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IMPROVE THE QUALITY OF PRODUCTS IN WOVEN APPAREL INDUSTRIES BY PLAN-DO-CHECK-ACT (PDCA) CYCLE

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ABSTRACT

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Textile and apparel industry's product quality is calculated in terms of acceptable quality level (AQL). Quality assurance covers all the process within a company that contributes to the production of quality products. The examination process of the quality of the industry is the inspection and it is carried out by representatives of the current production and the result records on control chart which is a process to assure the product quality acceptable or not. A Factory has been taken for analysis at AQL 2.5 level. Then the faults are needed to identify and quantify them. After analysis the percentage of different faults in woven garment, most of the faults are covered by broken stitch, un-cut thread and oil stain which is around 47% of total fault. And all those fault produce due to low quality of stitching and machine performance. By applying PDCA cycle, the quality has been improved significantly. On average, 50% of total faults are reduced by this concept.

Key words: *quality, apparel, faults, stitch, AQL, PDCA cycle*

INTRODUCTION

Quality control is a procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of the client or customer (Carr 1988).

The "Acceptable Quality Level" is defined as the maximum percent defective (or the maximum number of defects per hundred units) that, for purpose of sampling inspection, can be considered satisfactory as a process average. According to ISO 9000:2000, "It is the degree to which a set of inherent characteristics fulfills requirements." (Mehta *et al.* 1998).

A defect is any nonconformance of the unit of product with the specified requirements. A defective is a unit of product, which contains one or more defects. Failure to meet requirements with respect to quality characteristics are usually described in terms of defects or defectives. There are mainly 3 types of Defects: a) Critical defects, b) Major defects, c) Minor defects.

A sample consists of one or more units of product drawn from a lot or batch, the units of the sample being selected at random without regard to their quality. The number of product in the sample is the sample size. One sample of items is selected at random from a lot and the disposition of the lot is determined from the resulting information. These plans are usually denoted as (n,c) plans for a sample size n, where the lot is rejected if there are more than c defectives. These are the most common (and easiest) plans to use although not the most efficient in terms of average number of samples needed.

MATERIALS AND METHODS

'PDCA Cycle' Theory:

The process approach promoted by ISO 9001:2000 systematically identifies and manages processes that combine the quality system and the interactions between the processes. This process model is actually based on the Plan-Do-Check-Act cycle (PDCA) which can be applied to all processes. Related to the quality management system, the PDCA cycle is a dynamic cycle that could be implemented about any process within the organization. It combines planning, implementing, controlling and continual improvement within the realization processes.

Plan: The planning is combined of the WH questions: What is required to be done? How much is required to be done? Where it is required to be done? Who should do it? When it is required to be done?

Do: After planning, you must realize your plan – put words into actions.

Check: Monitor and measure the processes and the products according to the plan, policies, objectives and requirements.

Act: Take measures and activities to improve the performance.

METHODOLOGY

- ❖ At first a garment industry, maintaining AQL level 2.5 at production sector, has been selected (Behda *et al.* 2003).
- ❖ Then the production plan is analyzed and is maintained AQL level procedure. Sample size, acceptable and rejectable quantity are determined from AQL sampling plan chart.

- ❖ Then we have been collected possible number of checklist from the factory and note out the data of the shipment inspection checklist. From the check list we have been found the number of total order quantity, lot size, number of lots, sample size, AQL offered for the shipment, name of the every inspected defects, number of the defects in every check list.
- ❖ Then we have been listed every defects in a chart, and found the major defects number and the minor defects number in each checklist. From the chart, we have been found the total number of major defects and minor defects. From the AQL level and the number of defects, using the AQL sampling plan charts it have been found that which lot was accepted or rejected.
- ❖ Then total number of the each defect in all lots have been found and can be converted the numbers in a percentage. From the percentage, it is possible to compare that, which defects are occurred frequently during the production.
- ❖ Then PDCA cycle has been applied to identify the cause for the fault and plan to minimize the fault. Then data have been collected again after applying the PDCA Cycle (Bisen and Srivastava, 2009).

EXPERIMENTAL DATA

Opex Group which is established at Narayanganj, Dhaka, Bangladesh, is one of the biggest woven garment producing industries. It has produced 100% export oriented woven products. Product types are Jersey, Jacket, Trouser, Skirt, Shorts, Blouse, and Shirts etc. It has 130 sewing lines. 20,000 pcs garments at random inspection at AQL level 2.5 and the fault garment found 39 pcs at inspection. The faults are analysed below:-

