

## IMPLEMENTATION $\bar{X}$ AND R CONTROL CHART AT PT. GRAND TEXTILE INDUSTRY

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### ABSTARCT

It can be known by using of the  $\bar{X}$  and R control charts a limitation of quality control for permitted or standardized yarn unevenness. After data processing of quality control by Trial Control Limit method, where preceeding period is made use as reference of quality limitation that would be implemented on succeeding period. It is obtained a control limit for RSCD7T yarn unevenness as  $8.99 \pm 0.45$  (in % units). After its implementation on succeeding period, then it was understood that there are still some data out of control limit that is furthermore analyzed. Results of analysis show that product possibility to defect is 8.13% from total production, consequently it is necessary to make any corrective action, and such correction must be conducted on Engineering Department, Human Resource Department, Production (Scheduling) Department, Raw Material QC Department, and Department of Facility.

Keywords : Quality,  $\bar{X}$  and R Quality Charts

## 1. INTRODUCTION

### 1.1. Background

The temporary community or consumers have already understood the importance of quality control for a specific produced item or offered services by its producers, so that company is demanded to correct, improve, and maintain their product quality in attempt to make their consumers perceive a satisfaction with offered products.

The defective products from textile products have a close relationship with quality control on product defects, especially its yarn. A yarn defects are, among other, called as unevenness, hairness, twist, and other defects, and they are difficult yarn defects for controlling and tend to unstable. Meanwhile, those properties are absolute components expected by consumers to give the best quality, therefore it can produce the best product in succeeding production.

Based on description that become primary subjects for above problems solving are :

1. How to determine limit of production quality control by application of the trial control limit method and then it is implemented on further periods.
2. How to make analysis on affecting factors in product quality of RSCD7T yarn produced by PT. Grand Textile Industry.

Whereas, objectives in performing of this research are as followings:

1. To establish a new specification limit values, so that yarn quality may be maintained and to reduce presence of values out of quality limit.
2. To identify factors causing presence of value out of control
3. To understand product quality standard for produced yarn.
4. To see types of quality measurement used by PT. Grand Textile Industry
5. To understand quality tolerance of yarn products used by PT. Grand Textile Industry as raw materials for succeeding production process.

## 2. THEORETICAL BACKGROUND

### 2.1. Definition of Quality Control

The company performs quality control in making product (outputs) in according to predetermined specifications or standards on the basis of company's policies and consumer's perception on product quality.

Because of quality is an important issue that contribute to company survival, thus product or service quality produced by company must be controlled. In performing of this quality control, all products must be checked in accordance with existing standards and all deviation from standard must be recorded and analyzed. Furthermore, all those

findings would be applied as feedback, so it can be executed a corrective action for future production process.

A quality control is a very important activity as checking, analysis and correction systems which is required urgently in production process; therefore, presence of accurate raw material checking, both in-process materials or finished products, an analysis can be made to determine what controlling acts must be taken in production process to reach and maintain predetermined product quality. Therefore, it is clearly that such quality control also assure that produced items are accountable one.

## 2.2. Peta Pengendalian $\bar{X}$ dan R

The  $\bar{X}$  and R control charts are variable controls that is utilized to control measurable quality characteristics such as dimensions (weight, length, wide, volume).

The  $\bar{X}$  chart illustrate  $\bar{X}$  (average) value position from a subgroup (samples). Meanwhile, R control chart is a specific graphic illustrating position of range values of relatively members of data groups toward its control. Therefore, it is appropriate to use in handling of this case.

Some steps taken in making of  $\bar{X}$  and R charts are as followings:

- To determine objective of control chart
- To specify subgroups
- To prepare data recording form
- To determine measurement method
- To make a measurement
- To record measurement data

After all those preparation steps were performed, thus succeeding steps is to start data processing from those collected data, those collected data is made in plots in graphics that has formerly obtained from average, standard deviation and control limit, thus such process will be stopped and continued to look for causes of those processing errors. After processing correction took place, thus production will be restarted and it will continuously operate up to finish production. If average, standard deviation and control limit have not been understood, thus it will be conducted observations and recording on results of

executed production process, and further steps are as followings:

- To calculate subgroup ( $\bar{X}$ ) and range (R) values :

$$\bar{X} = \frac{\sum X_i}{n} \text{ and } R = X_{i_{\max}} - X_{i_{\min}}$$

- To calculate total average ( $\bar{\bar{X}}$ ) and average range (R) values.

$$\bar{\bar{X}} = \sum_{i=1}^k \frac{\bar{X}_i}{k} \text{ and } \bar{R} = \sum_{i=1}^k \frac{\bar{R}_i}{k}$$

- To calculate control limits for individual control charts.

