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Investigation of Sewing Production Quality Improvement of a Garment unit by Application of Statistical Process Control

Authors Details

Yonathan Tesfaye Sissay[1*]
Department of Garment Industry Research and Development Desk, Textile and Garment Industry Research and Development Center.

Dereje Balcha[2]
Department of Garment Industry Research and Development Desk, Textile and Garment Industry Research and Development Center.

Corresponding Author: *Yonathan Tesfaye Sissay*

ABSTRACT: This research work applied some of the basic SPC tools in a selected case factory to improve production quality and establish a way of monitoring quality in a better way than the conventional way of inspection.

Most of the data for analysis was collected through primary method with secondary data being used for defect categorization and Pareto analysis. The primary data was collection of variable data for measurement of shirt critical parts (3-measurement positions) as stated by the manufacturer and on a total of 330 samples; with 22 subgroups of 5 observations each.

An X and R Control charts were developed for the collected data, and it was found out that the process was out of control for body length and round collar measurements.

Later, a cause-and-effect analysis was conducted to reach the possible causes for the process to be out of control. A scatter diagram was also developed and was found out that the variation in measurements of the selected parts keep increasing through time.

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Accordingly, poor machine maintenance, use of old pattern papers, and carelessness of operators were identified as the causes.

After implementation of identified gaps, data was recollected on the same parameters. 20 samples of 5 observations each were made on front body length to see if the process was still out of control or has moved within the control limits and it was able to remove 9% of the observed assignable causes (quality problems) from the process.

Keywords: *Statistical Process Control Tools, Assignable causes, Normal causes, Pareto, Control chart, fishbone*

1. INTRODUCTION

Organizations nowadays are concerned about the quality of the products and services they offer. A key to retaining and improving quality is systematic use of *data* in place of intuition. In the words of StanSigman, former CEO of Cingular Wireless, “What gets measured gets managed.” (CNNMoney, " My Golden Rule,", 2005). Because using data is a key to improving quality, statistical methods have much to contribute.

In thinking about statistical interpretation, we distinguish between the *sample* data we have in hand and the wider *population* that the data represents. We hope to use the sample to draw conclusions about the population. In thinking about quality improvement, it is often more natural to speak of *processes* rather than populations. This is because work is organized in processes.

Many manufacturers are actually concerned about the quality of their products, and this raises an important question. How can we control or ensure the quality of our products? To answer the question, many management philosophies and statistical methodologies have been developed through the times and stated in various literatures. A central part of these methodologies is the so-called *statistical process control (SPC)*.

Variations in the process that may affect the quality of the product can be detected and corrected, thus reducing waste as well as the likelihood that problems will be passed on to the customer. With its emphasis on early detection and prevention of problems, SPC has a distinct advantage over other quality methods, such as inspection, that apply resources to detecting and correcting problems after they have occurred. (B. Mason, 2007)

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The aim of this study was to apply Statistical Process Control techniques for improvement and maintenance of product quality in a selected garment manufacturing unit. Various SPC tools have been applied in identifying and removing nonconformities from the production process and making sure that a process is continually producing conforming products.

Then process was tracked by installation of appropriate control charts and whenever the process got out of control (for assignable causes of variations) a cause analysis was conducted through fishbone diagram. Corrective action was taken regarding the issues, and the process was again tracked to make sure it stays in state of control. In this manner the quality of the product was eventually improved and maintained through continuous data collection and analysis and training of concerned personnel on the same.

SPC can be used as quality control tool, or it can contribute to increasing the total volume of production. With this tool, the production manager can easily identify the causes responsible for poor product quality, machine breakdowns and also huge wastage.

2. METHODS

The below method of SPC Implementation is taken from the GOLD practice and was customized for the present research work.

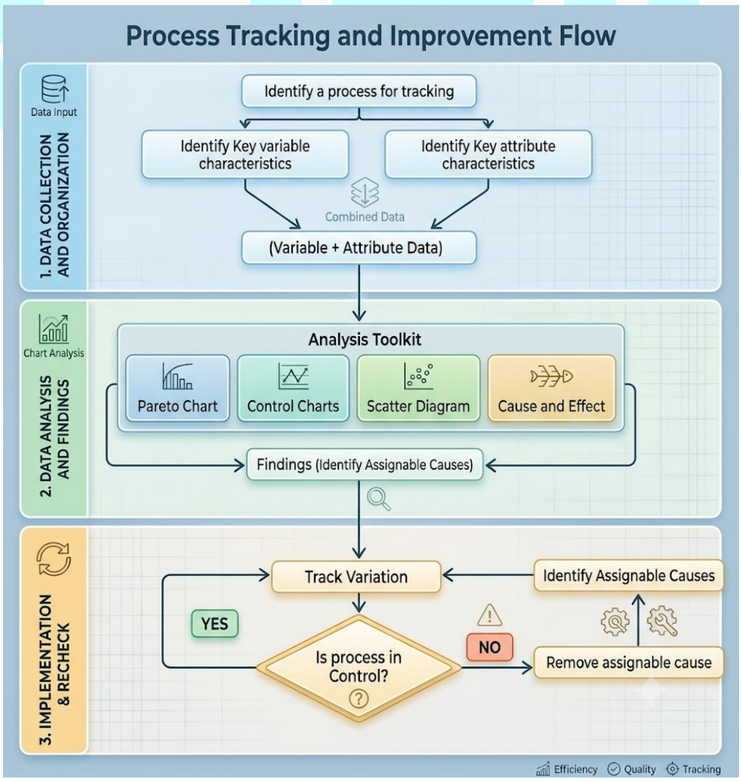

Figure 1: - SPC methodology (Customized from the GOLD practice)

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2.1 Data Collection for Variable Data

The case company is known for its production of various size male and female shirts. With a discussion with the production and quality manager and supervisors, three characteristics were chosen for the variable data on the 2XL shirt. These were,

- ❖ Body Length measurement (HSP to bottom) of the shirt
- ❖ Collar measurement (button hole to button distance on the collar band)
- ❖ Chest width measurement (1 inch down from the underarm) and

For these 22 subgroups of 5 observations each were selected, data was collected for 10 days and was entered on a spread sheet. The Mean, Range and the Control limits for both the charts were also set based on the collected data.

