Quality Control System using Simple Implementation of Seven Tools for Batik Textile Manufacturing

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Abstract. 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 the simple implementation of the seven tools in quality control defects. The case studied in this research was the level of disability xyz grey fabric on a shuttle loom 2 on the Batik manufacturing company. The seven tools that include: flowchart, check sheet, histogram, scatter diagram combined with control charts, Pareto diagrams and fishbone diagrams (causal diagram). Check sheet results obtained types of defects in the grey fabric was woven xyz is warp, double warp, the warp break, double warp, empty warp, warp tenuous, ugly edges, thick warp, and rust. 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 a scatter diagram shows a positive correlation between the percentage of disability and the number of production. Based on Pareto diagram, repair needs priority is for the dominant type of defect is warp (44%) and based on double warp value histogram is also the highest with a value of 23635.11 m. In addition, based on the analysis of the factors causing defect by fishbone diagram double warp or other types of defects originating from the materials, methods, machines, measurements, man and environment. Thus the company can take to minimize the prevention and repair of defects and improve product quality.

Keywords: quality control, seven tools, batik manufacturing, defective products

1. Introduction
The growing global market introducing a competition between companies in providing high quality products in accordance with the wishes of the consumer. Due to the increasing consumer demand for certain products led to the company strives to meet the needs of consumers, thus demanding the company strives to improve the quality of its products. Judging from the views of consumers, subjectively people say the quality is something that is suited to the taste (fitness for use) [1]. With the good quality products, the company will benefit in terms of marketing and satisfaction of consumers. Although the company has been striving hard to make a high quality product produced products must have disabilities. Defective product is one of the common problems shared by all companies. Usually a defective product contained in a product produced physical changes that are not in accordance with prescribed standards due to causes in the production process as well as other causes. Disability products may be due to the factors of machines, humans or the environment. Product defects can also cause loss of the company such as cost and production time. Moreover, if many defective products produced, it will increase the cost for repairs and other expenses. Not only that, defective products also reduce the selling price. In order to cope with product defects each company must have a quality

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control department that is in charge of checking whether there is a defect of the product before it is marketed.

This company is engaged in textiles also experienced defective products. Products produced by this company is grey cloth (calico cloth), and Batik fabric (fabric for batik material). The company also has a quality policy for orientation in its business activities. To respond with the often discovery of defective fabric products therefore it is necessary to control the quality of the existing products so that later can reduce defective products. One basic way in quality control of products is to make corrections to the elements concerned with the production and evaluation of the results. So with the correct quality control company will know how to deal with the problem there and get a result that is useful for subsequent excretion process. One of the tool that can be used is quality control system using simple implementation of seven tools. This seven tools includes flowchart, check sheet, histogram, scatter diagram combined with control charts, Pareto diagrams and fishbone diagrams (causal diagram).

From the above purposes, for reducing and preventing of defects, researchers will conduct research on quality control in cloth/textile product in Batik Company. Hence the title that will be raised is “Quality Control System using Simple Implementation of Seven Tools for Batik Textile Manufacturing”.

2. Literature review

2.1. Quality Control

Quality consists of a number of product features, either directly or privilege attractive feature that meets the needs of customers and thus provide satisfaction on the use of the product [2]. Quality can also be defined as the number of attributes or properties as described in the product (and services) are concerned with [3]. Quality definition is also sourced from two sides, producers and consumers. Manufacturers determine the requirements or specifications of quality, while consumers determine the needs and desires [4]. Quality control is an activity to ascertain whether the policy in quality (standard) can be reflected in the final results, or in other words the effort to maintain the quality or the quality of goods produced to fit the specifications of the products that have been determined by policy leaders [5]. The purpose of quality control [5]: 1. that manufactured goods can reach the quality standards that have been required, 2. arranged for inspection costs to be as small as possible, 3. improve the cost estimation of the design of products and processes with the use of certain production quality to be as small as possible. And 4. provide production costs as low as possible. In general, the factors that can affect the quality [1] can be classified as follows: 1. The operating facility such as the physical condition of the building, 2. equipment and supplies (tools and equipment), 3. raw materials or materials, and 4. employment or staff organization.

