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Analysis of Cable Product Quality Control Using Statistical Quality Control (SQC) Methods At PT SCC Tbk.

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Abstract
As the largest cable manufacturing company in Indonesia, PT SCC Tbk. carry out the application of quality control on the products. The product manufacturing process must follow market or consumer quality standards but in the manufacturing process there are still product deviations. Based on the problems described, a Statistical Quality Control (SQC) analysis will be conducted in this study. Statistical Quality Control (SQC) analysis data collection methods are interviews, observation, and documentation. As a result of the observation, the visual deviation of the N2XCK2Y cable product is the highest deviation. The Statistical Quality Control (SQC) method uses 7 quality control tools to analyze kbel N2XCK2Y products, namely flowcharts, check sheets, histograms, Pareto charts, p control charts, sctter diagrams, and fishbone diagrams, which are then repaired using the 5W + 1H method. The samples used were 402 drums and 5 sources. The results of the study, the highest deviation occurred in the cable visual by 80% from other deviations, so it is a priority for repair. Based on the fishbone diagram and the results of the discussion, there are 7 factors that cause visual deviation and then take corrective action. From the repair results, there were no visual deviations on the N2XCK2Y cable.

Keywords: *Quality control, Statistical Quality Control, cable visual deviation, N2XCK2Y cable.*

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I. Introduction

The current demand for cables increase along with the construction of government electricity projects and the demand for transmission cables that are commonly used by the private sector for housing, building and industrial developments.Perusahaan Listrik Negara (PLN) opens a 35,000 MW project which is part of the government's efforts to sustain and encourage national economic growth, such as encouraging the emergence of new industrial centers [1].The Indonesian Electric Cable Factory Association (APKABEL) projects domestic production capacity to increase by 10% -15% from capacity at the end of 2018, driven by the increase in power cable factories to 24 units in 2019, previously 22 units [2].PT SCC Tbk. is one of the cable manufacturing industries in Indonesia.Companies that have and implement a good quality control system will be able to survive the competition[3]. A business that can delight customers by improving and controlling quality can dominate its competitors [4]. If the quality control carried out by a company is not good, it will cause additional costs, that is cost of quality control, and the level of damage to the resulting product is very low or the product is slightly damaged [5].A bad work environment causes productivity to be low so that it will have an impact on the quality of the product produced [6].Even so, there will always be product deviation. Deviation at PT SCC Tbk occurred more than the company targeted, namely 7 cases in 1 year. The most deviations in cable products were found in cable products type N2XCK2Y with 18 cases in 2018 and 22 cases in 2019 within 1 year that an be seen in Figure 1.

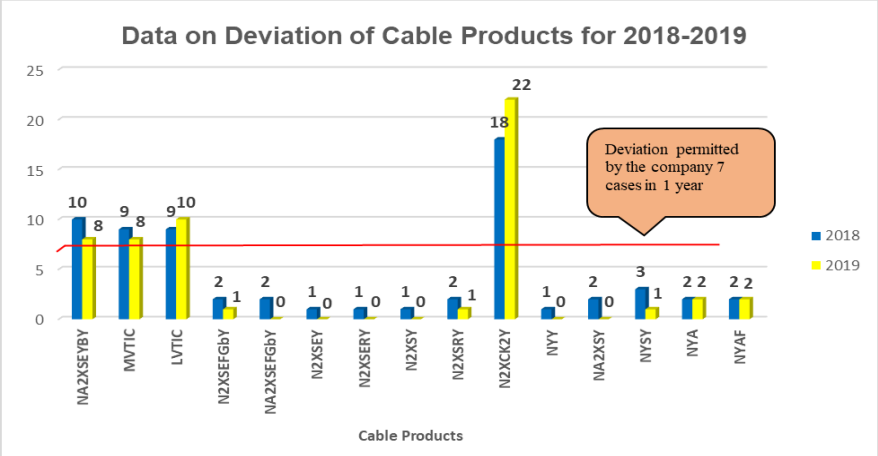

Figure 1. Product deviation data for 2018 and 2019

The highesttype of deviation of type N2XCK2Y cable products is in the visual section of the cable with the number of 32 cases or about 80% (Figure 2).