body length			Size:- 2XL	UoM	cm								
Sample	X_1	X_2	X_3	X_4	X_5	Xbar	Xdbar	Range	Rbar	UCL (Xbar)	LCL (Xbar)	UCL Rbar	LCL Rbar
1	79	79	78.25	78.7	78.5	78.590	78.898	0.75	0.957	79.450	78.346	2.022	0.000
2	77.5	78	78	78.5	79	78.200	78.898	1.5	0.957	79.450	78.346	2.022	0.000
3	79	78	78	79.5	79	78.700	78.898	1.5	0.957	79.450	78.346	2.022	0.000
4	78	78	79	78.5	78.5	78.400	78.898	1	0.957	79.450	78.346	2.022	0.000
5	78.3	79	78.5	78.5	79.5	78.760	78.898	1.2	0.957	79.450	78.346	2.022	0.000
6	78	78.5	79	78.8	78.5	78.560	78.898	1	0.957	79.450	78.346	2.022	0.000
7	79	79.2	78.5	79.3	79.5	79.100	78.898	1	0.957	79.450	78.346	2.022	0.000
8	78.9	79.5	79.2	78.5	79.3	79.080	78.898	1	0.957	79.450	78.346	2.022	0.000
9	79	78.2	79.8	79	79.2	79.040	78.898	1.6	0.957	79.450	78.346	2.022	0.000
10	79.3	79.2	79.5	79.3	79.2	79.300	78.898	0.3	0.957	79.450	78.346	2.022	0.000
11	78.5	78.2	78.9	78.7	79.5	78.760	78.898	1.3	0.957	79.450	78.346	2.022	0.000
12	79.1	79.2	79.3	79.4	79.3	79.260	78.898	0.3	0.957	79.450	78.346	2.022	0.000
13	79.5	79.3	79	79.8	79.5	79.420	78.898	0.8	0.957	79.450	78.346	2.022	0.000
14	79.2	79.1	79.5	79.3	79.2	79.260	78.898	0.4	0.957	79.450	78.346	2.022	0.000
15	79	79.5	79	78.8	78.9	79.040	78.898	0.7	0.957	79.450	78.346	2.022	0.000
16	79	79.5	79	79.5	79	79.2	78.898	0.5	0.957	79.450	78.346	2.022	0.000
17	79.2	79	79	79.2	79.1	79.1	78.898	0.2	0.957	79.450	78.346	2.022	0.000
18	79	79.3	79.5	79	78.8	79.12	78.898	0.7	0.957	79.450	78.346	2.022	0.000
19	79	79	78.9	79.3	78.9	79.02	78.898	0.4	0.957	79.450	78.346	2.022	0.000
20	79.1	79	79.4	79	79.2	79.14	78.898	0.4	0.957	79.450	78.346	2.022	0.000
21	79.2	78.8	79.2	79.3	79.5	79.2	78.898	0.7	0.957	79.450	78.346	2.022	0.000
22	79.3	79.2	78.8	79	78.6	78.98	78.898	0.7	0.957	79.450	78.346	2.022	0.000

Figure 2: - Data collected for variable data on Body length

Collar			Size:- 2XL	UoM	cm								
Sample	X_1	X_2	X_3	X_4	X_5	Xbar	Xdbar	Range	Rbar	UCL (Xbar)	LCL (Xbar)	UCL Rbar	LCL Rbar
1	45	46	44.5	45	44.5	44.900	44.874	1	0.540	45.186	44.562	1.142	0.000
2	45	45	45	45	45	45.000	44.874	0	0.540	45.186	44.562	1.142	0.000
3	44.5	45	44.5	45.3	45	44.860	44.874	0.8	0.540	45.186	44.562	1.142	0.000
4	45	44.75	44.5	45	45	44.850	44.874	0.5	0.540	45.186	44.562	1.142	0.000
5	45	44.5	45	45	45	44.900	44.874	0.5	0.540	45.186	44.562	1.142	0.000
6	44.7	44.5	44.8	44.7	44.9	44.720	44.874	0.4	0.540	45.186	44.562	1.142	0.000
7	44.8	45	44.8	44.6	44.8	44.800	44.874	0.4	0.540	45.186	44.562	1.142	0.000
8	44.9	44.8	44.5	45	45.2	44.880	44.874	0.7	0.540	45.186	44.562	1.142	0.000
9	45.3	44.9	45	44.8	44.7	44.940	44.874	0.6	0.540	45.186	44.562	1.142	0.000
10	45.4	45.2	44.6	45	45.2	45.080	44.874	0.8	0.540	45.186	44.562	1.142	0.000
11	44.7	44.9	45.2	44.9	44.8	44.900	44.874	0.5	0.540	45.186	44.562	1.142	0.000
12	45.2	44.9	45.2	44.6	45	44.980	44.874	0.6	0.540	45.186	44.562	1.142	0.000
13	44.5	45	44.7	44.5	44.6	44.660	44.874	0.5	0.540	45.186	44.562	1.142	0.000
14	45	44.5	45	44.6	44.8	44.780	44.874	0.5	0.540	45.186	44.562	1.142	0.000
15	45	44.9	44.7	44.8	44.9	44.860	44.874	0.3	0.540	45.186	44.562	1.142	0.000
16	45	45	44.6	45	44.7	44.86	44.874	0.4	0.540	45.186	44.562	1.142	0.000
17	44.5	44.5	45.1	44.5	45	44.72	44.874	0.6	0.540	45.186	44.562	1.142	0.000
18	44.5	44.5	45	44.7	44.9	44.72	44.874	0.5	0.540	45.186	44.562	1.142	0.000
19	44.9	44.7	44.5	44.5	44.8	44.68	44.874	0.4	0.540	45.186	44.562	1.142	0.000
20	44.5	44.5	44.7	44.5	44.2	44.48	44.874	0.5	0.540	45.186	44.562	1.142	0.000
21	44.7	44.5	44.5	45.2	44.7	44.72	44.874	0.7	0.540	45.186	44.562	1.142	0.000
22	44.8	44.7	44.8	44.9	44.6	44.76	44.874	0.3	0.540	45.186	44.562	1.142	0.000