2.2. Statistical Quality Control

There are many methods and tools used to perform statistical quality control but famous is using seven tools or some call the magnificent seven tools. According, Paliska, G, Pavletic, D and Sokovic, M. (2007) in every stage of the production, Quality tools could be applied, from the start of manufacturing of the products until the sale of these products [6]. Seven tools can also be used to identify the problems that exist within an enterprise. Where seven tools are as follows:

- **Flowchart**
  Flow chart one effective method for defining a process. Flow chart is a simple drawing of a process [7]. It could be said processing from start to finish the process in a system.

- **Check sheet**
  check sheet is a form, in which the items to be inspected has been printed on the form, with the intention that can be collected easily and concisely [9].

- **Histogram**
  Histogram is one tool that helps to find variations, and histogram is one method to make a summary of the data so that the data is analysed, which present the data graphically on how often elements in the process of emerging [9] and [7].
• Scatter Diagram
Scatter diagram is a useful tool to clarify whether there is a relationship between two variables, and whether the relationship is positive or negative [7].

• Control chart
Control chart is a tool in the form of process control charts to determine the upper control limit (upper limit control) and lower control limit (lower limit control) process performance [4].

In the quality control of products, often used Quality Control Chart. With chart or a control chart can be known immediately whether the quality of the goods being processed under or out of control. Control chart or map control is a graphic comparison of data performance process (test results/observations of the nature of the product), for calculating limit control which is described as a limit line on the map. The main objective of Control Chart is to determine whether there uniformities that can be avoided in the process. The types of control charts, there are 5 types:
- X - Chart, a chart that used for an average price, and chart thisis the most frequently used.
- R - Chart, used alongside the X - Chart, intended to show the magnitude of the variation of each subgroup.
- P - Chart, used to indicate the value of the defect (percent defective).
- Pn - Chart, is used to control the number of defects with sample values fixed size.
- C - Chart, used to indicate the number of times the value of the actual defect (not in percent) per piece or per unit.

• Pareto diagram
Charts Pareto are used to classify problems according to cause and symptoms [8]. Problems were depicted by priority or importance, using a bar graph format, where 100% indicates a total loss. The underlying principle of this diagram is the '80 -20 rule 'which states that "80% of the trouble comes from 20% of the problems'.

[Image: Pareto diagram]

Fig 1. Pareto diagram

• Fishbone Chart
Fishbone diagram (fishbone diagram - because it is shaped like a fish bone) is often called Cause-and-Effect Diagram. This diagram was developed in 1950 by a Japanese quality expert, ie Kaoru Ishikawa and is one of the seven basic quality tools (7 basic quality tools). Fishbone diagrams are used to identify and analyse a process or situation and find possible causes of an issue / problem that occurred [8]. As Figure 4.3 above common causes of a problem that is used in the fishbone diagram is 5M 1E or materials (raw materials), methods (method), machines (machines), measurements (measurement), man (people) (human), and environment (environment) which is used as a factor for manufacturing the initial fishbone diagram. As for the manufacture of end-use fishbone diagram 5W 1H or W1 (What), W2 (Who), W3 (When), W4 (Where), W5 (Rev), and H (How). 5W 1H basically is a method used to carry out investigation and research on the problems that occur in the production process. The addition of5 Why this question and answer simple technique to investigate the causal relationship is at the root of a problem. [10] In essence this diagram can be used for the needs of the following:
- Helps identify the root cause of a problem.
- Helps generate ideas for solutions to problems.
3. Methods
This study was conducted in Batik Textile Manufacturing Company. The resulting product is a yarn clothes, grey cotton, cambric (bleaching, mercerized, Sanforized).
The first stage of the research is done in the field observations, in the shop floor. In this observation phase researchers will conduct direct observation to see all production activities in the company.
After making observations the next step is to identify the problem, researchers will know the problems-problems that occur in the company. In this research focus is the problem identification shuttle loom two departments that have problems in production on disability production so it needs to be quality control of products.
After looking for theories that could be used as a support and research support to match the existing theory and workable, next is the data collection. The required data are flawed product data for the month of a certain month in Shuttle loom 2. Data have been collected covering total production, the type of defect and the number of defects check sheet then combined in a useful order for the data neatly and concisely. After it makes a comparison chart between the amount of production and the number of defects in order to determine the level of the comparison.
The next step is data processing. At this stage there are a few sequences in the data processing that is the first to calculate and determine the value of upper and lower control limits of the product are used to determine whether the process that has been known to be in a controlled or uncontrolled. The second is to create a scatter diagram to see the positive and negative relationship between two variables: the amount of production and the number of defects. The third is to identify the highest type of disability through the histogram. The fourth is to create Pareto diagram is used to classify problems according to cause and symptoms. The fifth is to identify the most influential defects and identify the cause. Sixth, once known cause then create fishbone diagrams or cause-effect diagram which is useful as a tool to identify problems and provide solutions to improvement or change in the object studied.
In the discussions, the researcher will discuss and analyse the overall results of the data processing method of the seven tools. From this analysis, researchers will find out what the cause of the defect can cause problems in production.
Lastly is the conclusions and suggestions, which conclusion is the result of that will be missed from the formulation of the problem has been determined. While the advice is input and solutions to related parties are expected to be useful for future evaluation.