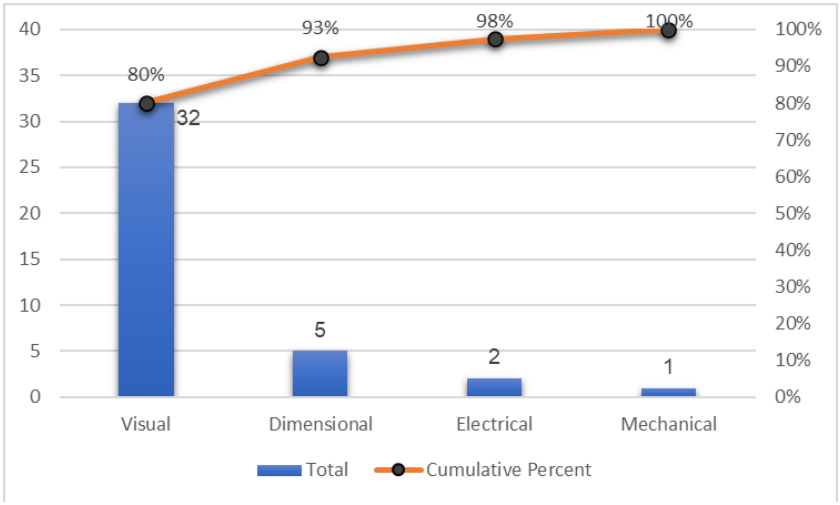

Figure 2. Types of deviation in cable products of type N2XCK2Y

Statistical Quality Control (SQC), which is a system developed to maintain standards of quality production, at a minimum cost level by using statistical methods to collect and analyze data [7].Quality has a correlation with the customer satisfaction and how company understand customer expectations [8].

II. Material and Methods

The methods of data collected by field observations, interviews, secondary data collection, documentation, and literature study. The population in this study is each batch process of N2XCK2Y cable products in 2018 and 2019, where for the process of N2XCK2Y cable products there is only 1 batch / day which produces 3 to 4 drums of N2XCK2Y cable products with a total population of cable products is 402 drums, and population, resource persons as many as 5 people.The analytical method used is Statistics Quality Control (SQC), which can make it easier to identify, analyze and solve various problems related to work and apply them in the company's operationalactivities [9]. The effective way to apply the SQC method is by using 7 Tools.The research stages are as follows [10]:

1) Determine the flow of quality control using a flowchart.
2) Collecting production data and defective products using a Check Sheet
3) Create a Histogram for easy reading or explaining data quickly
4) Determine the priority of improvement using the Pareto diagram
5) Creating a control chart (P-chart)
6) Making Scatter Diagram to test how strong the relationship between 2 variables is and determine the type of relationship.
7) Looking for the most dominant causative factors with a fishbone diagram

8) Make quality improvement proposals with 5W + 1H

III. Result and Discussion

3.1 Flowchart cable product quality control flow

Based on observations at PT SCC Tbk., quality control processes that will be carried out on cable products can be seen in Figure 3.