Figure 3: - Data collected for variable data on Collar Length

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Across chest			Size:- 2XL	UoM	cm								
Sample	***X_1***	***X_2***	***X_3***	***X_4***	***X_5***	***Xbar***	***Xdbar***	***Range***	***Rbar***	***UCL (Xbar)***	***LCL (Xbar)***	***UCL Rbar***	***LCL Rbar***
1	61.5	61	62.5	61	61.5	61.500	61.262	1.5	0.827	61.739	60.784	1.749	0.000
2	61	61	61.5	61.3	61	61.160	61.262	0.5	0.827	61.739	60.784	1.749	0.000
3	61.5	61.4	62	61.5	61.5	61.580	61.262	0.6	0.827	61.739	60.784	1.749	0.000
4	61	62	61.5	61	61	61.300	61.262	1	0.827	61.739	60.784	1.749	0.000
5	61.5	62	61.7	62	61.5	61.740	61.262	0.5	0.827	61.739	60.784	1.749	0.000
6	61.2	61.5	61	61.2	61.5	61.280	61.262	0.5	0.827	61.739	60.784	1.749	0.000
7	61.5	60.5	60.8	61	60.9	60.940	61.262	1	0.827	61.739	60.784	1.749	0.000
8	61.5	61	60.5	61.6	61.5	61.220	61.262	1.1	0.827	61.739	60.784	1.749	0.000
9	60.9	60.5	61	61.3	61.5	61.040	61.262	1	0.827	61.739	60.784	1.749	0.000
10	61.2	61.2	60.8	61	60	60.840	61.262	1.2	0.827	61.739	60.784	1.749	0.000
11	60.9	62	61	61.2	61.4	61.300	61.262	1.1	0.827	61.739	60.784	1.749	0.000
12	61	61.5	61.5	61.2	60.2	61.080	61.262	1.3	0.827	61.739	60.784	1.749	0.000
13	60.9	61.2	61	61.5	61.5	61.220	61.262	0.6	0.827	61.739	60.784	1.749	0.000
14	61.5	61.4	61.1	61.5	61.3	61.360	61.262	0.4	0.827	61.739	60.784	1.749	0.000
15	61.2	60.8	61.7	61.5	61	61.240	61.262	0.9	0.827	61.739	60.784	1.749	0.000
16	61	61.8	60.8	61.5	60.9	61.2	61.262	1	0.827	61.739	60.784	1.749	0.000
17	61.3	61.5	61	61.5	61	61.26	61.262	0.5	0.827	61.739	60.784	1.749	0.000
18	61	61.5	61.2	61.5	61.4	61.32	61.262	0.5	0.827	61.739	60.784	1.749	0.000
19	60.8	61.2	61	61.5	61.5	61.2	61.262	0.7	0.827	61.739	60.784	1.749	0.000
20	61.5	61	61.9	61.5	61.3	61.44	61.262	0.9	0.827	61.739	60.784	1.749	0.000
21	61.3	60.9	61.5	61	61.8	61.3	61.262	0.9	0.827	61.739	60.784	1.749	0.000
22	61	61.3	61.4	61	61.5	61.24	61.262	0.5	0.827	61.739	60.784	1.749	0.000

Figure 4: - Data collected for variable data on Chest width

2.2 DATA ANALYSIS

2.2.1 X and R charts for Body Length

The below graphs of control charts portray the analysis made on the variable data, body length measurement.

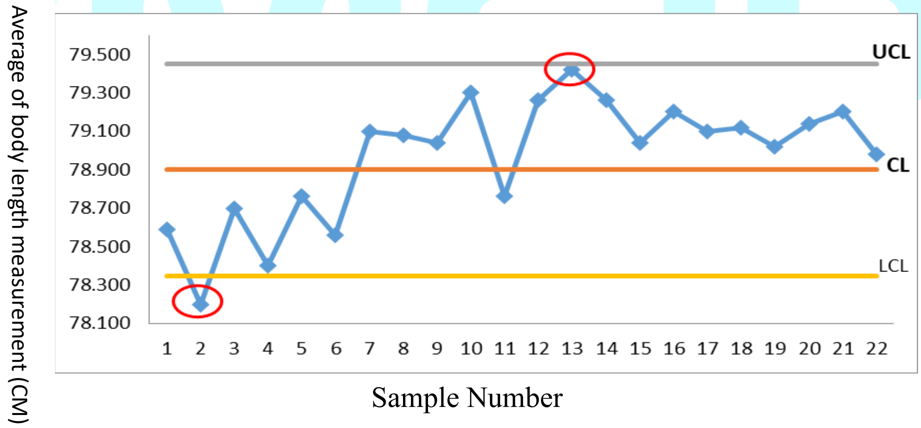

Figure 5: - X Chart for body Length

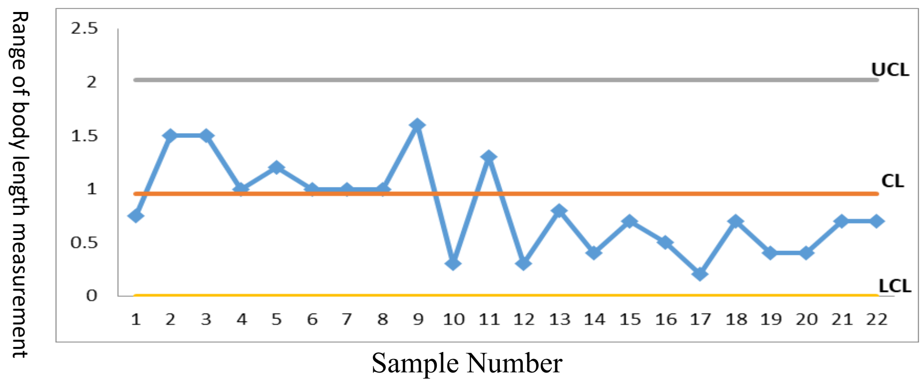

Figure 6: - R Chart for body Length

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From the figures above it can be observed on the X chart that the points corresponding to samples 2 and 13 lie outside and close to the upper control limit respectively. Therefore, the process is out-of-control, and some assignable causes are present in the process. To bring the process under statistical control, it is necessary to investigate the assignable causes and take corrective action to eliminate them.

2.2.2 Scatter Plot for Body Length

A scatter diagram was plotted to see the relationship between the variations in average measurements of the body length and the sample observation.

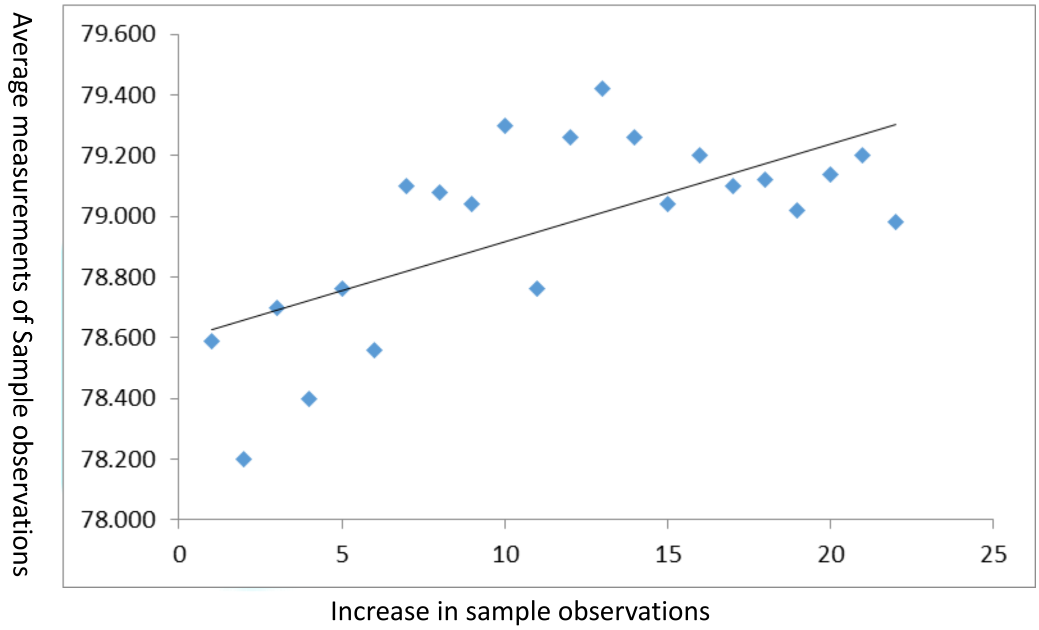

Figure 7: - Scatter diagram for body length

It can be seen from trend line of the scatter plot that the variation in body length keeps increasing as the number of observations increase and makes the process out of control.

