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Applying DMAIC methodology to reduce defects of Sewing Section in RMG- A Case Study

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Abstract- *Global competition, crying off profit margin, customer requirement for high quality product at near to the ground cost and other economic factors set in motion the manufacturer to reduce their production cost without concession of quality in order to stand up in business area. Defect or wastages* reduction *is the initial step to reduce production cost as well as improve the quality. Higher quality comes with the reduced cycle time by reducing alters. Apprehension this issue, this work walks around the use of DMAIC methodology of six sigma to lessen the defect rate in sewing section of FCI (BD) LTD.* Throughout *five phases of DMAIC methodology name*d *define, measure, analyze, improve and control, this approach minimizes defects analytically. In different phases different types of six sigma tools were exercised. Pareto analysis w*as *acted* to identify the top defects *and root causes of those defects were sensed. These were done for Ladies' tops and trousers. Brainstorming and literature review helped to endow with some potential solutions to overcome the problem. With the remedial action and implementation in pilot run the result found is very noteworthy. The defect percentage has been reduced from 11.67 to 9.672 and as a result the sigma level has been upgraded from 2.69 to 2.8*

Keywords: DMAIC, Sewing defects, Six sigma, Sigma level.

1. INTRODUCTION

In Bangladesh economy RMG sector plays a vital role. From the last decade, RMG sector becomes popular in our country and it contributes to the national economy in considerable rate. It is necessary to focus on quality control of garment industry. In the garment industry quality control is a big challenge for existing and it maintained from the initial stage to the stage of final finished garment. In this industry, product quality can be calculated by different kind of scale. These are quality and standard of fibers, fabric construction, yarn, surface designs, color fastness and the final finished garment products. Number of defected occurs, percentage of defected product are very common way to calculate product quality.

The major departments of a garment manufacturing industry are cutting section, sewing section, finishing section. After finishing of the cutting operation garments components, all the garments parts are joined and sewn as sequentially. In this study, defects of sewing operations for ladies' tops and trousers are discussed. Defect is the common term in the garment industry. Defect is the loss of time, cost and raw material. So, it is a burning question for manufacturer that how to reduce defects. To reduce defects of RMG DMAIC methodology is used which is a problem solving of Six sigma. The Six Sigma proposes to use a method of problem solving [2, 5]. This method follows a conductive five-step necessary to obtain reliable results, contracted in the acronym DMAIC for: Define, Measure, Analyze, Improve or Innovate and Check. The DMAIC approach of Six Sigma works as a filter to pass from a complex problem with many uncontrolled variables to a situation where quality is controlled.

2. METHODOLOGY

For garment item, i.e. ladies' tops and trousers, data sheets were collected for the length of one month (January). The end line quality inspectors provided the data sheets from their record books from the production lines of the sewing section of FCI (BD) LTD when we visited the garments factory. 15472 ladies' tops and trousers were examined and we found 1806 defective pieces. Our main purpose was to identify the top most defects, the root cause of the defects, give some suggestions to reduce the per cent of defects and improve sigma level [1]. DMAIC methodology is used for this purpose [3]. It can be illustrated with the following

Define: problem selection and benefit analysis. Identifying and mapping relevant processes, identifying stakeholders, prioritizing customer needs & making a business case for the project.

Measure: translation of the problem into a measurable form, and measurement of the current situation.

Analyze: identification of influence factors and causes, identifying potential influence factors & selecting the vital few influence factors.
Improve: design and implementation of adjustments to the process to improve the performance & conduct pilot test of improvement actions.
Control: empirical verification of the project's results and adjustment of the process management and control system in order that improvements are sustainable, the new process capability & implement control plans.

3. DATA ANALYSIS AND CALCULATION

Here goes the data collection & analysis through five phases-

3.1 Define Phase

The purpose of this phase is very clear, define the problem. We here discussed about the defects problems. The goal of the project also should be defined very well through this phase and finally here come the processes. Before works begin we must know about all relevant elements of a process improvement. SIPOC diagram is the tool to show the process map about this information [4].
Problem Statement-In apparel industries quality is achieved when the defects of the products are decreased. The manufacturers are trying to reduce defects. In our country garment factory face high rate of rejections due to defects. For this reason they can't meet quality standards. This also increases the number of rework, scrap cost, delay of delivery due to rework etc.
Goal Statement-The ultimate goal is to minimize the percentage of defects which results in minimize the production cost, improve quality, reduce wastes and enhance sigma level.
SIPOC-The quality of a process is evaluated by the output of the process. Table 3.1shows the SIPOC flow of the FCI (BD) LTD.