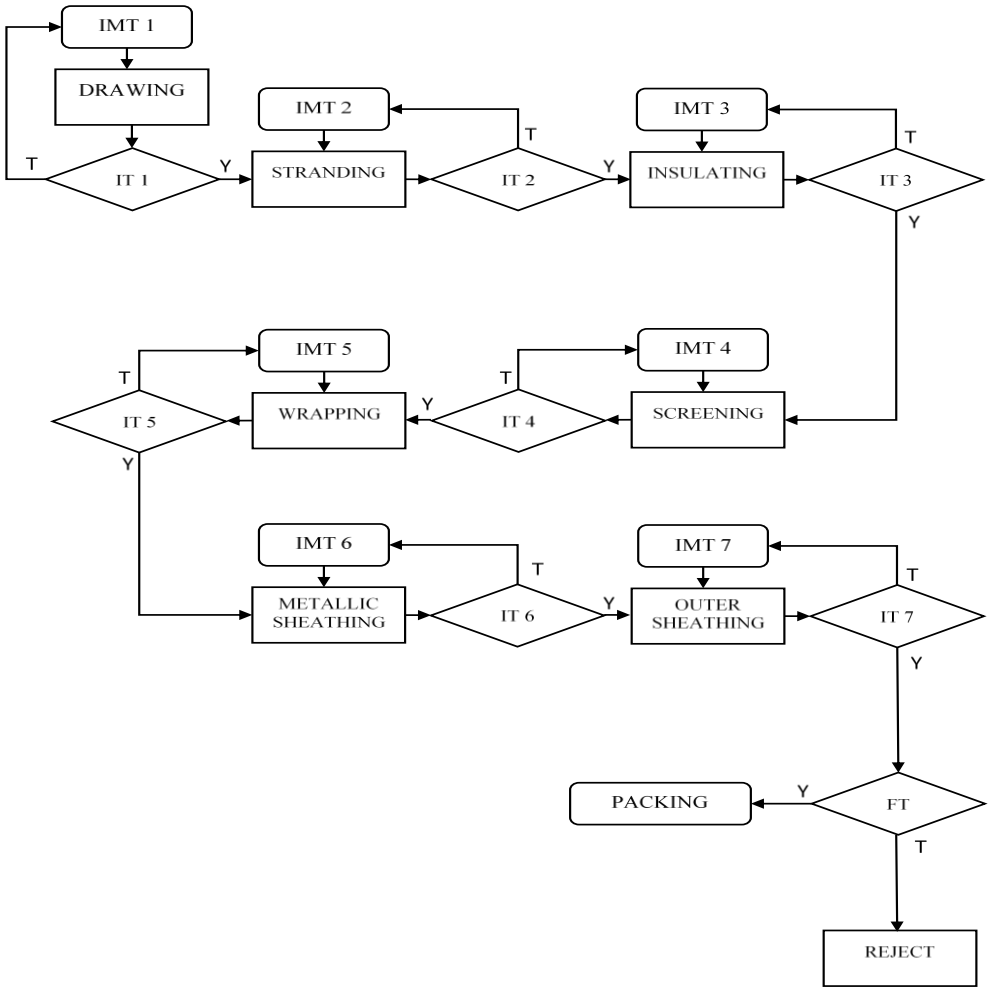

Figure 3. Cable product quality control process

Note :
IMT : Incoming Material Test
IT : Intermediate Test

FT : Final Test

3.2 Collecting data with Check Sheet

Check sheets are useful for knowing problem areas based on the frequency of the types or causes and making decisions to make improvements or not. The results of data collection with a check sheet for cable type N2XCK2Y in 2018 and 2019 can be seen in Table 1.

Table 1. Number of N2XCK2Y cable defect in 2018 and 2019

No	Month	Year	Total of Production (Drum)	Type of Defect				Total of Defect (Drum)	Percent of Defect (%)
				Visual	Dimensional	Electrical	Mechanical		
1	January	2018	29	1	0	0	0	1	3.45
2	February	2018	27	3	1	0	0	4	14.81
3	March	2018	32	4	1	0	0	5	15.63
4	April	2018	31	4	0	1	1	6	19.35
5	May	2018	19	2	0	0	0	2	10.53
6	February	2019	36	1	0	0	0	1	2.78
7	March	2019	42	2	1	0	0	3	7.14
8	April	2019	42	1	0	1	0	2	4.76
9	May	2019	25	7	1	0	0	8	32.00
10	June	2019	37	3	1	0	0	4	10.81
11	August	2019	15	0	0	0	0	0	0.00
12	September	2019	24	2	0	0	0	2	8.33
13	October	2019	31	2	0	0	0	2	6.45
14	November	2019	12	0	0	0	0	0	0.00
	Total		402	32	5	2	1	40	9.95

3.3 Create a Histogram

To make it easier to see more clearly the types of deviations that occur according to the table above, the next step is to make a histogram in Figure 4

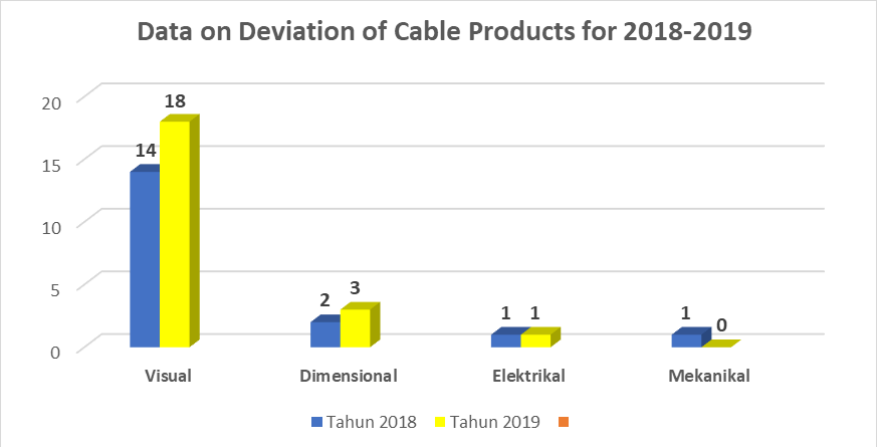

Figure 4. N2XCK2Y cable deviation data for 2018-2019

3.4 Determine the priority of improvement using the Pareto diagram

To determine the priority for improvement based on the greatest number of deviations, a Pareto diagram can be used as follows in Figure 5.

