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Analysis of Production Defects Using The 5 WHYS and RCA Method at PT. X

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ABSTRACT

PT. X, a textile company established in 1975, faces production defects in its Spinning Division 6, which produces 100% cotton yarn. Despite its long-standing presence in Indonesia, these defects threaten the company's reputation and consumer loyalty. The research aims to identify the causes of these defects to improve production quality and achieve zero defects. The study employs the 5 Whys analysis through Root Cause Analysis to uncover the underlying issues. Key problems include stains on rolls due to inadequate supervision of pallet layers, rolls going off track from a damaged glider on the winding machine, and tangles caused by the suction mouth touching the reel's surface. Addressing these issues is crucial for enhancing quality control and reducing defects.

Keywords: Defects, 5 why, Root cause analysis, Pareto diagram, Rejection

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1. Introduction

Currently, many manufacturing companies are competing increasingly fiercely in Indonesia. This business competition has resulted in business people wanting to win the competition in terms of the quality of their production results. One company after another is trying to use various methods to improve product quality. By utilizing current technological developments, companies can increase the quality and quantity of production more efficiently, so that they have high competitiveness and sales for consumers. To fulfill this, companies must stabilize the quality of their production or even improve production quality [1]. Therefore, quality control in the production process needs to be paid very close attention. Product quality is one of the most important problems in industrial activities. Interest in quality has become vital.

Quality control is a very important aspect for the sustainability of all types of companies so that the products have high competitiveness and sales, consumers will trust the company for their needs [2]. The products produced must meet the desired standards and meet consumer needs. Production quality control can be done in various ways, for example by using good materials, using adequate production machines/equipment, skilled labor, and the right production process. Quality comes from control and control is a result of disciplined training, example and leadership, where the quality standard is zero defects. Quality control that is often carried out by a company is quality control of defective products. Defective products are often found in companies, both during the production process and outside the production process, such as during the delivery process. Defect indicators that are classified as defective products are products that do not meet the

standards determined by the company and buyer [3]. Therefore, quality control efforts are needed for defective products to minimize the number of defects for a company, especially for a garment or textile company [4].

PT. X is a textile industrial company founded in 1975, starting commercial production in 1976 with a cotton spinning factory in Purwakarta which continuously diversifies and expands the Spun Yarn business and increases production for making Polyester Filament Yarns, "Polyester Staple Fibers PET Resin," Polyester Chips and Polyester Filament Fabrics for the global market with factory locations in West Java (in Purwakarta, Campaka and Bandung), Indonesia. The company has been listed on the Indonesian Stock Exchange since 1990. The company is one of the largest exporters in Indonesia and has been a regular winner of the prestigious Primaniyarta award for its export achievements. The company exports to premium customers in North America, Europe, South America, Asia, Australia and the Middle East. A continuous process of reinvestment and productivity improvement programs have made the Company one of the most competitive polyester producers worldwide. However, even though it has been established for a long time and is the largest textile company in Indonesia, there are still defects that occur in the results of production activities at Spinning Division 6, namely the division that produces 100% cotton yarn.

These defective products will reduce the company's reputation where consumer loyalty to the company is at stake, some even do not want to cooperate and negotiate with companies that have a poor reputation [5]. This will result in the company losing consumers and being unable to compete with other companies, so it will have a negative impact on the company both from a financial and material perspective.

Based on these problems, research is needed to find out the factors that cause defective products to be able to evaluate and improve the scope of production activities so as to minimize the occurrence of defects again in production results and improve zero defect quality control. The analysis method that can be carried out is using the 5 Wyhs analysis through the Root cause analysis approach which is used to find out the root of a problem that causes defects in production results.

1.1 Pareto Diagram

A Pareto diagram is an image that orders a classification of data from left to right according to the highest to lowest ranking order. This can help find the most important problems to be resolved immediately (highest ranking) to problems that do not need to be resolved immediately (lowest ranking). The Pareto diagram can also be used to find 20% types of defects which constitute 80% of defects in the entire production process. This diagram follows the Pareto principle, also known as the 80/20 rule. This theory provides the opinion that 80% of the benefits come from 20% of the effort and 80% of the problems come from 20% of the causes. So it can be said that through this principle companies can prioritize things that are more important to achieve maximum results [6].