Table 1. Inspection Checklist

Total Order Qty: 20,000 pcs		AQL Level: 2.5				No. of Lots: 3			
		Lot-1		Lot-2		Lot-3		Total no of Defects in all Lots	Defect % Among all Defects
Lot size		6500		6500		7000			
Sample size		80		80		80			
Ac/Re		5/6		5/6		5/6			
No.	Defects name	Mj	Mn	Mj	Mn	Mj	Mn		
1	Broken Stitch	1			2		3	6	15.38
2	Bottom width uneven		1				1	2	5.13
3	Waist mouth up-down	1			2			3	7.69
4	Skip Stitch		1	2		1		4	10.26
5	Poor iron		3		1			4	10.26
6	Rivet missing	1						1	2.56
7	Un-cut thread		2				3	5	17.95
8	Oil stain			2		1	2	5	12.82
9	Foreign yarn				3			3	7.69
10	Shade variation			1		1		2	5.13
11	Dirty spot				1	1		2	5.13
Total		4	8	5	9	4	9	39	100%
Inspection Result		Passed		Passed		Passed			

Table 2. Defects Percentage

Faults	Defects %
Broken Stitch	15.38
Bottom width uneven	5.13
Waist mouth up-down	7.69
Skip Stitch	10.26
Poor iron	10.26
Rivt missing	2.56
Un-cut thread	17.95
Oil stain	12.82
Foreign yarn	7.69
Shade variation	5.13
Dirty spot	5.13

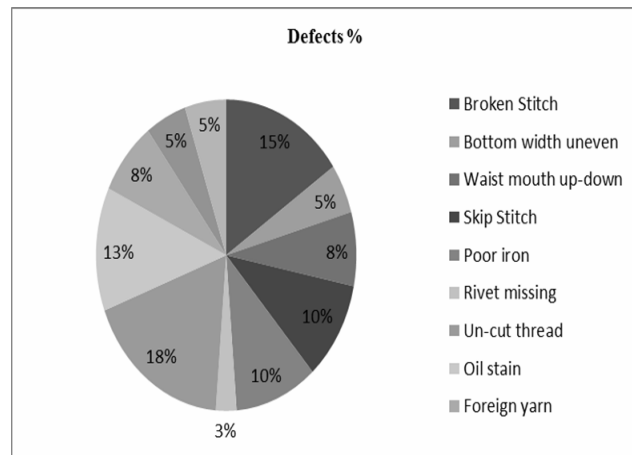


Fig. 1. Graphical presentation of defects Percentage

Here, it has been found that the most faults happen at broken stitch, un-cut thread and oil staining. It is more than 46% of total fault. After analysis those fault, below causes are identify:-

PLAN	5 WH Questions: Q-1: What is required to be done? Q-2: How much is required to be done? Q-3: Where it is required to be done? Q-4: Who should do it? Q-5: When it is required to be done?	Answers of the 5 WH Questions: A-1: Perfect stitching. A-2: Towards zero number of defects. A-3: In every stitch on seam line. A-4: The Operator. A-5: During sewing.
DO	Process implementation according to PLAN: Adjust the machine properly Using good quality sewing thread. Recruit expert operator Give proper time for stitching	
CHECK	Inspection of the process: Monitoring and measure the process and the products. Either the Broken Stitch is occurring or not. If Broken Stitch is not occurring then ACT the process successfully. If Broken Stitch is occurring then go back to the PLAN stage to come up with some new ideas for solving the problem and go through the cycle again.	
ACT	Take action to continually improve process performance. If any Broken Stitch is found then start the PLAN stage for solving it.	

Reason for Oil Stain:

Oil stains generally come from sewing machines; machines such as over lock and flat lock machines are more prone to have oil stains. Dirt stains are usually due to cleanliness of both the machine and the operator. Extra Oil in machine transfers to the garment components and create faults in garments.

Reason for Broken Stitch:

Defects generally come from improper trimming or improper machine usage. Also the timing adjustment of stitch formation cause broken stitch rapidly.

Reason for un-cut thread:

Machine knife is not properly sharp and timing was not correct due to shortage of time. Also online Quality control is not clearing the un-cut thread.

PDCA cycle has been followed for each fault to reduce and improve quality. Below a PDCA Cycle given for broken stitch:-

After implementing the PDCA Cycle at production, then it has been analyzed 20,000 pcs garments at production. The inspection chart given below:-

Table 3. Inspection Checklist after implementing PDCA cycle

Total Order Qty: 20,000 pcs		AQL Level: 1.5				No. of Lots: 3			
		Lot-1		Lot-2		Lot-3		Total no of Defects in all Lots	Defect % Among all Defects
Lot size		6500		6500		7000			
Sample size		80		80		80			
Ac/Re		3/4		3/4		3/4			
No.	Defects name	Mj	Mn	Mj	Mn	Mj	Mn		
1	Broken Stitch	1			1		1	3	12.50%
2	Bottom width uneven		1				1	2	8.33%
3	Waist mouth up-down	1			1			2	8.33%
4	Skip Stitch		1	1		1		3	12.50%
5	Poor iron		2		1			3	12.50%
6	Rivet missing	1						1	4.17%
7	Un-cut thread		1				2	3	12.50%
8	Oil stain			1		1	1	3	12.50%
9	Foreign yarn				1			1	4.17%
10	Shade variation			1		1		2	8.33%
11	Dirty spot				1			1	4.17%
Total		3	5	3	5	3	5	24	100%
Inspection Result		Passed		Passed		Passed			