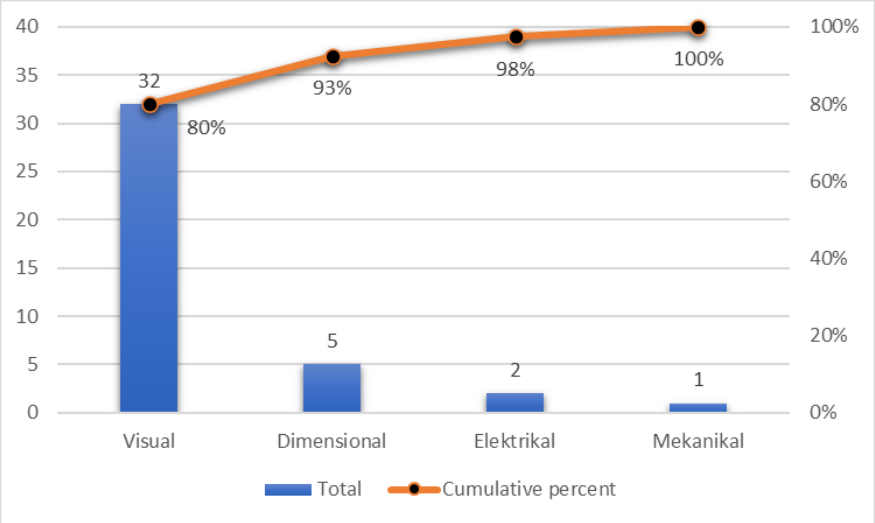

Figure 5. Deviation improvement priorities for 2018 to 2019

3.5 Creating a control chart (P-chart)

Based on the data in Table 1, then the data were analyzed to determine the extent to which the disability occurred was still within the limits of statistical control with a control chart. The steps in making p control chart are as follows [11]:

1) Calculating the percentage of deviation with formula

$$p = \frac{\text{np}}{\text{n}}$$

2) Calculating the center line (CL) with formula

$$CL = (\bar{p}) = \frac{\Sigma \text{np}}{\Sigma \text{n}}$$

3) Calculating the upper control limit (UCL) with formula

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

4) Calculating the lower control limit (LCL) with formula

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

The P-Charts can be seen in Figure 6.

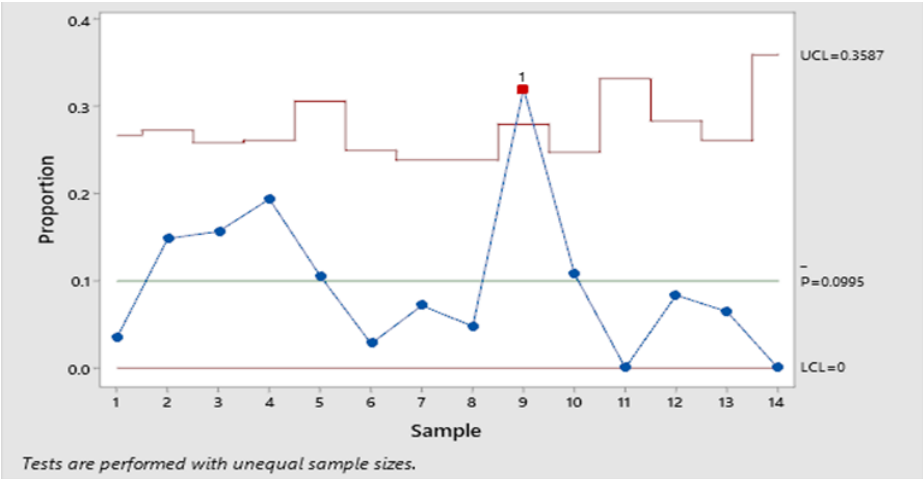

Figure 6. P-Chart wiring product deviation

Based on Figure 6, it can be seen that there is data that is outside the control limits, namely at point 9 with a total production of 25 drums which has a total of 7 drums of visual deviation. The case of visual deviation that occurred in May 2019 can be seen in Figure 7 below:

Figure 7. Visual deviation in May 2019

By looking at the visual deviations that occur in the N2XCK2Y cable product, it can be seen that the occurrence of visual deviation of the cable product occurs during the processing in the PEX 175 extrusion machine, so that the possible causes for the visual occurrence are focused on the PEX 175 extrusion machine.Based on the May 2019 Process and Production Report (PPR) data and a visual check of each N2XCK2Y cable product, it is known that visual deviations only occur on one end of the cable, and at the end of each production batch. From the visual deviation that occurs, a thin slice of cable sheath is sampled which is then viewed on the projector profile as in Figure 8 to ensure the shape of the visual deviation of the N2XCK2Y cable.

