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Analysis of Quality Control to Reduce Defect Products in Steel K-015 Cable Using DMAIC Method at PT. SUCACO, TBK

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Abstract:- PT. Supreme Cable Manufacturing & Commerce Tbk, (PT. SUCACO) is a national company that is diverse in manufacturing that produces various types of cables, one of which is STEL K-015 Cable. The problem that occurs is when there is a defect when making the product. because at the time of production at PT. Supreme Cable Manufacturing & Commerce Tbk there are still products that do not meet the prescribed standards. This situation can result in increased production costs and a decrease in product quality which ultimately reduces profits for the company. In the process of making the product defects during October 2018 - March 2019 To improve quality, researchers use the six sigma method which consists of five stages. This stage is known as DMAIC which stands for the abbreviation stands for each stage, namely define, measure, analyze, improve, and control. Admittedly, there are 4 types of defects based on data processing, namely the type of leather defect, rough cable with a percentage of 14%, imperfect printing, percentage of 19%, loose buffer iron 40% and fiber breaking with a percentage of 27%. Then for the sigma value in the product production process, it is calculated to be 4 during that period. Based on the calculation table of FMEA Part Wire Metal Connector on the outer sheath machine that does not work optimally, it is the cause of product defects with the highest RPN value. Based on the research that has been done, it can be concluded that the type of iron buffer defect which is the dominant defect with a percentage of 40%. While the factors that cause defect are 4 factors, namely human, machine, material and method. Then the proposed improvements that can be given are the leading machine checks on the outer sheath engine, more regularly carrying out machine maintenance regularly, providing training to workers to improve work skills.

Keywords:- *DMAIC (Define, Measure, Analyze, Improve, Control), Quality, Pareto Diagram, Fishbone Diagram, FMEA, Product Defect.*

I. INTRODUCTION

A. Background

One important effort to be able to excel in industrial competition in the current global market is to give full attention to the quality of products produced, in order to meet international quality management standards. A company will succeed in reaching the market if the quality or quality of the product is good, but still pay attention to other aspects such as the selling price that can compete and also service to consumers. Product quality is good or not depends on the factors that influence it such as the quality of the raw material of the product being produced, the condition of the engine is good, the good human resources are skilled physical and spiritual operators, who can work effectively producing a product for the company. Quality is defined as the consistency of improvement or improvement in a product (goods and services) that is produced in order to meet the requirements that have been specified, in order to increase internal or external customer satisfaction. Based on the basic understanding of quality, it appears that quality is customer focused (customer focused quality). Quality in statistical process control is how well an item or service meets the specifications and tolerances set by the design part of the company.

PT. Supreme Cable Manufacturing & Commerce Tbk, (PT. SUCACO) which has now proven to be a high-quality cable factory in Indonesia. PT. SUCACO has become a cable manufacturer that supplies cable needs to large companies such as PLN, Telkom, etc. But the fact is that when making a production process in a factory there are things that are not cold like products that do not meet company standards, even though the company itself has carried out activities to maintain the quality standards of the products produced.

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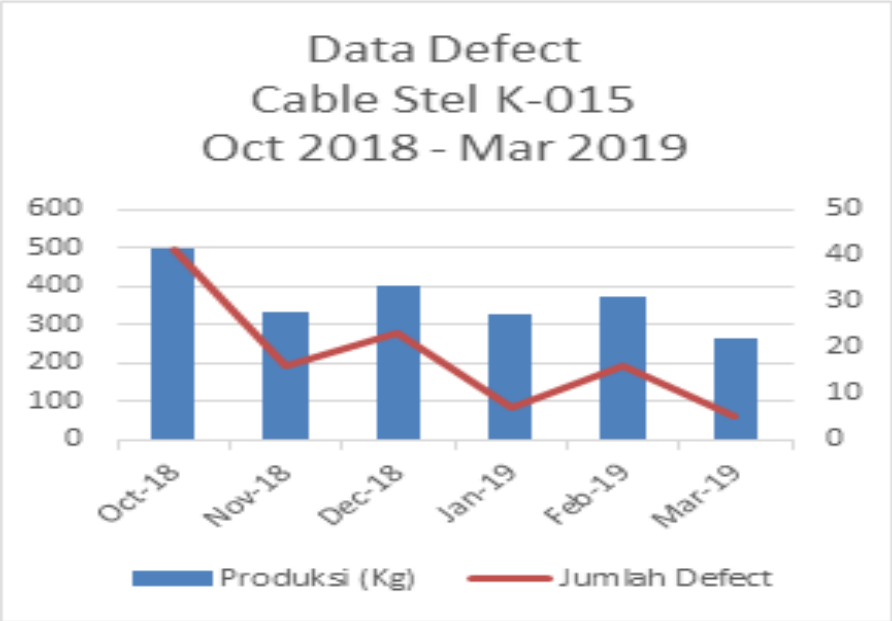