4. Results and Discussion
From the research conducted, it is effective to use seven tools for implementing and analysing quality control system. These tools combined would be a beneficial for research conducted in quality system [11], [12], [13] and [14]. The table below is a defective product data type xyz grey cloth during the month of May 2015 on a shuttle loom 2. Following the results of the data collection check sheet:

| Day number | Length produced (m) | Unwoven weft | Double warp | warp breaking | Double woven | Empty woven | warp tenuous | Ugly edge | Thick warp | Rust |
|------------|---------------------|--------------|-------------|---------------|--------------|-------------|--------------|-----------|------------|------|
| 2          | 6669                | 25,11        | 0           | 166,73        | 968,97       | 81,60       | 12,90        | 0         | 65,2839    | 0    | 1320,59 |
| 3          | 4984                | 141,21       | 354,55      | 436,16        | 654,35       | 53,08       | 111,24       | 0         | 0          | 0    | 1750,59 |
| 4          | 6236                | 8,84         | 357,34      | 141,37        | 1114,38      | 0           | 73,91        | 0         | 164,11     | 0    | 1859,95 |
| 5          | 4948                | 45,16        | 384,51      | 98,96         | 746,51       | 0           | 30,69        | 0         | 134,25     | 0    | 1440,08 |
| 6          | 5491                | 80,70        | 281,20      | 422,08        | 788,46       | 25,91       | 306,54       | 161,50    | 161,50     | 73,09 | 2300,99 |
| 7          | 6458                | 53,36        | 0           | 671,46        | 734,15       | 0           | 434,08       | 0         | 0          | 0    | 1893,05 |
| 8          | 4700                | 139,30       | 329,18      | 537,54        | 743,43       | 44,91       | 68,39        | 85,35     | 0          | 0    | 1948,10 |