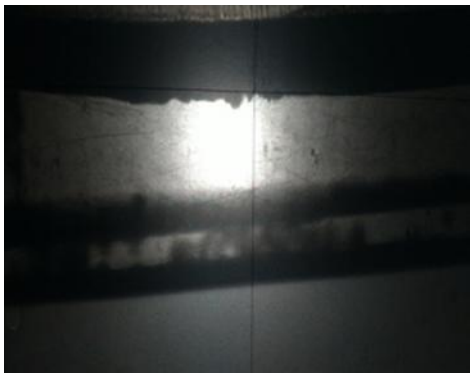

Figure 8 Slice of sheath on profile projector

Based on Figure 8, the most likely cause of visual deviation on the PEX 175 extrusion machine is the tube process. At the end of the production process of each batch, it is suspected that the water in the tube process is reduced due to the damage to the rubber seal which causes leakage in the tube process so that the ends of the cables at the end of each batch are not submerged by water, while the cable is still hot due to the extrusion process. so that when in contact with the rubber seal the visuals is not smooth.

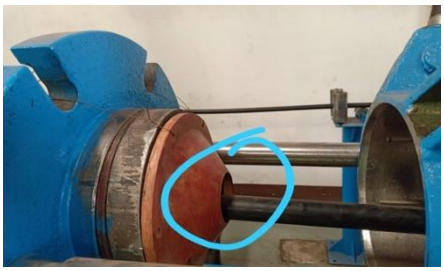

Figure 9. The part of the tube process that leak

The next step is to replace the damaged rubber seal with a new rubber seal as shown in Figure 10 as follows.

Figure 10. Seal Rubber

After replacing the rubber seal, to find out the results of the repair on the tube process that had been carried out, a sample of 25 drums was taken based on the production output in May 2019 to re-process the cable sheath and then inspect the cable until the packing process. The inspection result data of 25 drums can be seen in Table 2, the calculation of the control limit for the repair results as follows.

Table 2. Data of cable deviation after improvement

No	Month	Year	Total of Production (Drum)	Type of Defect				Total of Defect (Drum)	Percent of Defect (%)
				Visual	Dimensional	Electrical	Mechanical		
1	January	2018	29	1	0	0	0	1	3.4
2	February	2018	27	3	1	0	0	4	14.8
3	March	2018	32	4	1	0	0	5	15.6
4	April	2018	31	4	0	1	1	6	19.4
5	May	2018	19	2	0	0	0	2	10.5
6	February	2019	36	1	0	0	0	1	2.8
7	March	2019	42	2	1	0	0	3	7.1
8	April	2019	42	1	0	1	0	2	4.8
9	May	2019	25	3	0	0	0	3	12.0
10	June	2019	37	3	1	0	0	4	10.8
11	August	2019	15	0	0	0	0	0	0.0
12	September	2019	24	2	0	0	0	2	8.3
13	October	2019	31	2	0	0	0	2	6.5
14	November	2019	12	0	0	0	0	0	0.0
	Total		402	28	4	2	1	35	8.7

From the results of the improvements that have been made, it can be seen in number 9, the output in May 2019 with a total production of 25 drums, the number of visual deviations that occurred was 3 drums with a deviation percentage of 12% from 32% previously. Theresults of the repair on the tube process can reduce the percentage deviation by 20%.From the data in table 2, then a P control chart can be made as shown in Figure 11 below.