Using the Pareto diagram will focus on the causes that have the greatest influence on a problem. So, the problem-solving process using the Pareto diagram becomes more efficient. Only by focusing on 20% of the causes of 80% of the problems to solve the problem.

1.2 The 5 WHYS

The 5 whys is a method used to analyze qualitative data to find the root of the problem. 5 why analysis carried out by asking the question "why" five times will help see the root cause of the problem, because the results of the answer to one question can lead to the next question until it cannot be continued. This is one of the simplest investigation tools that is easy to complete without statistical analysis. Also known as a why tree, it is considered a simple form of root cause analysis. By repeating the words “why?” To identify the cause of a problem, we can get to the root of the problem [7]. Therefore, the resolution process will be very effective by resolving the root of a problem because it continues to explore the cause of a problem until it finds the root cause of the problem.

1.3 Root Cause Analysis

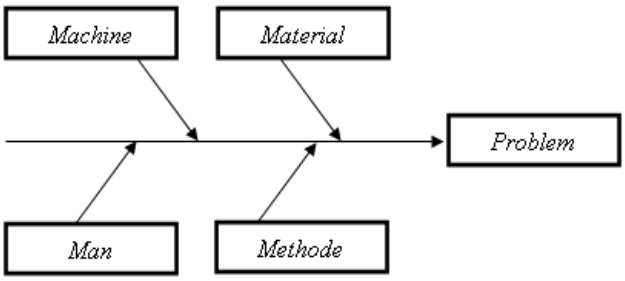

Figure 1. Fishbone Diagram

Root cause analysis is an analytical method for identifying the cause of a problem to help find the problem. The fishbone diagram (cause effect diagram) is the root cause analysis used in this research. Fishbone diagram is an analysis that identifies problems with related factors [8]. These factors are usually called the 5M, namely Man, Machine, Method, Material and Environment. These factors are presented in diagram form so that they are easy to understand. The factors can be found out that influence the problem, to evaluate and provide solutions to the causes of the problem.

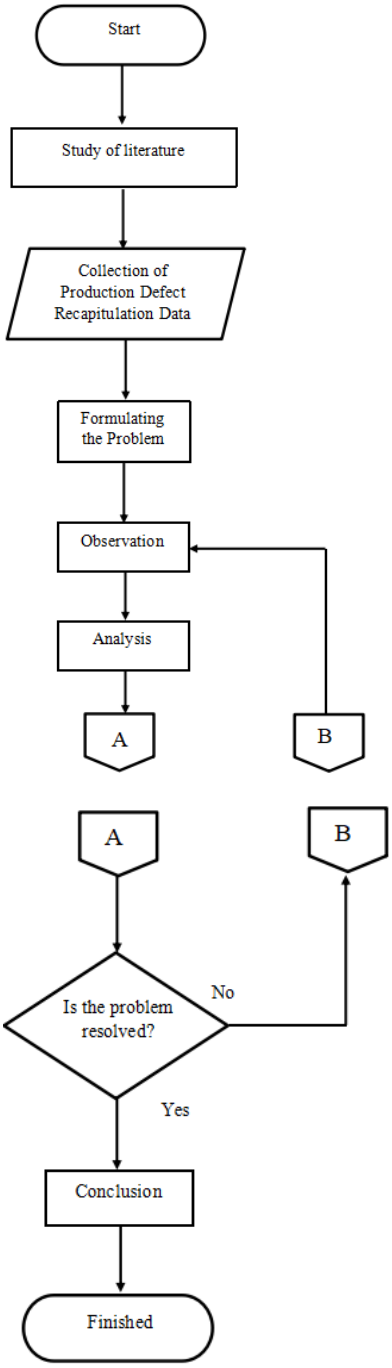

Figure 2. Research Flowchart

2. Methodology of Research

In this paper we use some method for indentifies problems with related factors. The method we use are Root cause Analysis and will combine with The 5 wyh analysis to identify the causes of defective production of 100% cotton yarns at the factory [9].