- Assist in the investigation or fact-finding further.
| Day number | Length produced (m) | Unwoven weft | Double warp | Warp breaking | Double woven | Empty woven | Warp tenuous | Ugly edge | Thick warp | Rust |
|------------|-------------------|--------------|-------------|---------------|--------------|-------------|--------------|-----------|------------|------|
| 9          | 5391              | 45,38        | 163,36      | 87,52         | 1174,41      | 73,59       | 6,85         | 0         | 174,92     | 0    | 1726,02 |
| 10         | 6149              | 0            | 154,32      | 332,38        | 332,38       | 0           | 321,89       | 0         | 0          | 1140,97 |
| 11         | 5341              | 213,74       | 0           | 164,91        | 1222,53      | 0           | 719,21       | 0         | 166,91     | 0    | 2487,30 |
| 12         | 6116              | 55,24        | 38,77       | 164,21        | 813,62       | 102,18      | 343,46       | 0         | 165,30     | 0    | 1682,78 |
| 13         | 6188              | 147,16       | 0           | 133,76        | 799,10       | 0           | 136,36       | 0         | 157,09     | 0    | 1373,48 |
| 14         | 5128              | 86,22        | 165,42      | 836,45        | 423,10       | 15,13       | 496,26       | 0         | 0          | 0    | 2022,57 |
| 15         | 6377              | 110,66       | 589,11      | 654,05        | 830,63       | 119,98      | 113,28       | 0         | 65,60      | 0    | 2483,31 |
| 16         | 3990              | 34,47        | 388,87      | 69,84         | 599,95       | 0           | 0            | 0         | 61,72      | 0    | 1154,86 |
| 17         | 7326              | 432,45       | 666,00      | 241,73        | 1653,04      | 0           | 348,62       | 266,68    | 0          | 0    | 3608,52 |
| 18         | 4411              | 34,84        | 278,03      | 51,05         | 251,32       | 163,37      | 265,57       | 0         | 0          | 0    | 1044,19 |
| 19         | 6267              | 0            | 548,15      | 553,42        | 464,60       | 0           | 419,55       | 164,92    | 0          | 0    | 2150,64 |
| 20         | 6046              | 53,08        | 163,41      | 755,01        | 1320,78      | 0           | 322,72       | 0         | 0          | 0    | 2614,99 |
| 21         | 5105              | 43,13        | 329,35      | 248,46        | 525,83       | 0           | 330,94       | 0         | 0          | 0    | 1477,71 |
| 22         | 5739              | 0            | 272,55      | 544,07        | 764,95       | 77,78       | 238,79       | 165,97    | 0          | 0    | 2062,10 |
| 23         | 6154              | 23,90        | 166,32      | 460,13        | 788,62       | 0           | 332,65       | 0         | 0          | 0    | 1771,62 |
| 24         | 6278              | 135,70       | 66,28       | 0             | 800,59       | 61,26       | 566,99       | 0         | 0          | 0    | 1630,82 |
| 25         | 5310              | 14,43        | 402,55      | 165,94        | 830,37       | 51,29       | 165,94       | 165,94    | 0          | 0    | 1796,46 |
| 26         | 5910              | 61,68        | 328,33      | 265,04        | 645,96       | 0           | 292,76       | 0         | 0          | 138,40| 1732,17 |
| 27         | 7273              | 14,76        | 409,79      | 195,80        | 1845,10      | 31,48       | 169,24       | 0         | 0          | 0    | 2666,17 |
| 28         | 4559              | 0            | 117,87      | 487,08        | 980,42       | 115,87      | 14,97        | 0         | 0          | 0    | 1716,21 |
| 29         | 5677              | 70,56        | 491,97      | 746,31        | 817,57       | 0           | 589,36       | 0         | 0          | 0    | 2715,77 |
| Total      | 160221            | 2071,08      | 7447,25     | 9631,43       | 23635,11     | 1017,46     | 7233,16      | 1008,36   | 1316,68    | 211,48| 53572  |

From the data on known types of defects are often found in xyz grey cloth that has been set by the company, the type of defect, respectively are:

- **Unwoven weft weaving** is a type of defect in which there is no pitch thread woven perfectly due to several reasons.
- **Double warp** is a type of defect in which yarn that goes double numbering resulting in woven wicker is not perfect.
- **Wrap breaking out** is a type of defect in which there are broken threads in woven wicker resulting imperfect.
- **Double woven** is a type of defect in which there is a thread that is woven thick double that grounds exist on the surface of the fabric.
- **Empty woven** is a type of defect in which there is a part of the fabric that is discharged from the turn of the pallet is not perfect during the weaving process.
- **Warp sprawl** is a type of defect which occurs apart on the fabric.
- **An ugly edge** where the defect type on the edge of the fabric is not woven well.
- **Warp thick** is a type of defect in which there is a thread that is woven with thick, so there is a thick line on the surface of the fabric.
- **Karat** is a type of defect in which there are rust stains on the fabric, this is due to rust obtained from the engine when the fabric weaving process.
- **Here is a graph illustrating the amount of production and the number of defective products in the grey cloth xyz starting on day 2 to day 31, is as follows**
- The flowchart to understand the process in the company is as follows (fig 3.). This process was obtained by observation and discussion with the company.

![Flowchart](image)

**Fig 3. Production process (form observation)**

### 4.1. C-Chart

The C Chart control data will be shown on the next table.

| Total production number | Total Cacat | UCL     | CL      | LCL      |
|-------------------------|------------|---------|---------|----------|
| 160221                  | 53572,02   | 2044,51 | 1913,29 | 1782,06  |
| Average                 | 5722,17    | 1913,29 |         |          |

Once known the value of the upper limit (UCL), a middle value (CL) and the lower control limit (LCL), later described the results of calculation of a control chart that has been created as the following chart.