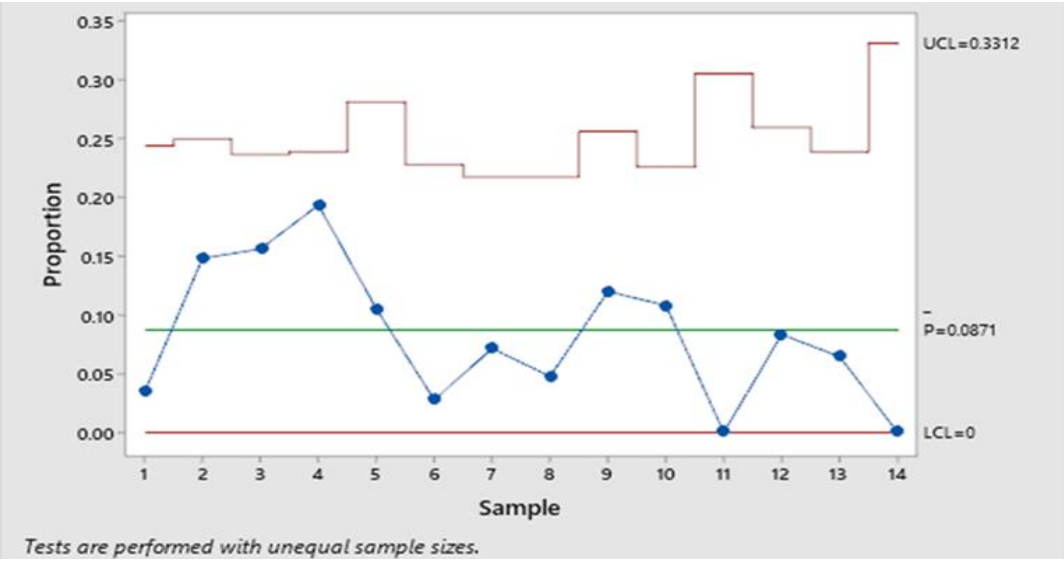

Figure 11. Control chart of product deviation after improvement

Based on the p control chart graph in Figure 11, the deviation of cable products that occurred at point number 9 output in May 2019 is already below the upper control limit (UCL). Thus, the quality of the cable product production process after corrective action can be said to be very good. However, there are still visual aberrations that are caused outside the area of the PEX 175 extrusion machine so that repairs need to be made to minimize the occurrence of visual deviations.

3.6 Make a Scatter Diagram

In this study, the variable being tested is the variable number of deviations from 2018 to2019 with the variable number of cable product production in 2018 to 2019 (Figure 12).

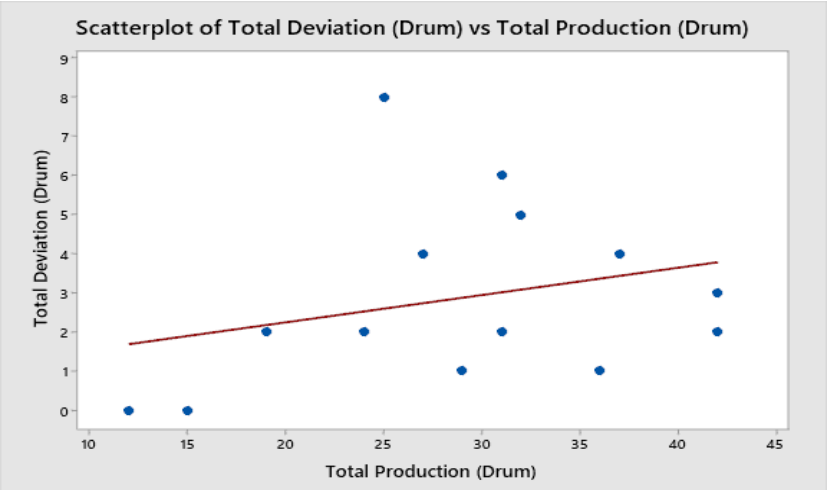

Figure 12. Scatter diagram of the number of wiring product deviations

Figure 12shows that the amount of deviation of cable products with the number of cable product production has a correlation value (R) of 7.6%, so it can be said that the amount of deviation in cable products that occurs with the number of cable product production has no correlation.

3.7 Make a Fishbone Diagram

Before make a Fishbone Diagram, to find out the cause of visual deviation in N2XCK2Y cable products, interviews to 5 employees. After knowing the cause of visual deviation on the N2XCK2Y cable product, you can make a fishbone diagram in Figure 13.