Table 1: SIPOC diagram for ladies' tops & trousers

Suppliers	Inputs	Process	Outputs	Customers
Alex Fabrics Ltd. Fabian Group	Unstitched cloth Machinery Thread Needles Button Zipper Label	Sampling Cutting Sewing Washing Ironing Finishing Packaging	Ladies tops Trousers	NyGard

3.2 Measure Phase

Some of the products are Executive Ladies' tops and trousers are inspected for defects since this was the critical product for the company as they had lot of demand and the profit margin for these particular products are high. Here the per cent of defectives is found 10.30. Defect per opportunity (DPO) is 0.1030 and defect per million opportunities is 103033. The sigma level is 2.76. Table 2 shows the outcome.

Table 2: Calculation of DPMO& Six sigma

Total checked items	15472
No of defectives	1806
% Defectives	11.67
DPU	0.1167
DPMO	116727
Sigma level	2.69

3.3 Analyze Phase

The main goal of the analyze phase is to go through the data to find out the top most defects which are reoccurring as well as the root causes of the problems and seek improvement opportunities.

Table 3: Details of percentage occurrence

Defects	Total Occurrences	% of occurrences	% cumulative
Puckering	361	20	20
Visible stitch	326	18	38
Out of shape	307	17	55
Skip stitch	199	11	66
Uneven stitch	163	9	75
Broken stitch	144	8	83
Raw edge	90	5	88
Uncut thread	90	5	93
Length stitch	72	4	97
Down stitch	54	3	100

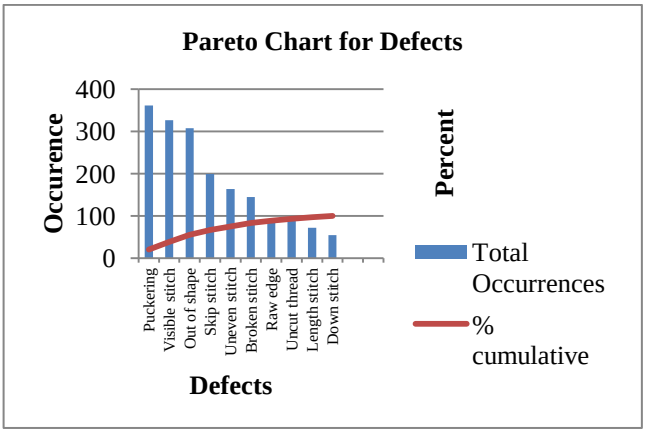

Fig. 1: Pareto chart for defects

Brainstorming: It is one of the major problem solving tools. The purpose of this step is to identify, validate and select the root cause for removal. We have analyzed the

causes of those defects and constructed Cause-Effect diagrams which are shown in fig 2.

3.4 Improve Phase The purpose of this step is to identify, test and implement a solution to the problems in part or in whole

Table 4: Suggested solutions for different types of Problems (defects occurring)

Defect Name and place	Potential Root Cause	Solution
1) Puckering at Side Seam	Parts handling method	Follow the guide properly, reduce speed at shape changing area
		Hold both parts in asymmetric
	Thread tension mismatched	Readjust thread tension
	There is no mark to hold the parts properly	Put cut mark at edge during cutting the panel
2) Raw edge at side seam	Parts handling method	Follow the guide properly, reduce speed at shape changing area
		Hold both parts in asymmetric
	Excessive Speed	Don't exceed the speed limit 4500rpm
3)Waist band mouth out of shape	Mouth close wrong	Straight sewing at mouth close bottom line
	Waist band top stitch inclined	Use the shape folder for waist band top stitch
4)Uneven stitch at back pocket top stitch	Stitch corner round shaped	Use split bar DNLS machine for ease of operating
		Don't stress the pocket corner during stitching
5)Uncut thread at loop tack	Wiper stopped	Never stop wiper
	Stitch continued over the space	Stop stitch at the parts end
	Bobbin thread loose	Adjust the bobbin thread
6) Broken stitch at cross point	Stitch cut during excess thread cutting.	Cut thread end carefully
	Use of air line during inseam join operation	Stop using air blowing if avoidable
7)Down stitch at waist band top stitch	Waist band attach wrong	Follow block pressing mark
	Waist band width measurement wrong	Keep the allowance same during waist band center tack
	Cut panel width shortage	Follow marker line properly to avoid cutting mistake
	Allowance not even at waist band attach	Keep the allowance even and follow the gauge properly
8)Visible stitch at waist top stitch	Waist band attach wrong	Follow block pressing mark
	Waist band width measurement wrong	Keep the allowance same during waist band center tack
	Cut panel width shortage	Follow marker line properly to avoid cutting mistake
9)Length uneven	Allowance not even at waist band attach	Keep the allowance even and follow the gauge properly
	Size mistake	Use single piece material in sewing line to avoid size mixing up.