2.2.3 X and R charts for Collar Length

The graphs below of control charts portray the analysis made on the variable data, Collar length measurement.

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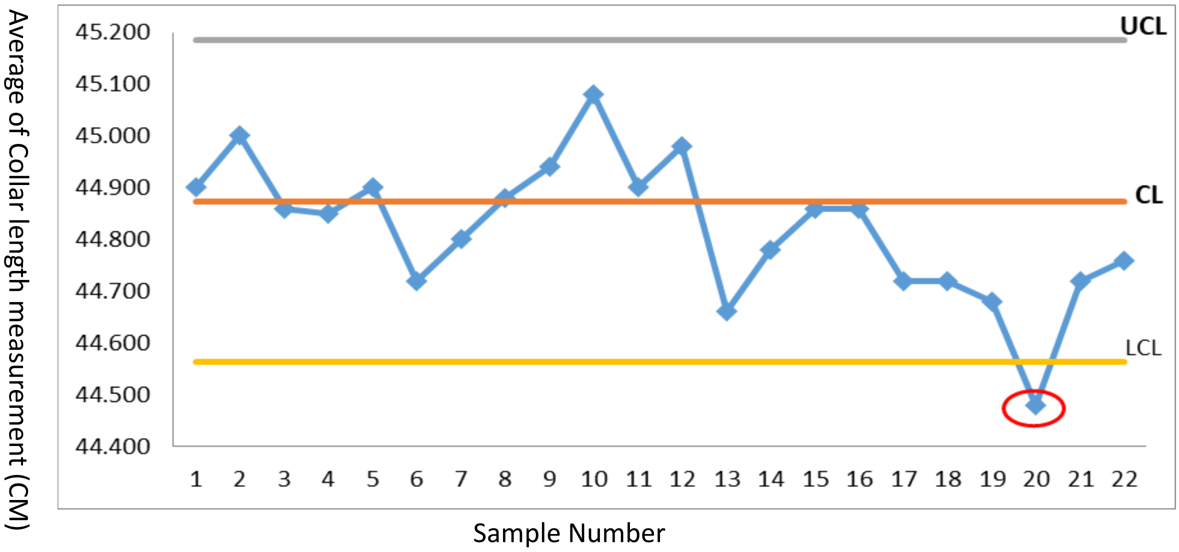

Figure 8: - X Chart for Collar Length

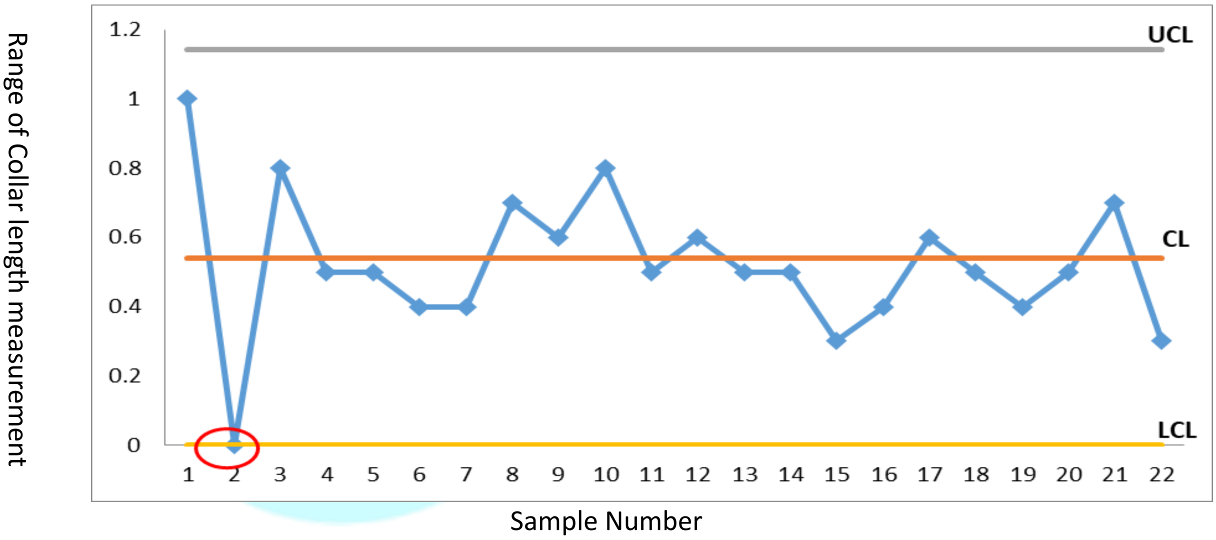

Figure 9: - R Chart for Collar Length

From the figures above it can be observed on the X and R chart that the points corresponding to samples 20 and 2 lie outside and close to the lower control limit respectively. Therefore, the process is out-of-control, and some assignable causes are present in the process. To bring the process under statistical control, it is necessary to investigate the assignable causes and take corrective action to eliminate them.

2.2.4 X and R charts for Chest width

The below graphs of control charts portray the analysis made on the variable data, Chest width measurement.