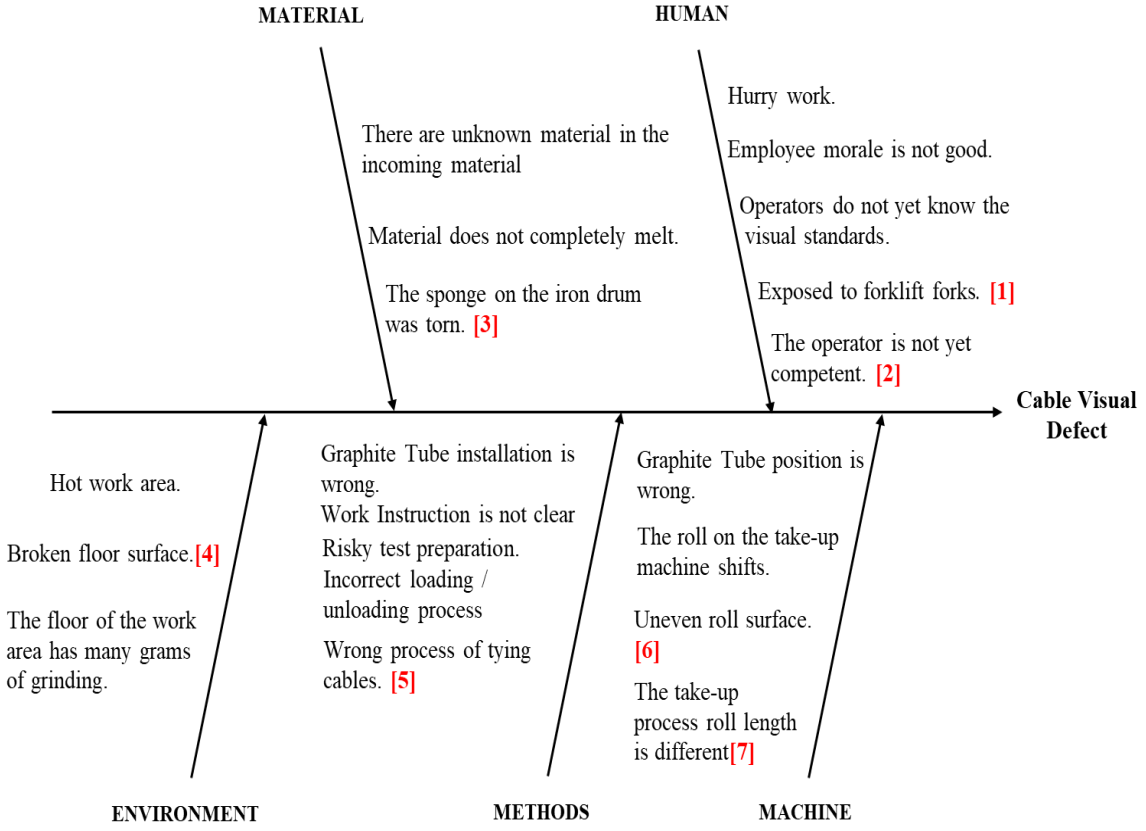

Figure 13. Fishbone diagram of cable visual defect

Based on the results of the analysis of the cause and effect diagram (Fishbone diagram) by discussions, there are 7 factors that cause problems that cause visual deviation/defect of cable products, namely:

1) Exposed to a forklift fork
2) Operators are not yet competent
3) The sponge on the iron drum was torn
4) Broken floor surface
5) Wrong process of tying cable
6) Uneven roll surface
7) The take up process roll length is different.

3.8 Make quality improvement proposals with 5W + 1H

After the dominant cause is identified, the next step is to plan and implement corrective actions. To facilitate the process of implementing corrective actions, it is necessary to plan corrective actions by following the 5W + 1H that can be seen in Table 3. Basically, 5W + 1H method can be used as a tool to make the proposed problem fix [12].

Table 3. Quality Improvement with 5W + 1H

No	FACTORS	WHY	WHAT	WHERE	WHEN	WHO	HOW
1	Exposed to forklift forks	To keep the cable visually from being scratched.	Create work instructions, and add co-workers	Testing Area, PEX 175 Machine	June 2020	Jainudin	Explain work instructions and give 1 co-worker to supervise.
2	The operator is not yet competent	So that operators understand about quality	Provide training	Testing Area, PEX 175 Machine	June 2020	Jainudin, and Rabby	Provide training on N2XCK2Y cables and briefings once a week.
3	The sponge on the iron drum was torn.	To close the rough parts on the iron drum	Add a layer of sponge	Testing Area	July 2020	Jainudin	Provide a cushion layer on the inner side of the iron drum.
4	Broken floor surface	To make cables secure when rubbing against the floor	Epoxy the floor	Testing Area	July 2020	Jainudin	Applying Epoxy floor to the entire Testing Area
5	Wrong process of tying cables	To keep the cable visually from being injured	Adding winch	Unroll Packing	July 2020	Julianto	The process of tying cables using a winch
6	Uneven roll surface	To keep the cable visually from being scratched.	Change the roll	*Unroll Packing*	July 2020	Julianto	Replace with a flat roll surface
7	The take-up process roll length is different	To make the take-up process stable	Change the roll	PEX 175 Machine	July 2020	Panggih	Change rolls that has the same length