Fig 1:- Defec Cable

From the graph above, there is still an unstable number or fluctuation in the number of defect products on the K-015 Stel cable.

B. Formulation of the Problem

1. What types of defects affect the K-015 Stel cable product?
2. How do you repair the defects that occur in the Stel K-015 cable product using the DMAIC (Define, Measure, Analys, Improvement, Control) method?

C. Research Purposes

1. Know the type of defect that affects the K-015 Stel cable product
2. Propose improvements to defects that occur in the K-015 Stel cable product using the DMAIC method (Determine, Measure, Analyze, Repair, Control)

D. Scope of Problem

1. This research is only carried out on STEL K-015 Cable Products
2. Data - data obtained and used are product defect data originating from the Quality Control and Quality Assurance department of PT SUCACO in the period October 2018 - March 2019
3. The method approach only covers DMAIC (Define, Measure, Analys, Improvement, Control)
4. This research is not related to the cost and time of the production cycle.

II. LITERATURE REVIEW

A. Quality

According to Deming (2009) Quality is conformity with market needs. If Juran defines quality as fitness for use and Crosby as conformance to requirement, then Deming defines quality as conformity to market or consumer needs. Companies must really be able to understand what consumers need for a product that will be produced.

B. Six Sigma

Six Sigma is defined as a high-tech method used by engineers and statistics to improve / develop processes or products (Hidayat, 2008). The purpose of Six Sigma is to help people and processes to have high aspirations to deliver defect-free products and services. The term zero defect does not apply here. Six Sigma realizes that there is always the potential for defects, even in processes that run well or in well-made products.

C. DMAIC

DMAIC is an approach used by Six Sigma in the form of five stages of problem solving namely define, measure, analyze, improve, and control. The DMAIC method is a process that aims to make continuous improvements to Six Sigma targets (Gaspersz, 2011). The five steps that must be taken when doing the DMAIC method are Define, Measure, Analyze, Improve, Control.

ISSN No:-2456-2165

III. METHOD

In this study to meet or achieve the research objectives in order to complete the final assignment, the types of data and information needed, among others:

A. Primary Data

According to Sugiyono (2012) explaining the type of primary data is a source of data that directly provides data to data collectors. Primary data collection in this study includes:

a. Data from the FMEA questionnaire conducted by the head of production, quality assurance at PT SUCACO.
b. Interview regarding the general description of the production process at PT SUCACO.
c. The interview on the description of the types of defects occurred in the production process on the K-015 Stel cable products
d. Information about the general description of PT SUCACO company.

B. Secondary Data

According to Sugiyono (2012) secondary data is data obtained by reading, studying and understanding through other media sourced from literature, books, and company documents. Secondary data collection in this study includes:

a. Data on the number of defects on the K-015 Stel cable in the period October 2018 - March 2019.
b. Data on the number of types of defects in K-015 Stel cable products for the period October 2018 - March 2018.