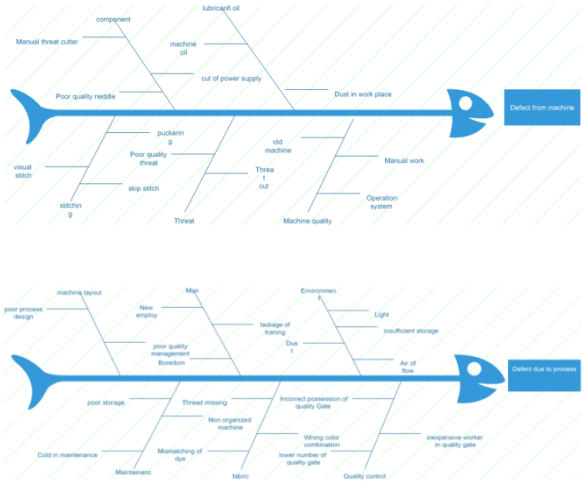

Fig.2 Cause-Effect diagram for all defects due to machine &process

Implementation: The implementation was done into one of their pilot sewing line and details are listed in the table 5 below.

Table 5**:** Defects after implementation of DMAIC

Date	Checked item	Good item	Defective item
Feb 1	431	397	34
Feb 2	570	411	159
Feb 4	805	730	75
Feb 5	843	791	52
Feb 6	743	658	85
Feb 7	887	826	61
Feb 8	832	801	31
Total	5111	4614	497

Table 6: Total defectives in ladies' tops and trousers after inspection

Defects	Total Occurrences	% of occurrences	% cumulative
Puckering	99	20	20
Visible stitch	89	18	38
Out of shape	85	17	55
Skip stitch	55	11	66
Uneven stitch	45	9	75
Broken stitch	40	8	83
Raw edge	25	5	88
Uncut thread	25	5	93
Length uneven stitch	20	4	97
Down stitch	14	3	100

DPMO and Sigma Level were calculated and reported on table 7.

Table 7: Calculation of DPMO & Six Sigma (after implementation of DMAIC)

Total checked items	5111
No of defectives	497
% Defectives	9.72
DPU	0.0972
DPMO	97241
Sigma level	2.8

3.5 Control Phase

To ensure continued and sustainable success a control plan is given [1].

Control plan:

i. Always use of the good quality needles, threads, and the other garment accessories.
ii. Tight quality controls should be enforced on those products coming from subcontractors.
iii. The drawings of the product must be made available at all the machines. The final garment pattern should be referred by all the operators.
iv. The administration ought to give the incentives for high quality performance.
v. The focus should be on preventing defects rather than correcting defects.
vi. Training the subcontractors on the importance of quality on continuous basis.
vii. The organization should develop a proper quality management system.

4. CONCLUSION

The aim of this study was to reduce the defect of products and improve quality. To minimize the defects of garment products DMAIC methodology has been used. In this method, at first problem were identified. In this thesis, root causes of this problem are searched and finally some long term and short term solutions are given for those finding problem. We have been focused on sewing section and found out sewing defects. Pareto chart is used to show sewing defects for experimental lot. The percentage of defects from total product is also calculated. Define phase showed that defected piece is 1806 in 15472 pieces. The percentage of defect was 11.67%. The range is not in tolerable range. In improve stage some solution is given for the problem which are indicated in analysis phase. For given solution, control phase show that defect percentage is reduced to 9.72%. To justify the given solution sigma level is used. In past sigma level was 2.69. After improve phase it has been upgraded to 2.8.

5. REFERENCES

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8. NOMENCLATURE

Symbol	Meaning	Unit
DPU	Defect Per Unit	Dimention less
DPMO	Defect Per Million Opportunities	Dimention less