1.  $\bar{X}$  Chart

$$CL_{\bar{X}} = \bar{\bar{X}}$$

$$UCL_{\bar{X}} = \bar{\bar{X}} + A_2 \cdot \bar{R}$$

$$LCL_{\bar{X}} = \bar{\bar{X}} - A_2 \cdot \bar{R}$$

2. R Chart

$$CL_R = \bar{R}$$

$$UCL_R = D_4 \cdot \bar{R}$$

$$LCL_R = D_3 \cdot \bar{R}$$

- Data plotting on control limit for individual charts.

1.  $\bar{X}$  data; toward limit of  $\bar{X}$  control chart.
2. R data; toward limit of R control chart.

- To make conclusions from data plotting outputs for individual charts.

1. There is available or no data out of control limits.
2. There is available o no formed pattern within control limit.

- To make preliminary conclusion from process, the objective of this primary conclusion is to know about wheather process is in control or not.

- If process is in control, thus its calculation is finished.

- If process is out of control, thus please to track its causes, and then make revision.

- Data causing uncontrolled process must be written off from calculation with respect to its individual occurrence on each control chart.

- To calculate new  $\bar{X}$  and R values.

$$\bar{\bar{X}} = \frac{\sum \bar{X}_i - \text{Data out of control}}{k - \text{Observations out of control}}$$

$$\bar{R} = \frac{\sum Ri - \text{Data out of control}}{k - \text{Observations out of control}}$$

- k. To calculate new control limit for individual charts.
- l. To make data plots on new control limits for individual charts.
- m. Then continue with conclusion drawing for individual charts.

### 2.3. The Process Capability Index

The process capability has purpose to state how extent users of control chart can provide improvement on characteristic of quality. In other words, such process capability has role to maintain process condition in fair situation. The process capability index is obtained by making a calculation as follows:

$$C_p = \frac{BSA - BSB}{6\sigma}$$

Dimana :

- Cp = Process capability index.
- BSA = Upper specification limit.
- BSB = Lower specification limit.
- $\sigma$  = Deviation standard of population.

With such  $\alpha$  assumption is obtained from:

$$\sigma = \frac{R}{D_2}$$

Where :

- $\sigma$  = Deviation standard of population.
- $\bar{R}$  = Average range.
- $D_2$  = Expected ratio between R and  $\alpha$ .

Notes:

- If  $C_p > 1.0$ , ideal process (capable).
- If  $C_p = 1.0$ , it is aid capable but must carefully be monitored
- If  $C_p < 0$ , process is not ideal (not capable).

## 3. RESEARCH METHOD

### 3.1 The Research Systematics

The research was carried out by author at PT. Grand Textile Industry where it was performed in step-by-step with function to fulfill author's requirements on data demanded.

Data processing is the most important section of this research, because presence of data processing on collected data, thus it

can be obtained a clear problems and their problem solving will be easy to understand. For data processing, there are available some steps as following:

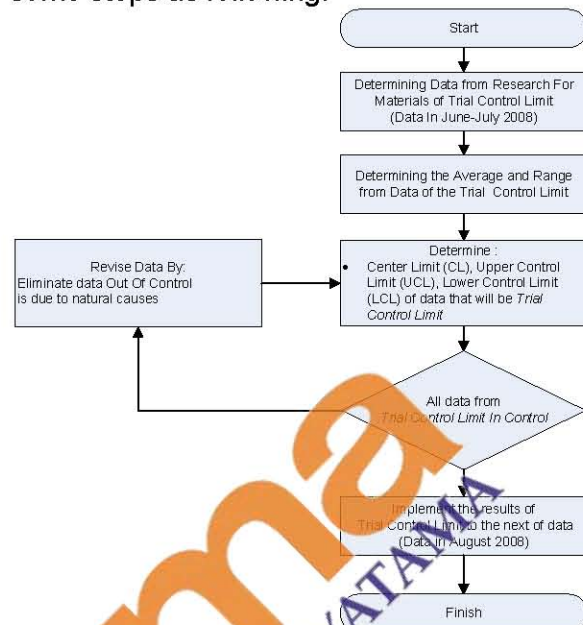


Figure 3. 1: Steps in Data Processing

## 4. RESULT AND DISCUSSION

### 4.1. Trial Control Limit

- To Calculate Average Subgroup ( $\bar{X}$ ) and Range (R)