IV. RESEARCH RESUL AND DISCUSSION

PT. SUCACO manufactures various types of cables. During the production of these types of cables can not avoid the existence of defects in the product. The following is the data on the number of defects and the number of production of K-015 Stel cables for the period October 2018 - March 2019:

NO	Month - Year	Produksi (Kg)	Jumlah Defect (Kg)
1.	Okt-18	500	41
2.	Nov-18	335	16
3.	Des-18	400	23
4.	Jan-19	325	7
5.	Feb-19	375	16
6.	Mar-19	265	5

Table 1:- Data on the Number of Defects and Production of K-015 Stable Cables

Based on table 1, it can be seen that there is a defect that occurs every month during the production period of the K-015 Stel cable for the period October 2018 - March 2019. There are several types of defects that occur in the K-015 Stel cable product. The types of defects that occur are classified by the Quality Control division of PT. SUCACO through the test results before the packaging process. The following is the data on the number of defects based on the type of defect that occurred in the period October 2018 - March 2019:

Jenis Defect	**Jumlah Defect**
Loose Buffer Iron	43
Broken Leather Cord	29
Fiber Disconnect	21
Printing is not perfect	15

Table 2:- Data on Defect Amount Based on Type of Defect Cable K-015

A. Define (D)

The first step in improving quality with the Six Sigma method is to define. Define formally defines the goal of improving processes that are consistent with the needs or desires of customers (Gaspersz, 2010). At this stage the tools used are SIPOC and CTQ diagrams.

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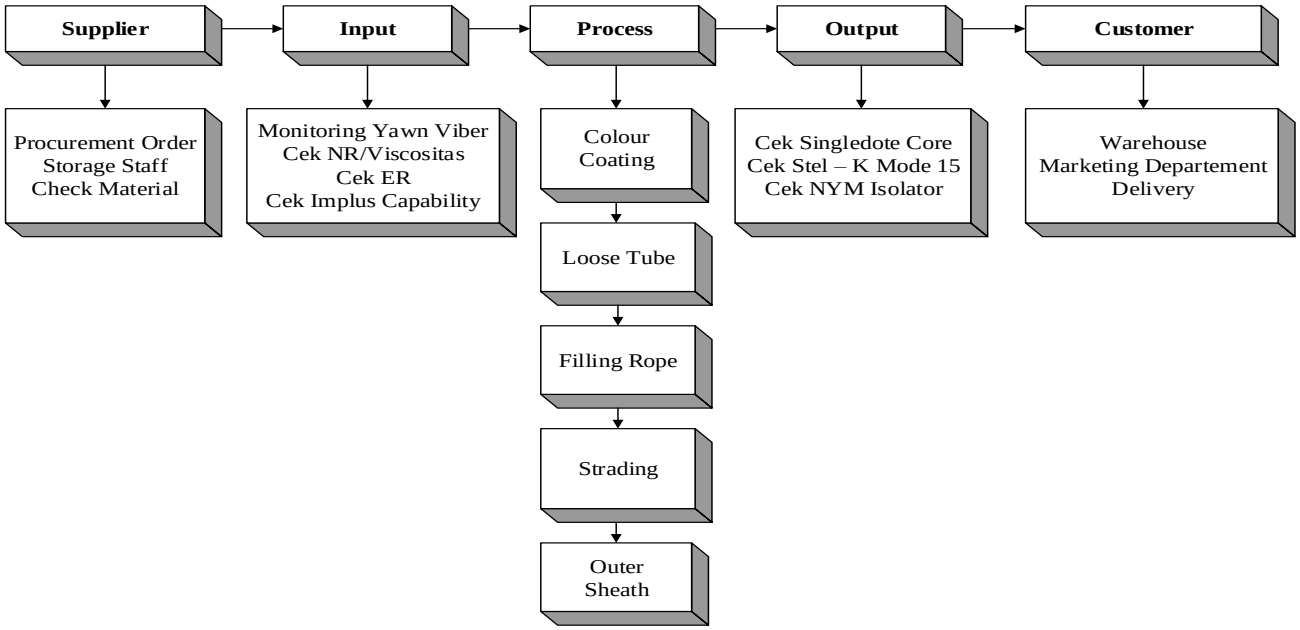

Fig 2:- Diagram SIPOC

➢ *CTQ (Critical To Quality) identification*

Before knowing the CTQ through the VOC, we also need to know the types of defects that occur in the Stel K-015 cable products, which include the following:

1. Not Perfect Printing
2. Separate Buffer Iron
3. Fiber Disconnect
4. Rough / Bolted Cable Leather

B. Measure (M)

➢ *Determining Sigma Levels*

To find out the Sigma Level of K-015 Stel cable products at PT. SUCACO needs to be calculated in advance, so that it is necessary to know in advance the DPO value, which then looks for the DPMO value with the following formula:

- Rumus DPU (*Defect per Unit)*
- ➢ $DPU = \frac{Total\ Defect}{Total\ output}$
- ➢ $DPU = \frac{41}{500}$
- ➢ $DPU = 0{,}082$

- Rumus DPO (*Defect per Opportunity)*
- ➢ $DPO = \frac{DPU}{Total\ CTQ\ Potensial}$
- ➢ $DPO = \frac{0{,}082}{4}$
- ➢ $DPO = 0{,}0205$
- Rumus DPMO (*Defect per Millioin Opportunity)*
- ➢ $DPMO = DPO\ x\ 1.000.000$
- ➢ $DPMO = 0{,}0205\ x\ 1.000.000$
- ➢ $DPMO = 20{,}500$

For complete calculations can be seen in table 3 below as follows:

NO	Month - Year	Produksi (Kg)	Defect (Kg)	DPO	DPMO	DPU
1.	Okt-18	500	41	0,021	20500	0,08
2.	Nov-18	335	16	0,012	11940,3	0,05
3.	Des-18	400	23	0,014	14375	0,06
4.	Jan-19	325	7	0,005	5384,615	0,02
5.	Feb-19	375	16	0,011	10666,67	0,04
6.	Mar-19	265	5	0,005	4716,981	0,02

Table 3:- Calculation of DPMO Value

ISSN No:-2456-2165

After the DPU and DPMO values are known, then calculate the probability value of the product not defective (Yield), with the following formula:

Yield formula

- $Yield\% = e^{-DPU} \; x \; 100$
- $Yield\% = 2{,}7183^{-0{,}08} \; x \; 100$
- $Yield\% = 92,\%$

NO	Month - Year	Produksi (Kg)	Defect (Kg)	DPU	YIELD
1.	Okt-18	500	41	0,08	92%
2.	Nov-18	335	16	0,05	95%
3.	Des-18	400	23	0,06	94%
4.	Jan-19	325	7	0,02	98%
5.	Feb-19	375	16	0,04	96%
6.	Mar-19	265	5	0,02	98%

Table 4:- Calculation of Yield Value

In the above tables it is known the value of the DPMO value until the probability of the product is not defective (Yield) on cable products. Next, determine the sigma value by converting the DPMO value using the sigma conversion table or by using the following formula:

- Rumus Menentukan Level Sigma
- normnsiv((1000000-DPMO)/1000000)+1,5
- normnsiv((1000000-20,500)/1000000)+1,53,55

To be able to find out the complete calculation of the sigma level, it can be seen in table 5 below as follows:

NO	Month -Year	Produksi (Kg)	Defect (Kg)	DPU	DPO	DPMO	YIELD	Sigma Level
1.	Oct-18	500	41	0,08	0,021	20500	92%	3,5
2.	Nov-18	335	16	0,05	0,012	11940,3	95%	3,8
3.	Dec-18	400	23	0,06	0,014	14375	94%	3,7
4.	Jan-19	325	7	0,02	0,005	5384,615	98%	4,1
5.	Feb-19	375	16	0,04	0,011	10666,67	96%	3,8
6.	Mar-19	265	5	0,02	0,005	4716,981	98%	4,1
TOTAL		2200	108	AVERAGE		11263,93	96%	4

Table 5:- Sigma Value

C. Analysis (A)

The next step after measure is analyze. At this stage an analysis of the problems that occur in the K-015 Stel cable products at PT. SUCACO Indonesia after the calculation was done at the measure stage. It is expected that at this stage the biggest defect in the K-015 Stel cable product and the factors that cause this defect will be known.

