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Quality Assurance System of Garments Industry in Bangladesh: A Case Study

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Abstract:*RMG sector is the backbone of today's Bangladesh economy. Improvement in quality assurance system can play a vital role for improving productivity of the industries as well as economic development for the country. Improved quality assurance system can add strength in global competitiveness in the global textile market through improving quality as low quality means high cost and loss of competitive position. This paper shows a case study on quality assurance system of a selected garment factory by applying different statistical tools. ANOVA test and independent sample test are used for data analysis purposes. Through regression analysis on average DHU percent, it is found that the quality assurance system of the industry is in a better position and implementation of TQM philosophy thoroughly is recommended for further development.*
Keywords: *Quality, Quality assurance, Statistical tools, TQM, DHU.*

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I. Introduction

Today apparel sector contributes more than 81% to the national export of which 14.06% contribution to the national GDP along with creating 4.02 million direct employments being an imperative role to reduce poverty to a minimum level, (Fiscal year 2013-2014, source EPB). Initially, potentiality of this sector was hardly recognized by government, till 1980s, this sector was concentrated only with woven item manufacturing and exporting [1].

Since the early 1990s, the knit section of the industry has started to expand. The export-quota system and the availability of cheap labor are the two main reasons behind the success of the industry [2].

Bangladesh exports its ready-made garments lion's share to EU markets (more than 60%, [1]) and to USA 21%. Recently (27th June, 2013) it has been unmarked for GSP facilities and yet it is out of GSP facilities though GSP has been revised again last 29th july, 2015. After the removal of quota, this industry may suddenly be exposed to a very high level of competition in the international market. It might be faced severe problems its companies are unable to compete, even with the South Asian countries on the dimensions of performance like timely delivery, consistency and reliability, innovation and quality of their products. This indicates that without making fundamental changes in its management approach and emphasizing on quality management, it cannot get decent share from the international market [3].

However, good quality can be achieved either by meeting the standard norms as devised by the buyer or passing the complete parameters for further shipping out the goods to the end user [4], this study shows a case study on existing quality assurance system of a selected garments industry of Bangladesh and defines the processes how much better they are by using different statistical control tools.

II. Theoretical discussion

Quality refers to the characteristics of a product or service to meet the expectations and needs of the customer [5]. Quality control can be defined as "A part of quality management focused on fulfilling quality requirements."Four simple steps for starting to do quality control are a) Establish clear expectations (b) Don't focus on final inspections(c) Inspections are not an option (d) Find the right balance between helping and arm-twisting [6]**.** On the other hand quality assurance is defined as "A part of quality management focused on providing confidence that quality requirements will be fulfilled" [7].

TQM can accurately be described as a philosophy about quality that suggest for involving everyone in the organization in a quest for quality [8]. Some distinguishing characteristics of TQM are Continual improvement; Customer focus; Organization-wide activity; Employee empowerment; Team approach; Competitive benchmarking; Knowledge of quality control tools; Internal and external customers; and Long term relationship with suppliers [9]. There are also some effective quality tools like PDCA cycle [10], Zero Defects, FMEA method [11], Traffic light system etc. that have been discussed in various studies.

III. Materials & Methods

3.1 Materials
100% cotton knitted T-shirt and polo shirt production processes have been studied.

3.2 Methods

3.2.1 Data collection
For the study both primary and secondary data from cutting and sewing sections have been collected. Secondary data has been collected from the quality control manager of the factory.

3.2.2 Data editing and coding
The data has been checked, cleaned then coded and finally entered into the computer SPSS software to process and analysis the data.

3.2.3 Graphical representation of data using TQM tools
Pareto analysis has been done to find out the major defects of cutting and sewing sections which are the standing blocks of quality assurance of the respective sectors. Following the Pareto analysis results Cause-effect-diagram for major cutting and sewing defects has been shown. Control chart for different sewing lines of sewing section has been given.

3.2.4 Correlation analysis
The correlation coefficient is a measure of association between two attributes or variables that estimates direction and strength of the linear relationship, after the statistician Karl Pearson as discussed by David, George & Akisa [12]. Correlation analysis of average efficiency, performance and DHU of cutting and sewing section has been done and the correspondent scatter diagrams have been provided.

3.2.5 Regression analysis
In regression analysis, it is also of interest to characterize the variation of the dependent variable around the regression function. For Regression analysis ANOVA test and coefficient test has been done. ANOVA or coefficient is significant at the level of 0.005 or less.

IV. Result & Discussion

4.1 Pareto analysis of major cutting and sewing defects

Table 01: Frequency of major sewing defects

Frequency of major sewing defects													
Defects	Raw edge	Dirty spot	Oil spot	Skip stitch	Uncut thread	Point up down	Puckering	Sharing	Broken stitch	Join stitch	Pleat	Reverse	Open seam
Frequency	175	20	73	41	40	147	12	15	48	16	16	16	23

Major cutting defects frequency					
Defects	Fabric hole	Dirty spot	Dia. (+/-)	Lycra missing	Slubs/Knots
Frequency	153	82	46	52	6