Table 4. Defects Percentage after implementing PDCA cycle

Faults	Defect%
Broken Stitch	12.50%
Bottom width uneven	8.33%
Waist mouth up-down	8.33%
Skip Stitch	12.50%
Poor iron	12.50%
Rivet missing	4.17%
Un-cut thread	12.50%
Oil stain	12.50%
Foreign yarn	4.17%
Shade variation	8.33%
Dirty spot	4.17%

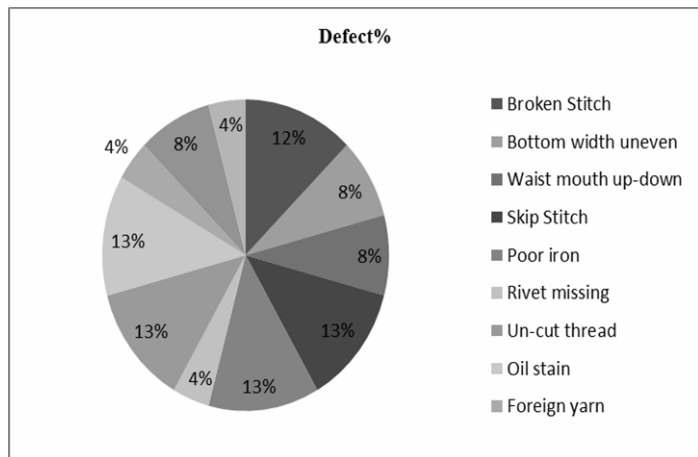


Fig. 2. Graphical presentation of defects Percentage after implementing PDCA Cycle

RESULTS

The garments have been examined at AQL 2.5 and found some major causes which are the main reasons for reducing the quality. However, the amount of faults are analyzed and reduced by PDCA Cycle. As the quality examined by AQL chart, the quality examined at AQL 1.5 and found some significant improvement at production quality. The compare of the fault before applying PDCA Cycle and after PDCA Cycle given below:-

Table 5. Compare of defects at before PDCA Cycle (at AQL 2.5) and after PDCA Cycle (AQL 1.5)

Faults	Defects at AQL 2.5 (Before PDCA Cycle)	Defects at AQL 1.5 (After PDCA Cycle)	Reduce%
Broken Stitch	6	3	50.00%
Bottom width uneven	2	2	0.00%
Waist mouth up-down	3	2	33.33%
Skip Stitch	4	3	25.00%
Poor iron	4	3	25.00%
Rivet missing	1	1	0.00%
Un-cut thread	5	3	40.00%
Oil stain	5	3	40.00%
Foreign yarn	3	1	66.67%
Shade variation	2	2	0.00%
Dirty spot	2	1	50.00%

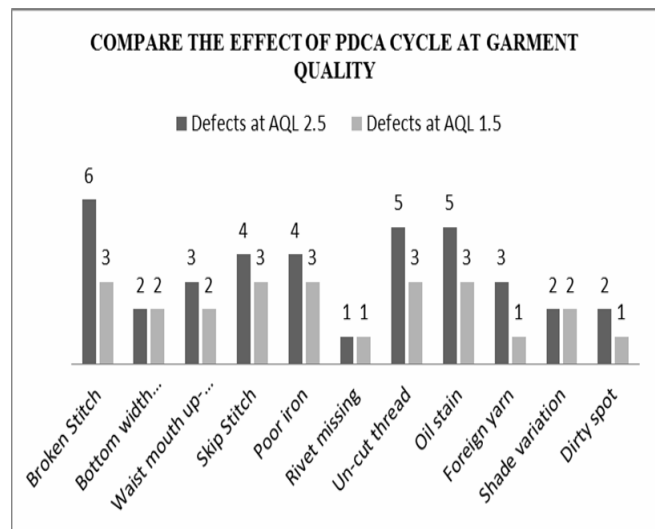


Fig. 3. Graphical presentation of defects comparison at AQL 2.5 and AQL 1.5

It seems that extra online inspection in sewing line and machine maintainence is required for improving quality at production. By applying the PDCA cycle at production floor, it has been found that the quality of the product can be improved by reducing the amount of un-cut thread, oil strain and broken stitch but extra online inspection and precaution must required which might reduce production rate.

CONCLUSION

Now a day Bangladesh is one of the significant garments export countries in the world. But most of the factories produce low quality product. Due to this reason, Bangladesh could not penetrate the value added market. Through applying PDCA cycle, Quality of the products will improve up to a level. To penetrate the value added market of the world, the technology and skilled manpower must be adopted.

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