IV. Result and Findings

After improvement, from the data obtained, there were no visual deviations in the N2XCK2Y cable product in the period August to November 2020, where in 2018 there were 14 cases of visual deviation of cables, in 2019 there were 18 cases of visual deviation of cables (Table 4).

Table 4. Number of N2XCK2Y cable deviations 2018-2020

No	Month	Year	Total of Production (Drum)	Type of Defect				Total of Defect (Drum)	Percent of Defect (%)
				Visual	Dimensional	Electrical	Mechanical		
1	January	2018	29	1	0	0	0	1	3.4
2	February	2018	27	3	1	0	0	4	14.8
3	March	2018	32	4	1	0	0	5	15.6
4	April	2018	31	4	0	1	1	6	19.4
5	May	2018	19	2	0	0	0	2	10.5
6	February	2019	36	1	0	0	0	1	2.8
7	March	2019	42	2	1	0	0	3	7.1
8	April	2019	42	1	0	1	0	2	4.8
9	May	2019	25	3	0	0	0	3	12.0
10	June	2019	37	3	1	0	0	4	10.8
11	August	2019	15	0	0	0	0	0	0.0
12	September	2019	24	2	0	0	0	2	8.3
13	October	2019	31	2	0	0	0	2	6.5
14	November	2019	12	0	0	0	0	0	0.0
15	Jule	2020	11	0	0	0	0	0	0.0
16	August	2020	21	0	0	0	0	0	0.0
17	September	2020	20	0	0	0	0	0	0.0
18	October	2020	15	0	0	0	0	0	0.0
	Total		469	28	4	2	1	35	7.5

V. Conclusions

By looking at the flowchart, the series of cable product quality processes at PT SCC Tbk is carried out at each stage of the cable product process. Every process starting from the drawing process to the outer casing is subjected to an incoming material test and an intermediate test to ensure product quality is up to standard. The data obtained from the check sheet shows that the total production of N2XCK2Y cables for the period 2018 to 2019 is 402 drums with a total deviation of 40 drums. Histogram data is made based on check sheet data for the period 2018 to 2019, visual deviation is the highest deviation.By looking at the pareto diagram, the highest deviation of N2XCK2Y cable for the period 2018 to 2019 is visual deviation with 32 cases or 80% of the total deviation of N2XCK2Y cable products.The control chart shows that there are points that are out of control that occurred in May 2019 with a total production output of 25 drums and a number of deviations of 8 drums with a deviation proportion value of 0.320 with an upper limit of 0.279.he scatter diagram shows that the large number of deviations from 2018 to 2019 has no correlation with the amount of cable product production from 2018 to 2019 because the correlation value (R) is 7.6%.From the results of the discussion, it was agreed that there were 7 factors that were most dominant in the occurrence of visual deviation of N2XCK2Y cables, that is exposure to forklift forks, incompetent operators, broken sponges on iron drums, damaged floor surfaces, wrong cable tying process, uneven roll surface, and the roll length of the take-up process is different.The Statistical Quality Control (SQC) method is able to reduce the level of visual deviation in cable products at PT SCC Tbk.

VI. Recommendation

The quality control processes is maintained because the incoming material test and intermediate test are filters for irregularities in the finished productso as to minimize the occurrence of deviations that will occur.Companies need to use statistical data to be able to find out the types of deviations that occur and the number of deviations that occur in cable products.If the deviation that occurs exceeds the limits allowed by the company, the company must immediately take quality improvement action.Quality improvement can be prioritized based on the highest number of deviations. By looking at the point of the highest deviation, the company can look for the causative factors associated with when the highest deviation occurred.The company can measure the level of correlation between 2 variables such as the amount of production with the number of deviations, the number of machine failures with the number of deviations, or the number of workers with the number of deviations by using a scatter diagram.The company can determine the factors causing the deviation by using a cause and effect diagram (fishbone diagram). The 5W + 1H improvement methods can be applied to solve the cable product deviation that occurs.

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