The following is data processing in the making of Pareto diagrams based on data on the type of defect of K-015 Stable Cable products for the period October 2018 - March 2019 at PT.SUCACO, namely:

Type of defect	Defect	Presentase (%)	Presentase Kumulatif (%)
Loose Buffer Iron	43	40%	40%
Fiber Disconnect	29	27%	67%
Printing is not perfect	21	19%	86%
Broken Leather Cord	15	14%	100%
Total	108		

Table 6:- Calculation of Cumulative Percentages

- Persentase $= \frac{Defect \text{ per Jenis } Defect}{\text{Total } Defect} \; x \; 100\%$
  - Persentase $= \frac{43}{108} \; x \; 100\%$
  - Persentase $= 0{,}398 \; x \; 100\%$
  - Persentase $= 40\%$
  - Persentase Kumulatif = Percentage of the period + Previous cumulative percentagePersentase Kumulatif = 40% + 0
  - Persentase Kumulatif = 40%

After calculation, the next step is to make a pareto diagram based on the percentage of defects and the cumulative percentage, which can be seen in Figure 3 as follows:

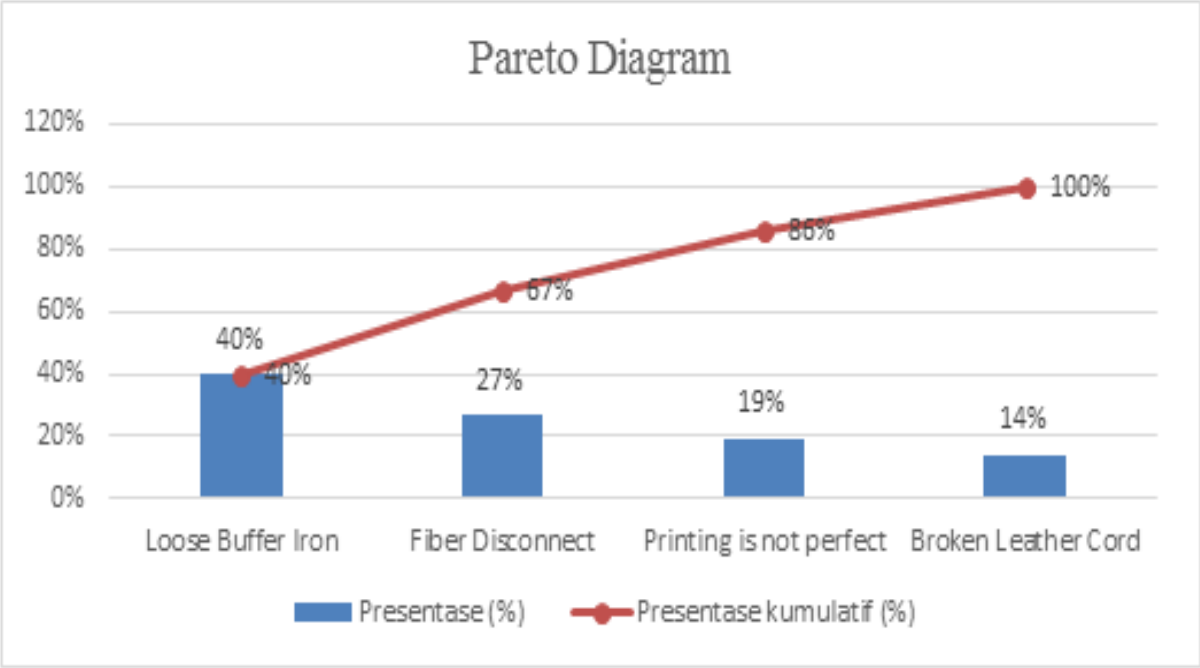

Fig 3:- Pareto Diagram

It can be seen in Figure 3, above that it can be seen that the dominant type of defect in the K-015 Stel cable product at PT. SUCACO is a loose buffer with a percentage reaching 40%, therefore the type of defect needs to be used as a focus for repairs.

