pareto Diagram above shows that the damage of the 19 liter gallon production process in the 2017 is in the form of four damage. Percentage the most basic damage is lid leakage of 34,050 or 75.38%.

Cause and Effect Diagram

The cause and effect diagram or fishbone diagram is a tool for identifying quality problems and knowing the cause. There are 4 categories of damage to 19 liter gallon product: raw materials, labor, machinery, method.

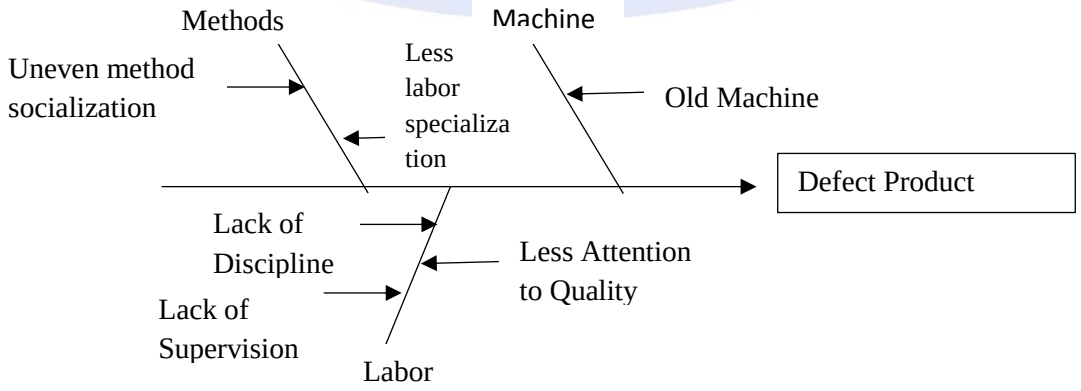

Figure 4. Cause and Effect Diagram of 19 Liter Product in PT.XYZ
Source: Data Processed, 2018

From the results of observations that observed by researcher in PT.XYZ to their 19 liter gallon product, researcher found several factors that caused damage to the product:

Labor

From the results of the observation, researcher found out that the labors in PT.XYZ has a lack of disciplinein managing time, they usually procrastinate tasks they should have do. Lack of supervision and training of employees can also causing damage to the products. The labors also tend to have less attention to the quality of the products that causing damages to it.

Machine

From the results of the interview with the manager of quality in PT.XYZ, researcher found out the machine that they used is old machine that affects damages to the product. Old machines will be more easily damaged, if one of the machines is damaged, the production process will be hampered.

Methods

The uneven method socialization also has an impact on product damage. The method applied can affect the damage to the product, before the production process, the machine should be checked to ensure no damage.

Discussion

PT.XYZ is a company operating in bottled drinking water product. In this occasion, researcher observes about the gallon production process. Viewed from the production process, the company must have ever done the mistake in its production process both because of the machine or the tool used in working and because the mistakes made by the employees, leading to the product damage.

This research aims to find out whether the product damage is still under control or not. The methods used are Control Chart (C-Chart), Pareto Diagram and Cause and Effect Diagram. The company can also find the Upper Control Limit (UCL) and Lower Control Limit (LCL) as well as to find out whether there is product damage out of control. By using these methods, the quality control is expected to minimize the damage level.

From the data analysis using C-Chart control chart, it can be found the average product damage occurring during 2017 in which the average product damage is 3,763.83, for upper control limit is 3,947.88, and lower control limit is 3,579.78. In 2017, there are five out of control errors that can be seen in C-Chart graphic: February, April, June, July and October.

From the calculation of the percentage of damage using Pareto Diagram shows that the damage of the 19 liter gallon production process in the 2017 is in the form of four damages: lid, body, label and dirty. Percentage the most basic damage is lid leakage of 34,050 or 75.38%, the body leakage is 20.25%, the label leakage is 3.82%, and the dirtiness is 0.65%.

From the results using Cause and Effect Diagram, researcher found out that the labors in PT. XYZ has a lack of discipline in managing time, they usually procrastinate tasks they should have do. Lack of supervision and training of employees can also causing damage to the products. The labors also tend to have less attention to the quality of the products that causing damages to it. From the results of the interview with the manager of quality in PT. XYZ, researcher found out the machine that they used is old machine that affects damages to the product. Old machines will be more easily damaged, if one of the machines is damaged, the production process will be hampered.The uneven method socialization also has an impact on product damage. The method applied can affect the damage to the product, before the production process, the machine should be checked to ensure no damage.

This result is in accordance with research by Bakhtiar, Tahir, and Hasni (2013), that found the most influential in the quality control process is the damage to the bottle type of break and cracked by the 4 factors: human, material, method, and process and preventive action that can be done from the human factor is giving direction and strict supervision and doing training for employees.

CONCLUSION AND RECOMMENDATION

Conclusion

Based on the analysis of quality control of gallon product implementation at PT.XYZ, there are several conclusions that can be drawn:

1. Based on calculations with the Control Chart (C-Chart) analysis in 2017 it was found that the damage was beyond the control limits such as in February, April, June, July, October.
2. Based on the analysis of Pareto Diagram can be seen that the highest percentage of damage is lid leakage which causes damage beyond the control limit.
3. From the Cause and Effect Diagram or Fishbone Diagram analysis can be known factors that causing damage to PT.XYZ 19 liter gallon product is less attention to maintenance and replacement of spare parts on the machine, also the lack of job training and skills for employees.

Recommendation

Based on the discussion of data analysis and conclusions in the results of the research, the results are expected to give a benefit to the company to determine further steps regarding quality control:
1. The company holds special trainings for quality control from component raw material receipts, the production process takes place and finished products to employees, with the training expected that the workforce can be more thorough and skilled in carrying out tasks or quality control work. The company is expected to pay more attention to employees so that the work carried out can run in accordance with the work procedures of the company. The human resource manager is expected to give more attention to socialize the methods to the employee or even the trainee.
2. There needs to be an increase, periodic maintenance of the machine every six months and replacement of the machine components that has been damaged, so that it will streamline the production process and prevent engine damage.
3. For further research, it is recommended to use the complete seven tools of statistical process control (SPC) since this research only used three tools of statistical process control (SPC).

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