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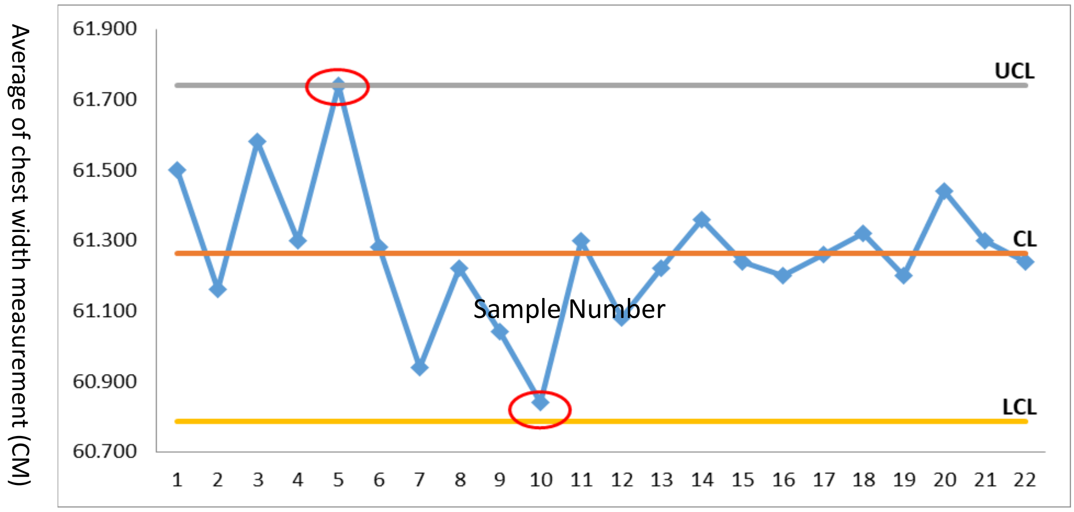

Figure 10: - X Chart for Chest width

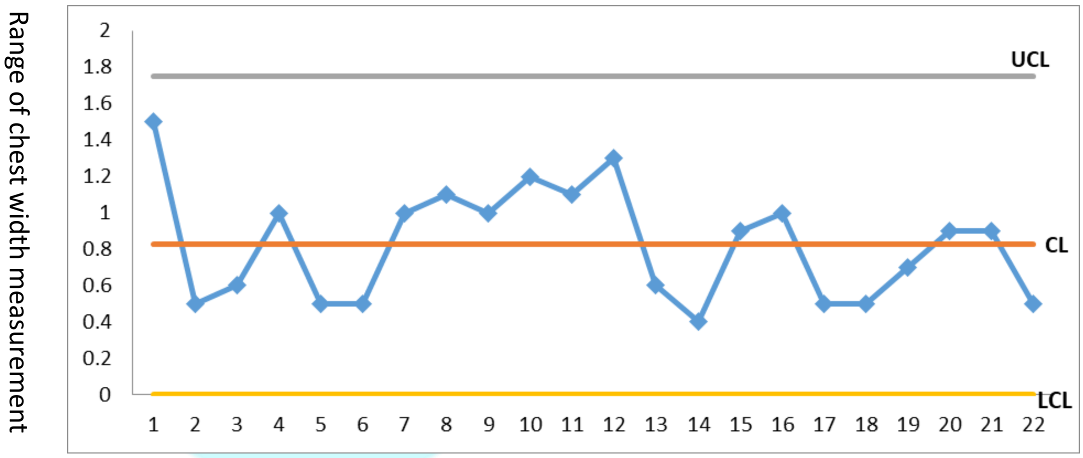

Figure 11: - R Chart for Chest width

From the figures above it can be observed on the X chart that the points corresponding to samples 5 and 10 lie close to the upper and lower control limits respectively. Therefore, the process is out-of-control or eventually will go out of control and some assignable causes are present in the process. To bring the process under statistical control, it is necessary to investigate the assignable causes and take corrective action to eliminate them.

2.2.5 Pareto Analysis for Defects

The factory has a practice of using Pareto but not in a way that the principle demands and what they do is more of a simple bar chart than Pareto.

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- They did not categorize defects which made it difficult for later understanding of the chart.
- They construct the chart and assume that the tallest bar is the defect with higher frequency. This is true but this is not what Pareto is about and it can lead to wrong conclusions.
- They did not normally take further actions after developing the chart. They just try to identify the defect with the highest frequency and Pareto is not just a frequency chart, but it goes beyond that.
- Overall, they did not fully understand the principles (80/20 rule) behind the Pareto chart and how to correctly construct it.

After observing the above gaps, a Pareto chart was developed by categorizing defects and labeling the cumulative line to clearly bring in the 80/20 rule into picture. The analysis as shown in the figure below depicted that around 80% of the failures were occurring because of 20% of the defects (highlighted section) which were open seams, broken stitches and missing buttonholes and these three defects need to be focus area of improvement.

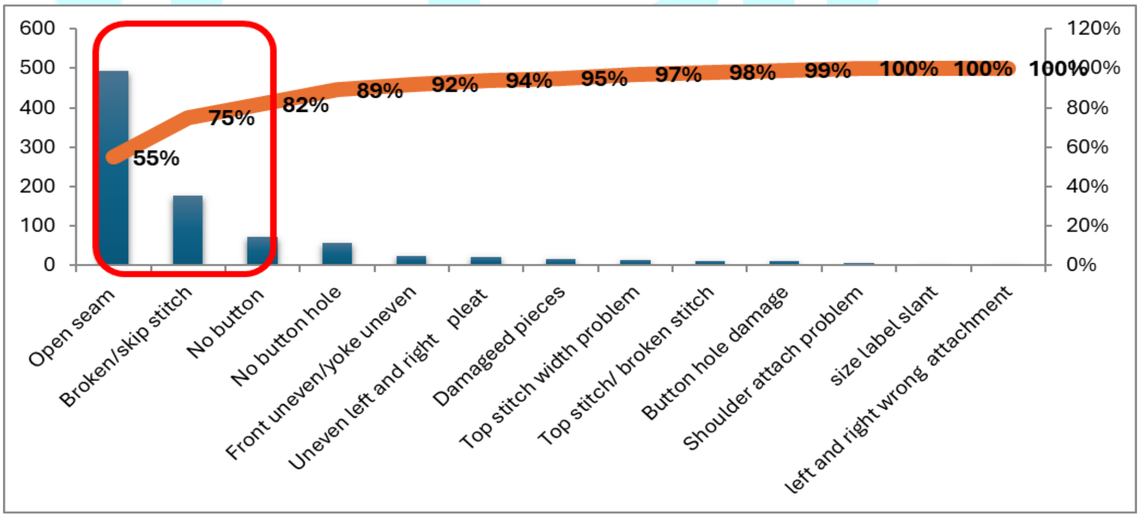

Figure 12: - Pareto chart of defects

2.2.6 Cause and Effect Analysis of Assignable Causes

A formal meeting was carried out with a team of 6 experts (2 from quality, 2 from cutting, 1 from Production, and 1 from Sampling Sections) so as to be able to brainstorm and raise possible causes for the process which went out of control.