To calculate average or mean from subgroup is required a formula:

$$\bar{X} = \frac{\sum Xi}{n}$$

Meanwhile, to calculate ranges from a data is:

$$R = Xi_{\max} - Xi_{\min}$$

Those above data is a subgroup average and range, and then they are used to look for control limit. Its calculation example is as following:

$$\bar{X} = \frac{(8,63 + 8,95 + 8,89)}{3} = 8,82$$

$$R = 8,95 - 8,63 = 0,32$$

- To Calculate Total Average ( $\bar{\bar{X}}$ ) and Range (R) Values

In calculation of total average ( $\bar{\bar{X}}$ ) and range (R) Values is used a formula:

$$\bar{\bar{X}} = \sum_{i=1}^k \frac{\bar{X}_i}{k} \text{ and } \bar{R} = \sum_{i=1}^k \frac{R_i}{k}$$

Meanwhile, a calculation example to look for such data is:

$$\bar{X} = \frac{(8,82 + 8,56 + 9,16 + \dots + 9,28 + 10,32)}{28} = 9,06$$

$$\bar{R} = \frac{(0,32 + 0,25 + 0,27 + \dots + 0,49 + 0,37)}{28} = 0,52$$

• To Calculate  $\bar{X}$  and R Control Limit

To calculate control limit from each control chart is performed like this:

1.  $\bar{X}$  chart

$$CL_{\bar{X}} = 9,06$$

$$UCL_{\bar{X}} = 9,06 + (1,023 \times 0,52) = 9,59$$

$$LCL_{\bar{X}} = 9,06 - (1,023 \times 0,52) = 8,53$$

2. R chart

$$CL_R = 0,52$$

$$UCL_R = 2,575 \times 0,52 = 1,34$$

$$LCL_R = 0 \times 0,52 = 0$$

• Data Plot on Trial Control Limit

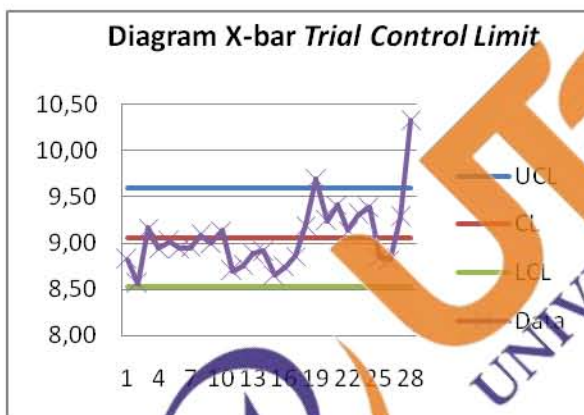


Figure 4.1. The Trial Control Limit X-Bar Diagram

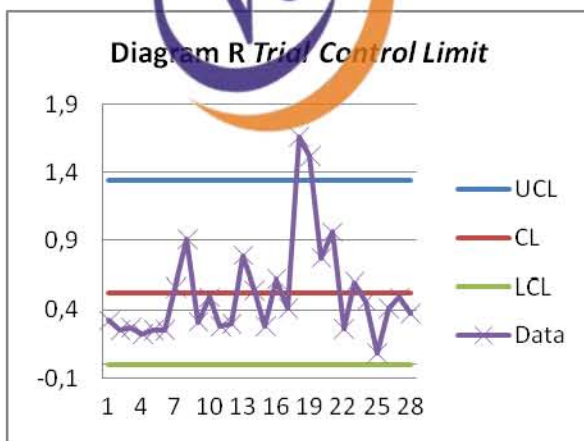


Figure 4.2. The Trial Control Limit R Diagram

• Revision of Trial Control Limit

1.  $\bar{X}$  chart

$$\bar{X} = \frac{253,72 - (9,68 + 10,32)}{28 - 2} = 8,99$$

$$CL_{\bar{X}} = 8,99$$

$$UCL_{\bar{X}} = 8,99 + (1,023 \times 0,44) = 9,44$$

$$LCL_{\bar{X}} = 8,99 - (1,023 \times 0,44) = 8,54$$

2. R chart

$$\bar{R} = \frac{14,63 - (1,66 + 1,52)}{28 - 2} = 0,44$$

$$CL_R = 0,44$$

$$UCL_R = 2,575 \times 0,40 = 1,13$$

$$LCL_R = 0 \times 0,40 = 0$$

• Data Plot was Revised

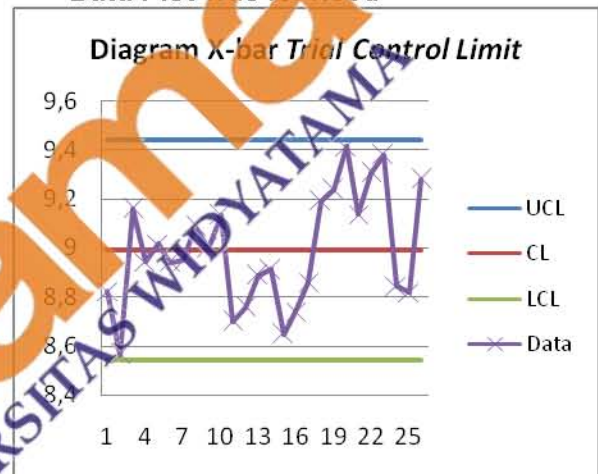


Figure 4.3. Revised The Trial Control Limit X-Bar Diagram

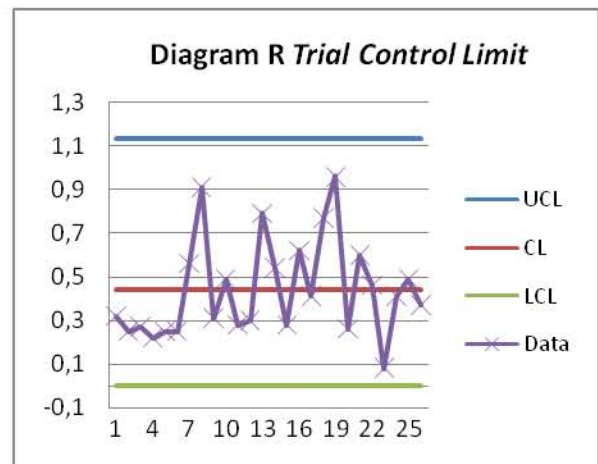


Figure 4.4. Revised The Trial Control Limit R Diagram

• Result of Company Policy

Table 4.1. Trial Control Limit

| $\bar{X}$ |      |      | R   |      |      |
|-----------|------|------|-----|------|------|
| LCL       | CL   | UCL  | LCL | CL   | UCL  |
| 8,54      | 8,99 | 9,44 | 0   | 0,44 | 1,13 |

## 4.2. Implementation of Trial Control Limit

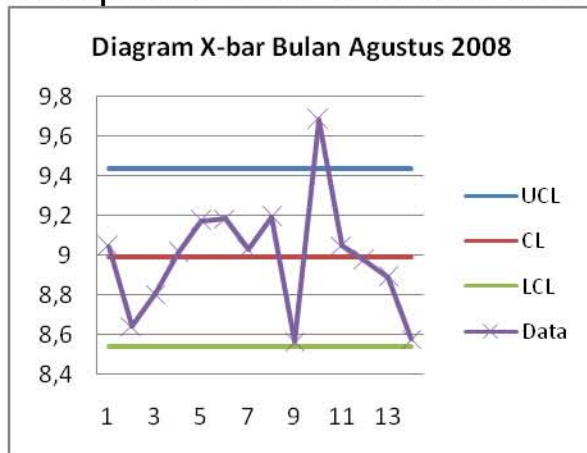


Figure 4.5. The Plot of X-Bar Data on August toward Output of Trial Control Limit

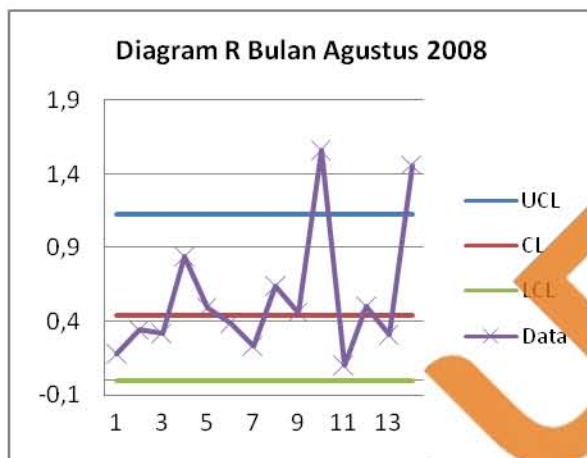


Figure 4.6. The Plot of R Data on August toward Output of Trial Control Limit

## 5. Conclusion

### 5.1 Analysis of Process Capability

The process capability is ability owned by a production process to adapt with existing standard, it is called as Process Capability Index (Cp).