- *Fish Bone Diagram (Fishbone Diagram)*

Based on the results of calculations that have been done before, it can be seen in the Pareto diagram that the largest type of defect in the production of the K-015 Stel cable at PT. SUCACO Indonesia is loose buffer iron. To be able to find out the causes of the defect of loose buffer iron on the production of Stel K-015 cable, analysis is needed using diagrams fishbone. The following are the results of the analysis using a fish bone diagram.

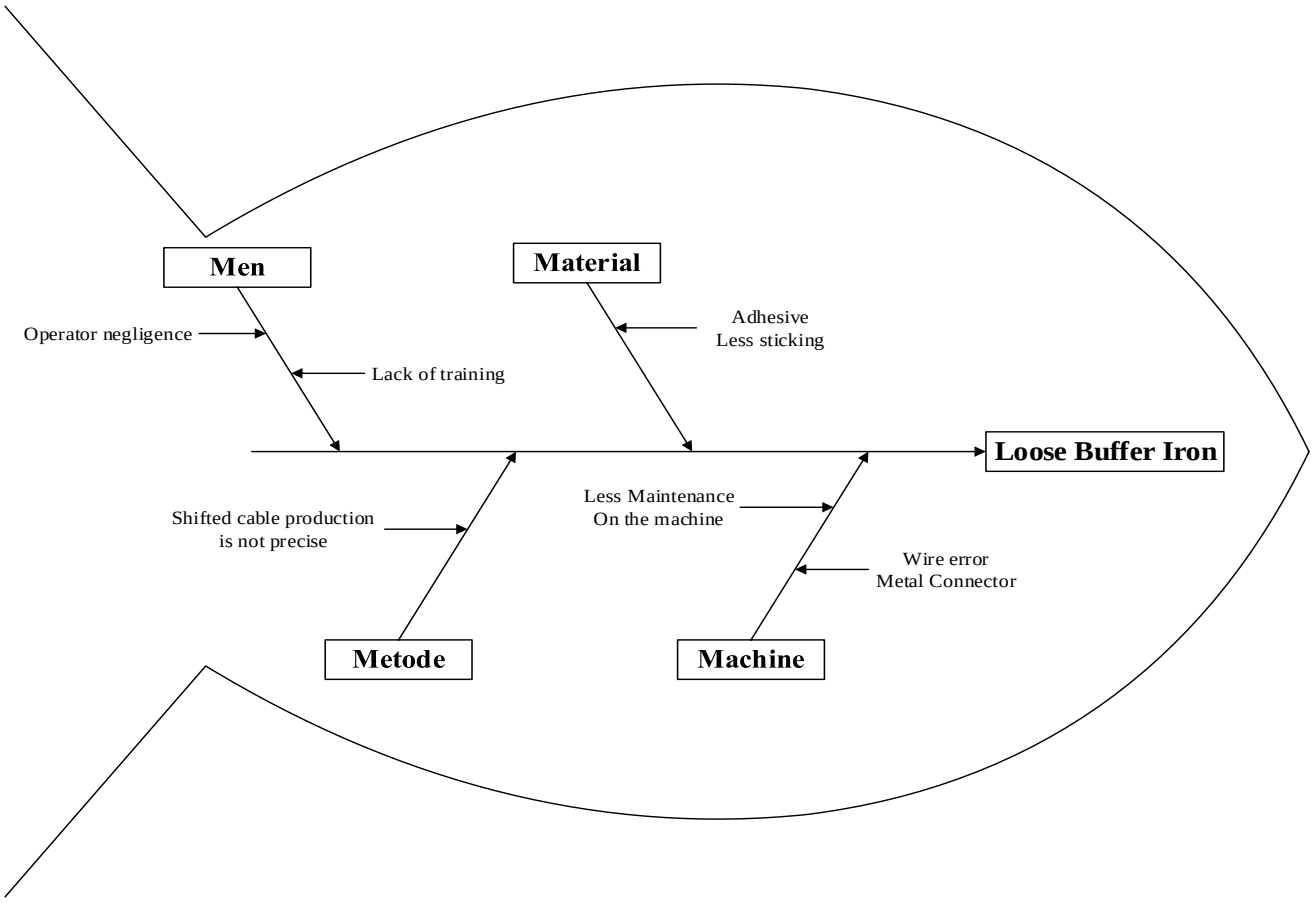

Fig 4:- Fishbone Diagram

D. Improve (I)

Failure mode and effect analysis (FMEA) To analyze and determine the focus of the problem as well as priority steps for improvement. Assessment for each factor in FMEA is the severity of failure (saverity), frequency of failure (occurance), and the level of detection (detection) is done by dividing the results of expert ratings. intended to facilitate assessment without expert dominance in research and provide feedback effects (Atilla, 2014). The experts / experts selected to fill out the questionnaire are:

1. The person in charge of the K-015 Stel Cable production process
2. Has approximately 15 years of experience in handling the K-15 Stel Cable production process
3. Already know the problems that occur in depth and make improvements when a production process problem occurs. People who are in the above criteria are head of production, head of Quality Assurance, and Head of Factory. With the following information:

KP: Head of Production
QA: Head of Quality Assurance

Causes of Defect	Saverity	Occurance	Detection	RPN	RANK
Operator negligence	3	2	3	18	6
Lack of training	5	3	3	45	4
Adhesives are less sticky	4	5	4	80	1
Shifted cable production is not precise	5	2	5	50	3
Wire error metal connector	3	3	4	36	5

Table 7:- Calculation of Score and Rank of FMEA

Examples of FMEA Score Calculations Table 7 as follows:

RPN = 3 X 2 X 3 = 18

a. 5W + 1H

After the main cause of the defensive iron defect on the K-015 Stel cable product at PT. SUCACO is known through the highest RPN results found in the FMEA questionnaire, then it is necessary to determine the action plan to overcome the problem of defect of the Removable Buffer Iron using 5W + 1H tools (What, Why, Where, When, Who, How). The following is a table of results of 5W + 1H analysis to find out the right solution to overcome excess water problems based on the results of FMEA questionnaire scoring.