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2.2.6.1 Cause and Effect for measurement of body length out of tolerance

From the fishbone below (Cause and effect diagram), the major areas that need intervention were summarized as;

- Carelessness of operators which lead to excess seam allowances which eventually lead to out-of-tolerance measurements
- Poor maintenance practice which leads to blade problems and eventually to out-of-tolerance measurements
- Use of old pattern papers that result in dimension variations through time and eventually lead to out-of-tolerance measurements

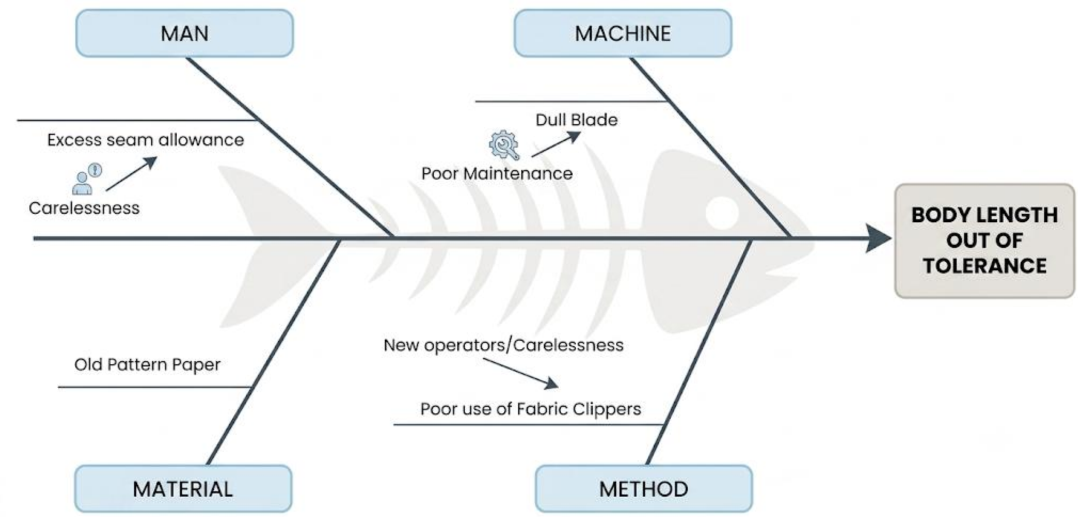

Figure 13: Cause and effect diagram for out of tolerance body length

2.2.6.2 Cause and Effect for measurement of Collar out of tolerance

From the fishbone below (Cause and effect diagram), the major areas that need intervention were summarized as;

- Carelessness of operators which lead to button and buttonhole miss placement which eventually lead to out-of-tolerance measurements
- Poor handling of material which leads to out-of-tolerance measurements
- Use of old pattern papers that result in dimension variations through time and eventually lead to out-of-tolerance measurements

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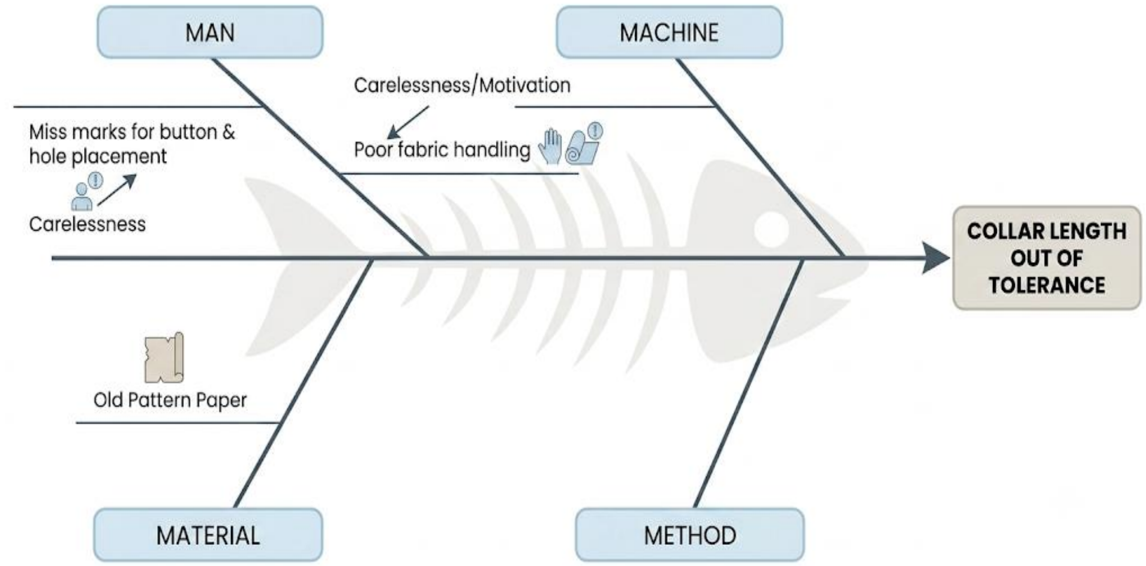

Figure 14: Cause and effect diagram for out of tolerance Collar length

2.2.6.3 Cause and Effect for Broken Stitches

The fishbone diagram reveals a few key areas that are likely contributing to the problem of broken stitches:

- **Machine:** There is an ongoing issue with "Machine adjustment," which implies that the sewing machines are not set up or calibrated correctly. This can put undue stress on the thread, leading to breakage.
- **Man (Operators):** Operator "Carelessness" was identified, which seems to lead to "Improper Trimming." When excess material isn't trimmed correctly, it can get caught in the machine's mechanism and cause the thread to break.
- **Material:** The "Fraying fabric" itself is listed as a cause. Weak or low-quality fabric can fray easily, and these loose fibers can create friction or block the thread's path, causing it to snap.

In summary, the diagram points to a combination of equipment setup issues, human error during operations, and material quality problems that need to be addressed to solve the issue of broken stitches.

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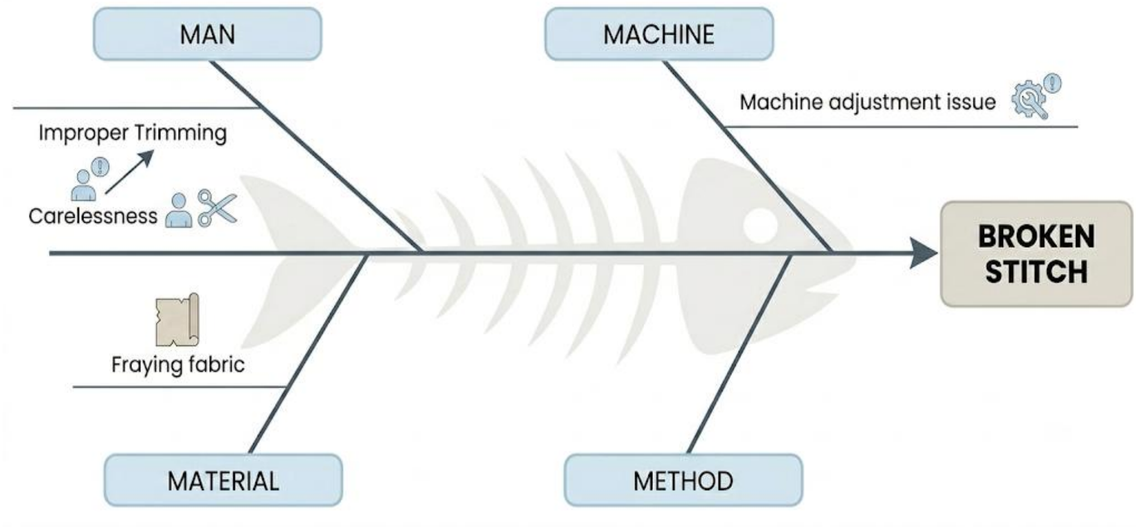

Figure 15: Cause and effect diagram for Broken Stitch

2.2.6.4 Cause and Effect for Open seams

Based on the analysis visualized in the final fishbone diagram, the primary root causes contributing to the problem of **"Open Seams"** are distributed across three main categories:

- **Machine (Equipment Factors)**: A critical technical issue was identified regarding the "Timing between needle & looper or hook. If the synchronization between these primary stitching components is off, the machine will fail to form a secure stitch, directly leading to an open seam.