The implementation of this research is within a period of 1 month or more precisely from June to July 2023 at PT. X has the address Ubrug-Jatiluhur Purwakarta, West Java. In this research, there is a flowchart to make it easier to understand each step of implementation. The following is a flow diagram of this research.

This is a flowchart that shows the stages of research from beginning to end. These stages begin with a literature study on related topics, then collect data on defective production results, formulate problems regarding these production defects, then make observations using root cause analysis, the results of the analysis in the form of problem factors are re-analyzed using The 5 why method analysis and then obtain the causes of defective production results [10].

2.1 Research Variable

1) Independent Variable

The independent variable in this observational research is the analysis of production defect problems that occur due to machine damage.

2) Dependent variable

The dependent variables are 100% cotton yarn products, machines, materials, environment, and humans.

3) Control Variables

The control variables in this research are:

- Observation Method
- Pareto Diagram
- Root Cause Analysis
- 5 WHYS Method

2.2. Data Collection Preparation

Before collecting data, prepare first so that during the data collection process there are no obstacles or shortcomings on the tools and materials used. Preparations made for testing these are as follows:

1) Prepare the tools that will be used in this research, such as stopwatches, ear plugs, gloves and stationery.
2) Prepare any data variables needed in carrying out field analysis.
3) Prepare the machine and operator in the best performance possible operate the machine.

2.3 Data Analysis Technique

The data analysis technique used is the descriptive method. Analysis of data obtained from taking field data on machines, materials, humans and the environment is then carried out by presenting the data for graphical analysis of research results. The results of the data processing then create an analytical method to find out what problems occur in the cotton yarn production process and are accompanied by discussion descriptions from graphs and tables, using simple sentences, easy to read, easy to understand, and presented as an effort to find answers to problems researched.

3. Result and Discussion

The novelty of this research is that the method used in this research is that we make observations and conduct analysis using Root cause analysis which is combined using the 5 why method, so that we can know the root of a problem from each of the factors that have been obtained from the results of root cause analysis, from each of the existing factors, analysis is carried out again with the 5 why method [11].

3.1 Flowchart of 100% Cotton Yarn Production Process.

The following is the flow from the initial process to the final process of producing 100% cotton yarn to assist in the process of identifying problems that occur in aspects of the production process. The production process flow diagram can be seen as follows.