Table 5.1. Data for the CP calculation

| BSB  | BSA  | $\bar{R}$ |
|------|------|-----------|
| 8,54 | 9,44 | 0,44      |

$$\sigma = \frac{\bar{R}}{d_2} = \sigma = \frac{0,44}{1,693} = 0,26$$

$$Cp = \frac{BSA - BSB}{6\sigma} \quad Cp = \frac{9,44 - 8,54}{6(0,26)} = 0,58$$

Therefore, it could be seen that  $Cp < 1$ , so production process for RSCD7T yarn is not ideal one.

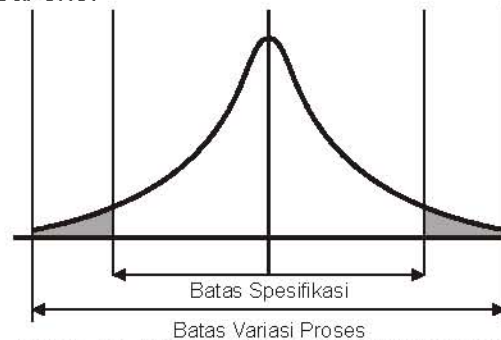


Figure 5.1. Graphic for comparison between specification limit and process variation

$$P = \left( \frac{1}{0,58} \right) \times 100\% = 172,41\%$$

Thus, the width of process variation is 172.41% from specification width.

Table 5.2. Data for calculating of the reject possibility product

| LSL  | USL  | $\mu$ |
|------|------|-------|
| 8,54 | 9,44 | 8,99  |

$$\begin{aligned} P_{\text{reject}} &= P(x < 8,54) + P(x > 9,44) \\ &= \left( \frac{8,54 - 8,99}{0,26} \right) + 1 - \left( \frac{9,44 - 8,99}{0,26} \right) \\ &= (-1,73) + 1 - (1,73) \\ &= 0,04182 + (1 - 0,95872) \\ &= 0,04182 + 0,04128 \\ &= 0,0831 = 8,31\% \end{aligned}$$

a percentage reject products is 8,31%.

### 5.2. Analysis for Product Defective Factors

In order to understand causes of RSCD7T yarn defection, thus it was performed a Brainstorming to collect opinions from questionnaire about "Whatever factors can affect RSCD7T yarn quality?". From Brainstorming output, it is obtained some ideas. In implementation of brainstorming, author individually do it or individual thought, so those searching of thinking is purely coming from author's opinion individually, therefore it is called as individual brainstorming.

From some above steps, it can be know whom has responsible to carry out such duty, among of them are:

1. Producing Maching Technical Section

- To perform machine and spare part checking.
  - Broken spare part replacement.
2. Human Resource Department
    - To provide employee training about yarn quality
    - To do trials for yarn quality.
  3. Production Department
    - To determine level of production difficulties in order that it can be adapted with machine ability.
    - To determine production time of production machine for avoiding overheat.
  4. Raw Material Quality Department
    - To clean cotton raw materials from their waste kernel.
    - To look for cotton raw materials that possess a long cotton fibres for creating a good yarn quality.
  5. Department of Facility
    - To clean production environment
    - To make working environment orderly for production activities

## 6. REFERENCES

1. Montgomery, Douglas C., 2001, "Introduction To Statistical Quality Control", Fourth Edition, John Wiley & Sons Inc., USA.
2. Mizuno, Shigeru, 1988, "Management For Quality Improvement", Juse Press, Tokyo:Japan.
3. Ariani, Dorothea Wahyu, 2004, "Pengendalian Kualitas Statistik; Pendekatan Kuntitatif Dalam Manajemen Kualitas", Andi, Yogyakarta.
4. Sarosa, Rizki Harry, 2008, "Analisis Proses Pembuatan Benang Jahit dengan Menggunakan Peta Kendali X-bar dan R", Kerja Praktek, Universitas Pasundan, Bandung.
5. Jufri, Hendra, 2006, "Analisis Pengendalian Kualitas Dalam Upaya Menekan Tingkat Kegagalan Produk Benang pada PT. Grand Textile Industry", Tugas Akhir, Universitas Pasundan, Bandung.



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