- **Man (Human Factors)**

  The findings point to human error rooted in "Carelessness" and potentially low "Motivation." These factors manifest in two ways:

  - **"Improper handling of fabric"** during the sewing process, which can cause misaligned stitching.

  - Creating **"Miss marks for button & hole placement,"** leading to sewing outside the intended seam path.

- **Material (Raw Material Factors)**

  The quality of the input material is a contributing factor, specifically **"Fraying fabric."** When the fabric edges are weak and unraveling, the stitches cannot hold the material together effectively, causing the seam to fail.

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In summary, the diagram reveals that the open seam issue is not caused by a single failure, but rather a combination of specific machine calibration problems, operator handling errors, and suboptimal material quality.

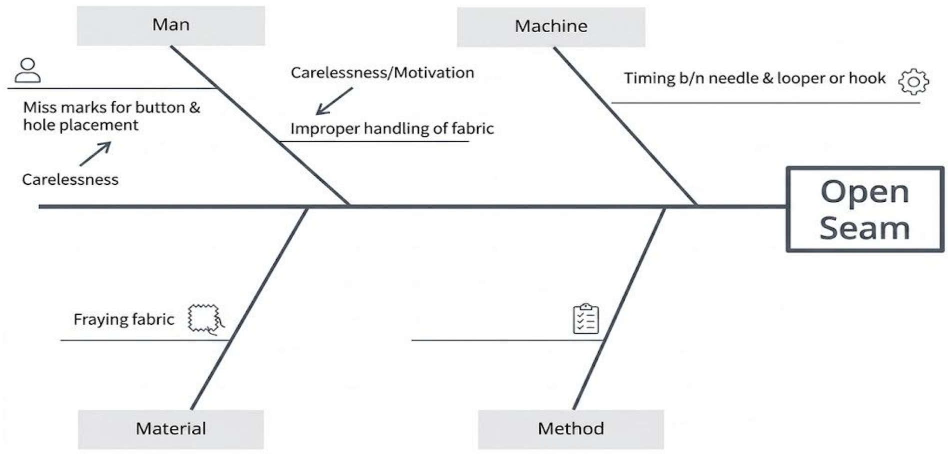

Figure 16: Cause and effect diagram for Open Seam

3. RESULTS AND DISCUSSION

3.1 Removal of Assignable Causes from the production process

Machine Issues

- **Dull Blade / Poor Maintenance:** a strict preventative maintenance schedule was established for regular blade inspection, sharpening, and timely replacements.
- **Machine Adjustment Issues:** Standard calibration checklists were created for technician setups before each production shift.
- **Timing between Needle & Looper/Hook:** Performance of pre-flight mechanical timing checks using standard gauge blocks was in place to ensure precise hook and needle synchronization.

Man (Human Factors)

- **Carelessness / Lack of Motivation:** factory was recommended to introduce quality performance incentives, rotate tasks to reduce fatigue, and reinforce a quality-first mindset on the shop floor.
- **Improper Handling of Fabric:** hands on training were conducted for operators on proper fabric feeding, guiding, and tension control techniques.

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- **Missed Marks for Button & Hole Placement:** Implement rigid template stencils or optical positioning aids were implemented so placement marks are standardized and easy to see.
- **New Operators / Inexperience:** supervisors were assigned as mentors to new hires during their onboarding period and implement a skill-verification gateway before they work independently.

Material Issues

- **Fraying Fabric:** Applying edge-binding/overclocking techniques early in the assembly were in place.
- **Old Pattern Paper:** worn out paper templates were discarded and were replaced by durable acrylic/plastic cut templates.

Method Issues

- **Poor Use of Fabric Clippers / Improper Trimming:** Trimming procedures were standardized by preparing and implementing (SOPs) and old trimming tools were replaced with ergonomic properly maintained tools for precise cutting.
- **Excess Seam Allowance:** pattern tolerances were standardized and fixed seam guides were attached to machines to enforce exact seam margins.

After implementing the above activities, 20 samples of 5 observations each were made on front body length to see if the process was still out of control or has moved within the control limits and the following result was obtained.

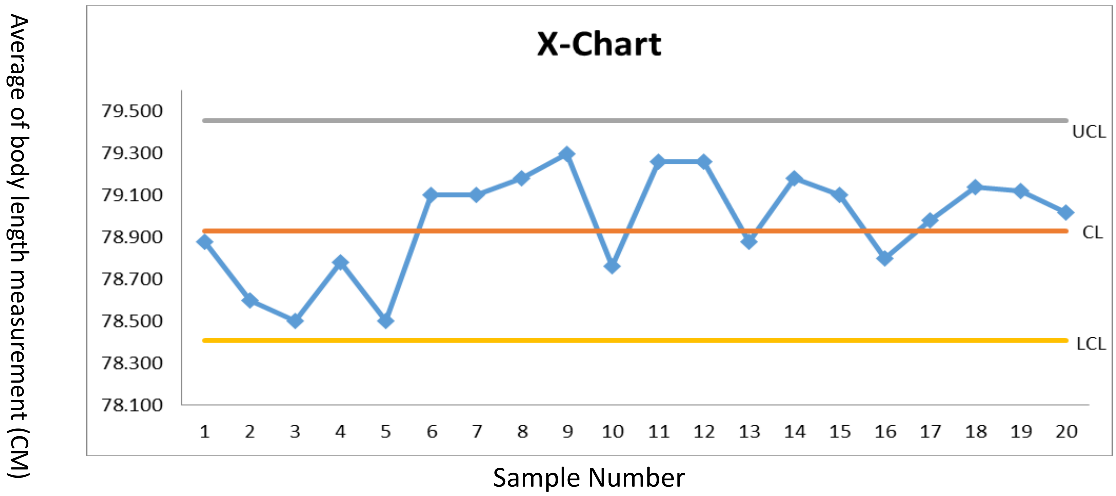

Figure 17: - X Chart for body Length (After Intervention)

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Before the intervention, from the 110 observed 9% of them resulted in assignable causes and has made the process go out of control. After the intervention, 20 samples of 5 observations each were made on front body length to see if the process was still out of control or had moved within the control limits and it was able to remove 9% of the observed assignable causes (quality problems) from the process.