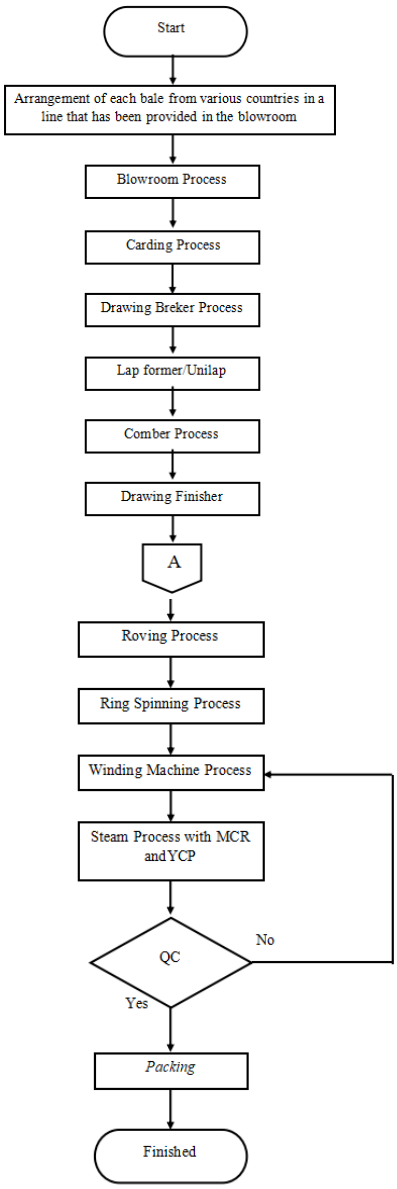

Figure 3. Production Flowchart

3.2 Observation Method

In research conducted at PT. X, a rejection was obtained due to a defect that occurred in the production of 100% cotton yarn. Based on the results of data collection from the company as well as direct observations in the field of production activities, it was found that a few defects caused thread rejects that occurred in the 100% cotton thread. The quantitative number of defect types found was obtained by looking at the recapitulation of cone reject data. The data taken is a recapitulation from May to July 2023. Based on the data, a total of 708 rejects were obtained from a total production of 1554842 skeins of thread. With the highest number of stains rejects at 668, 33 rolls were out of line, 3 were dirty and 4 were wet. The following is the recapitulation data for Cone Reject in July 2023.

Table 1. Reject data for May 2023 - July 2023

Reject Data in July 2023		
No	Reject/Defect Type	Total
1	Stain	668
2	Roll Out of Track	33
3	Dirty	3
4	Wet	4
Amount		708 cones
Total Production		1554842 cones

Apart from the defects known from the cone reject data, the author also found defects, namely tangled threads, these defects were not captured by the company because the roll defects would be immediately dealt with on the winding machine at that time if discovered by the winding machine operator, this would be very detrimental to the company. because it needs to increase the time and operational costs of the machine. Obviously this is very ineffective in taking action on spools of thread that are rejected [12].

Because if this roll defect has recapitulated reject data, we can create a strategy to reduce the defect by estimating when the cause of the defect occurs, if we know when the defect appears and align it with other factors, starting from machine factors that have a maintenance schedule, HR factors (Human Resources) or other related factors, we can find out the cause of the defect in the tangled roll. So, it can reduce the appearance of tangled roll defects and even prevent the causes of these defects before they occur.

According to the results of this data collection, it is necessary to qualitatively define the types of rejected goods that arise from production activities in the company. The following are the types of production results that are rejected.

Figure 4. Stained thread

Rejected threads that have yellowish stains or can also have dot stains (Fig 4). These stains are stains that absorb into the thread fibers. To follow up on the rejection, the company will usually throw away the part with the stain and will re-roll it in the winding machine process.

The thread winding on the cone is not aligned or out of the way of the winding according to the length of the cone (Fig 5). So the roll becomes bad, not suitable for use because it will complicate the next process and is also not suitable for sale to customers. As a result of this, the company had to carry out re-winding or re-winding of the threads that had been rejected and rolled out of line.

Figure 5. Get Off the Tracks

This defect occurs when there is tangled thread on the spool, sometimes during the winding machine process, the machine cannot process the spool because the ends of the thread are tangled so the pulling process for winding the thread cannot be carried out (Fig 6). As a result, the winding process cannot continue, so the winding process in the winding machine will be stopped and a new roll will be produced by removing the crumpled roll from the glider, which is where the cone is rolled. Then the machine will fill the cone automatically and operate again.

Figure 6. A Roll of Tangled Thread

3.3 Pareto Diagram

The image above is observation data in the form of a Pareto diagram obtained from cone reject recap data from May 2023 to July 2023. Identification using the Pareto diagram was carried out as a step to find out the biggest effect on the occurrence of rejects in the 100% cotton yarn production process [13]. It can be seen that stains are the thread defects that have the most effect on rejects, followed by out-of-line spools. So the author decided to analyze rejects with the 2 largest occurrences, namely stains and out-of-line rolls.

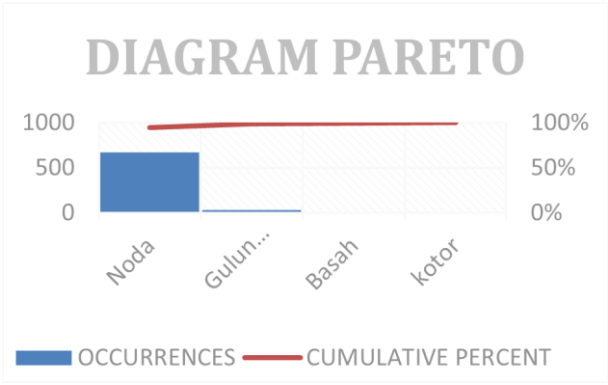

Figure 7. Pareto Diagram

3.4 Root Cause Analysis

3.4.1 Stain

From the results of observations and interviews with related parties. By carrying out a fishbone cause-and-effect analysis, the causes of stain defects on thread spools were found.