E. Control (C)

The control phase is the fifth stage and is the last in the use of the DMAIC method. This stage is the last stage of the application of the DMAIC method in six sigma which aims to control the process so that it runs in accordance with the initial objectives and it is expected that the problems that have occurred will not recur at other times. The control activities that can be carried out are monitoring by using a check sheet by reviewing the inspection process. But at this stage the writer only gets to the stage of giving a proposal not yet to the stage of implementation in the field.

V. ANALYSIS

DMAIC	Tools	Result
Define	CTQ	Loose Buffer Iron, Knotted Leather Cord, Broken Fiber, Printing Not Perfect
Measure	Level Sigma	LevelSigma = 4 DPMO = 11263.93Kg DPU = 0.02 DPO = 0.005 and Percentage of Yield% = 96%
Analyze	Fishbone Diagram	The effect of loose buffer iron is caused by Human, Machine, Method, Environment, Material
	Pareto Diagram	Loose Buffer Iron = 40% Fiber Disconnect = 27% Incomplete Printing = 19% Corded leather = 14%
Improve	FMEA	The highest RPN score is 80 and is ranked 1, which is a sticky adhesive
	5W+1H	Hold installation of temperature temperature control, measuring temperature of warehouse of raw material and making SOP of warehouse related to temperature maintenance
Control	Checksheet	Execution of inspection of raw material warehouse and implementation of repair of adhesive material which is not in accordance with standard

Table 8:- Results and Analysis

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VI. CONCLUSION

1. Based on the results of the analysis in the analyze stage, using the Pareto diagram obtained the largest type of defect of the K-015 Stel cable product is the type of loose buffer iron defect with a percentage of 40%, then using cause and effect diagrams can be known the causes type of loose buffer iron defect, namely there are four influencing factors consisting of human, machine, material, and method factors.
2. Improvements made to minimize the type of loose buffer iron defect found on the K-015 Stel cable is to check the quality of the adhesive material and provide an SOP (Standard Operating Procedure) to the operator during the cabling process.

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