![C-Chart](image)

**Fig 4. C-Chart**
4.2. Histogram

![Histogram](image1)

Fig 5. Comparison of defect

4.3. Scatter Diagram

| Table 3. Data Calculation for Scatter Diagram |
|-----------------------------------------------|
| **Length of Production/Jumlah Produksi** (x) | **Defect in Total/Total Cacat** (y) | **x^2** | **y^2** | **xy** |
|------------------------------------------------|-------------------------------------|---------|---------|-------|
| 160221                                         | 53572.02027                        | 93488412 | 111258420.6 | 312742634.4 |

So the correlation coefficient between the total production and total production defects is 0.4923 means that the two variables have a fairly close relationship because if the value of r > 0 means that there is a positive relationship. Close to 1 means a strong relationship. If made into a scatter diagram of the shape as shown below:

![Scatter Diagram](image2)

Fig 6. Scatter Diagram

4.4. Pareto diagram

| Table 4. Defect Type Percentage |
|---------------------------------|
| **Defect Type** | **Frequency** | **Percentage from Total** | **Cumulative Percentage** |
|-----------------|---------------|---------------------------|---------------------------|
| Double Warp/Pakan Double | 23635,11     | 44%                       | 44%                       |
| Warp Break/Lusi Putus | 9631,43      | 18%                       | 62%                       |
| Double Warp/Lusi Double | 7447,25     | 14%                       | 76%                       |
| Warp tunous/Pakan Renggang | 7233,16     | 14%                       | 89%                       |
| Unwoven Warp/Pakan Tak Teranyam | 2071,08 | 4%                        | 93%                       |
| Thick Warp/Pakan Tebal | 1316,68      | 2%                        | 96%                       |
| Empty Warp/Pakan Kosong | 1017,46      | 2%                        | 98%                       |
Ugly Edges/Tepi Jelek 1008,36 2% 100%
Rust/Karat/Oli 211,48 0% 100%
Total 53572,02 100%

4.5. Fishbone diagram

After an inventory of the problems and unknown factors cause of the defect under 5M 1E, then do manufacture fishbone diagram, that also had been combined with 5 W (what, why, when, who and where), 1 how and 5 whys.

The Pareto analysis and fishbone diagram would enhance company to explore the root cause of the problem identified as shown in the fig 8. This result is similar for building remediation contractor for elimination problem [15].

5. Conclusions and Recommendations

5.1. Conclusions

- The types of defects that occur in grey cloth warp xyz is not woven, warp double, dropping out of warp, weft double, empty warp, warp tenuous, ugly edges, thick fodder, and rust. And
of the various types of disabilities that are categorized by the company, the most common defect is a defect warp double the percentage value of 44%. 

- Based on the analysis of the fishbone diagram above, it can be seen that there are several factors causing the defect types that double warp material, human, machine, and environment management. Hence there is need for improvement and evaluation of the company.

- Efforts need to be made by the company in order to reduce defects in the fabric of gray xyz types are
  - In terms of the company's material should be tightened and more thoroughly in attention and choose the quality of the raw material fabric
  - In terms of human or workers in the company will have to give directions or training to them in order to improve performance and improve the regulation and strict supervision over again so that the workers could work properly
  - In terms of engine actions that must be done is to improve the care and cleaning of the machine regularly
  - In terms of its working methods should be the elements of the company's more obedient again and adhere to the SOP that has been applied
  - In terms of the measurement of the company should be more attention to measurement of the testing equipment so as to meet the standards in the company so as to produce a desired output quality
  - In terms of the environment should the company further improve the implementation of 5S workplace culture that covers everything about the company's environmental conditions.

5.2. Recommendations

- The result shown that the seven tools could be effectively used in this company, and therefore, seven tools could be implemented in other garment industry and duplicated the same method.

- Companies should improve the quality of raw materials according to the standard specified

- Companies should improve control over the performance of its employees in order to avoid deterioration in performance and negligence at work

- Perform routine engine maintenance, and pay attention to cleanliness of the engine so that the engine is not damaged or distractions while walking

- Follow standard operating procedures that have been defined

- Perform calibration routine within 6 months-12 months

- Evaluate the working environment such as lighting and 5S for workplace [10].

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