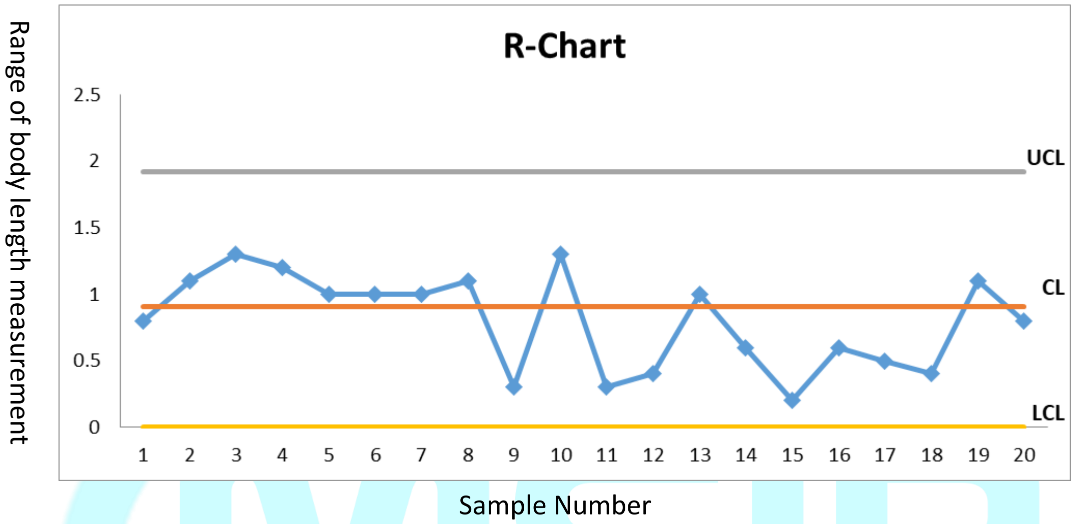

Figure 18: - R Chart for body Length (After Intervention)

As can be observed from the X -chart above, the process has moved within the allowable tolerance limits and can be said that the process quality has improved.

4. CONCLUSION AND RECOMMENDATIONS

Conclusions

- By implementing SPC on variable parameters it has been able to remove assignable causes on 9% of the samples observed.
- The study looked at implementation of SPC tools in a selected case factory in Addis Ababa, Ethiopia and was learnt that the company had no prior experience of proper application of the SPC tools. The main reason for this was the gap in the knowledge of SPC and its powerful impact if applied properly.
- If an organization needs to compete on a global scale, embracing SPC is inevitable. When SPC is utilized properly, it enables manufacturers to prevent problems, control their production processes, and ultimately increase profits and customer satisfaction.

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- The approach of well-known methods (in this case SPC) made it possible to identify significant points of improvement at almost zero cost, thus avoiding the implementation of costly projects that would be implemented without due knowledge of the process; based on simple calculations and common sense.

Recommendations

- Soft skills or life skill training should be incorporated in the employment processes of companies so that these could contribute to the reduction of high labor turnovers which makes applying and sustaining of any kind of research work challenging.
- The applied research work needs continuous follow-up and committed measures both from the center and the factory side to sustain and keep getting positive results.
- Broadening the level of implementation and sustainment of such tools to more case companies can contribute to improved production quality and production capacity levels in the country as a whole
- Process reviews and operator training have to be undertaken for industry wide appreciation of SPC tools and their benefits to the quality deployment of various Garment manufacturing entities in the country.

REFERENCES

1. *CNNMoney, " My Golden Rule,"*. (2005). Retrieved from money.cnn.com.
2. A. Aini, K. R. (2017). *SPC systems in Apparel production.* Diponegoro University, Indonesia, Deaprtment of Statistics.
3. A. Chowdhury, B. S. (2011). IMPROVING PERFORMANCE OF THE CUTTING SECTION APPLYING LEAN TOOL: A CASE STUDY OF A BANGLADESHI KNITWEAR COMPANY., (pp. 50-52).
4. A. Mulat, K. H. (2018, June). Implementation of SPC in the section of garment industry for quality improvement. *AUTEX Research JOurnal*, 1-13.
5. Antony, B. M. (n.d.). Is SPC just about control charts.
6. B. Mason, J. A. (2007). Statistical process control: an essential ingredient for improving service and manufacturing quality. *managing service quality*, 233-238.

 DOI: ***10.5281/zenodo.22055839***

7. C. kasemset, C. J. (2015). Application of MFCA in waste reduction: case study on a small textile factory in Thailand. *Journal of Cleaner Production, 79*(18), 1342-1351.

8. Carpinetti, L. (1998). Process Quality COntrol.

9. Charles, M. I. (n.d.).

10. Charles, M. I. (2016). Application of SPC in Manufacturing Industry in Developing country. *13th global conference on sustainable manuafcturing*, (pp. 580-583).

11. Felix, V. (2014). In *Introduction to Statistical Process Control: A problem Solving Process Approach.*

12. Franko M., a. K. (2007). Towards a Definition of a Business Performance Measurement System. *International Journal of Operation and Production Management*, 784-801.

13. H.Wendy. (2017). *Sewing Machine Maintenace.*

14. Control Charts for Attributes. In T. P. ignou..

15. Mahbubul, R. M. (n.d.). Investigation of fabric wastages in Knit T-shirt manufacturing Industry.

16. Montgomery, D. (2009). *INtroduction to Statistical quality control.* John wiley& Sons Inc.

17. R. Roberta, W. B. (2006). *Statistical Process Control: Operation Management* (5th ed.). Chattanooga.

18. R. Balakumar. (2021). *Preventive maintenace of industrial sewing machine.* Chennai.

19. R. Mominur, a. H. (n.d.). *Investigation of Fabric wastages in Knit T-shirts Manufacturing Industry.* Textile engineering, Daffodil International University, Bangladesh, Dahka.

 DOI: ***10.5281/zenodo.22055839***

20. R. Parvesh, M. B. (2012). Improving the process capability of a boring operation by the application of statitstical techniques. *International Journal of Science and Engineering Research*, 1-6.

21. Ribero, J. (2012). Quality Monographic Series: Statistical Process Control.

22. Safa, T. (2018, March). Keeping track of garment Production process and process improvement using quality control techniques. *Periodicals of Engineering and natural sciences*, pp. 11-26.

 DOI: ***10.5281/zenodo.22055839***