The image above is a cause-and-effect diagram of fishbone defects, stains on spools of thread caused by factors such as machines, materials and humans. To clarify in more detail the causes of the factors mentioned above, here is the explanation:

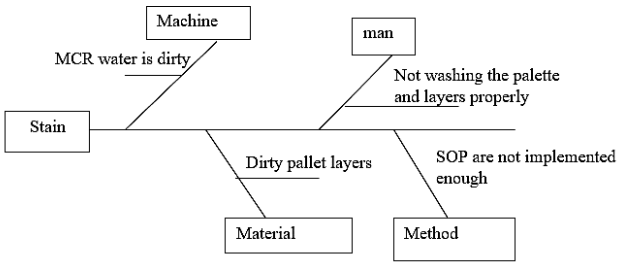

Figure 8. Fishbone Diagram Stain

a. Machine

This defect occurs in the MCR machine, which is a steam machine to increase the water content in the spool of thread. This machine has a nozzle that sprays water vapor. This water vapor is the cause of stain defects because it is dirty so it is absorbed by the skein of thread, resulting in yellowish stains appearing on the skein of thread.

b. Man

The employees on duty were not good at cleaning the pallets and layers for the spools of thread that would be fed into the MCR machine. This results in the spool of thread getting dirty stains. Employee negligence allows pallets and layers to become dirty.

c. Method

Poor implementation of the soup on the use of layers and pallets for spools of thread that will be processed in the MCR machine room.

d. Material

Dirty pallets and layers used to store thread rolls that will enter the MCR machine room.

3.4.2 Get Off the Tracks

According to the results of observations and interviews with related parties. By carrying out a fishbone cause-and-effect analysis, the causes of the roll defect occurred.

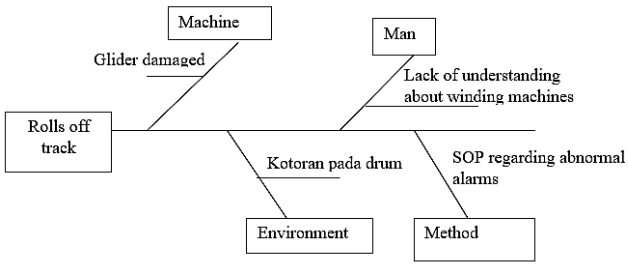

Figure 9. Fishbone Diagram Get off the Tracks

The image above is a cause-and-effect diagram of fishbone defects, stains on spools of thread caused by factors such as machines, materials and humans. To clarify in more detail the causes of the factors mentioned above, here is the explanation:

a. Machine

There was a failure in the glider, namely the cone winding place on the winding machine. Resulting in the end of the thread coming out of the line so that the machine rolls out the roll path that fits the cone.

b. Man

Winding machine operators who do not understand and are not careful in operating the winding machine. Because this winding machine runs automatically and will stop by itself if there is an abnormality. Sometimes this abnormality can be resolved by reactivating the machine again or requires further treatment. However, when the machine stops due to something abnormal, the operator immediately reactivates the winding machine without paying attention to the condition of each roll on the cone.

c. Method

There is a lack of implementation of SOPs regarding each abnormal alarm that occurs on the winding machine, because each abnormal alarm has its own cause and action that must be taken. As a result, due to the operator's ignorance, they only turn the machine back on if an abnormal alarm occurs.

d. Environment

There is dirt stuck to the winding machine in the drum section, which is a cylindrical part that has a rolling groove. This dirt sticks to the drum, thereby holding the thread out of the winding path.

3.4.3 A Roll of Tangled Thread

According to the results of observations and interviews with related parties. By carrying out a fishbone cause-and-effect analysis, the causes of the tangled roll defect were found. As previously explained, this defect is not captured in the cone reject data, therefore the author feels it is necessary to find out the cause of this tangled coil to suppress and prevent tangled coils from occurring.

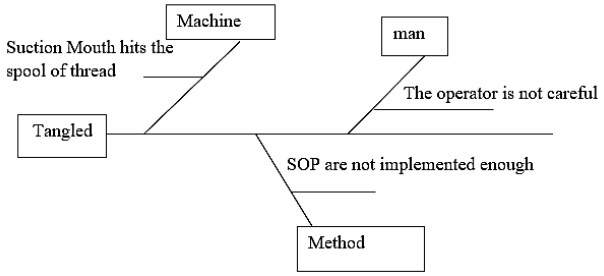

Figure 10. Fishbone Diagram A Roll of Tangled Thread

The image above is a cause-and-effect diagram of fishbone defects, stains on spools of thread caused by factors such as machines, materials and humans [14]. To

clarify in more detail the causes of the factors mentioned above, here is the explanation:

a. Machine

On the winding machine, the suction mouth section, the suction mouth functions to throw away the thread that is cut by the machine because it does not match the parameters. The suction mouth is too close to touch the spool of thread, so the thread is held by the suction mouth and causes tangles in the spool.

b. Man

Winding machine operators who do not understand and are not careful in operating the winding machine. Because this winding machine runs automatically and will stop by itself if there is an abnormality. Sometimes this abnormality can be resolved by reactivating the machine again or requires further treatment. However, when the machine stops due to something abnormal, the operators immediately activate the winding machine again without paying attention to the condition of each roll on the cone.

c. Method

It is not good to implement SOPs regarding each abnormal alarm occurring on the winding machine, because each abnormal alarm has its own cause and action that must be taken. As a result, due to ignorance, the operator immediately activates the winding machine again if an abnormal alarm occurs without investigating the alarm first.

3.5 *5 WHY Analysis*

The results of this research analysis were processed again using the 5 Why analysis method, by analyzing each factor that causes the problems above, we can find out the root of the problem [15].

Table 2. Results of the 5 Whys Analysis

No	Reject	WHY 1	WHY 2	WHY 3	WHY 4	WHY 5
1	Stain	Because the water coming out of the MCR machine is dirty	Because the layer is dirty	Because the layer cleaning is not correct	Due to employee negligence	Lack of supervision and checking
2	Rolls off track	Because the end of the thread is to the side of the reel	Because the glider does not stop and continuous to rotate during the cutting process	Because the glider was damaged	Lack of supervision	Lack of maintenance planning
			Because the operator is not careful	Because the operator only turns the knob and doesn't check it	Because the operator does not know the meaning of each abnormal alarm	There is no socialization or SOP
3	Tangled	Because the roll is stuck when the glider rotates	Because the suction mouth hits the surface of the roll	Because the distance setting on the suction mouth is not appropriate	Lack of maintenance	Lack of supervision from superiors

4. Conclusions

Based on the results of the research carried out, it was found that the factors that cause rejects in spools of thread produced at PT XYZ. The following are the errors that occur and their factors. Stains on the rolls occur on the MCR machine, this is caused by a lack of supervision and checking of the pallet layers to be used. There are layers and pallets that are dirty when they enter the MCR machine so that the water vapor becomes dirty and hits the surface and is absorbed by the yarn fibers, resulting in stains appearing on the yarn spools. The roll going out of track occurs on the winding machine because the glider is damaged so that during the thread cutting process the glider stops spinning for a long time resulting in the thread being wasted to the side so that when the operator starts the machine again, the roll comes out of the cone track. Apart from the cause of the glider being damaged, another cause is that the operator does not pay attention to each cone that is in the rolling process. Tangles occur due to the suction mouth touching the surface of the reel, resulting in the thread being stuck when the reel rotates. The distance parameter between the suction mouth and the coil is not correct so that when the coil increases in diameter, the coil will hit the suction mouth.

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