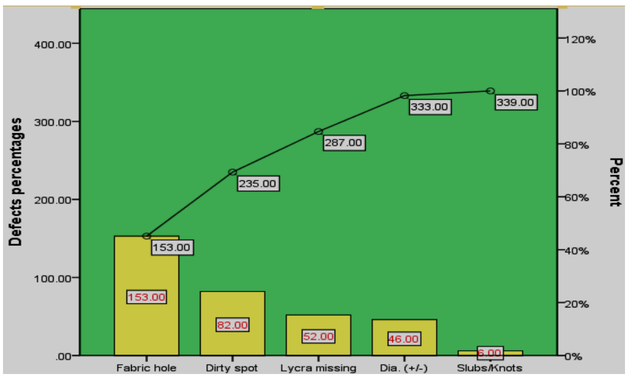


Figure 01:Pareto chart of cutting section defects

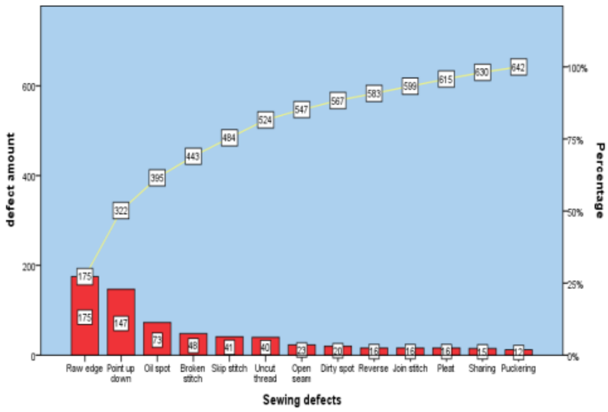


Figure 02:Pareto chart of sewing section defects

Above Pareto charts show that Fabric hole and Raw edge are the most frequent defects with 45.13% and 27.26% of total cutting and sewing defects respectively. Dirty spot and Point up down are the second most highest defects with 24.19% and 22.9% of the total cutting and sewing defects respectively.

4.2 Cause-effect-diagram of top three defects of cutting and sewing sections

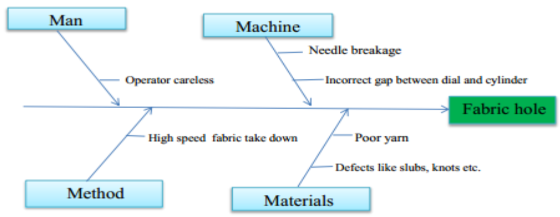


Figure 03: **Cause effect diagram of fabric hole**

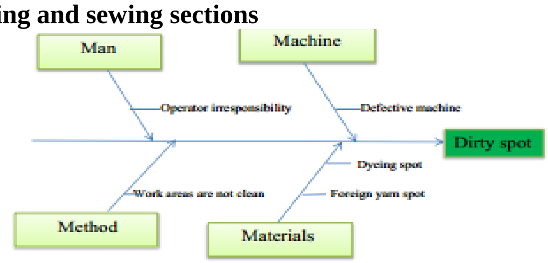


Figure 04: **Cause effect diagram of dirty spot**

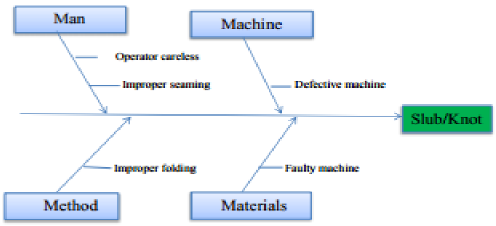


Figure 05: **Cause effect diagram Slub/Knot**

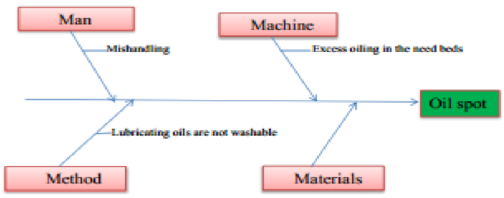


Figure 06: Cause effect diagram oil spot

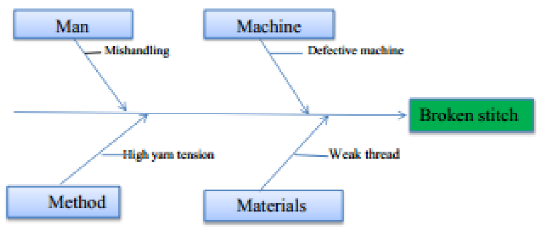


Figure 07: Cause effect diagram broken stitch

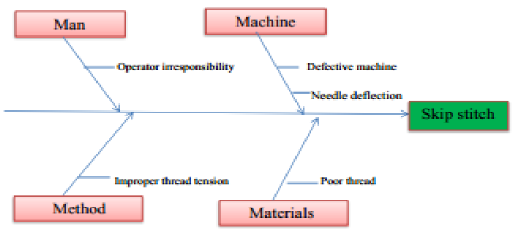


Figure 08: Cause effect diagram skip stitch

4.3 Suggestions to reduce top defects percentage of cutting and sewing sections

Table 02: Suggested Solutions for fabric hole

Cause Types	Causes	Suggested Solutions
Man	Operator careless	Operator should be careful
Machine	Incorrect gap between dial and cylinder	Gap between dial and cylinder should be accurate
Materials	Poor yarn	Yarn quality should be standard
	Defects like slubs, knots	Yarn should be defects like slubs, knots free

Table 03: Suggested Solutions for Dirty spot

Cause Types	Causes	Suggested Solutions
Man	Operator irresponsibility	Operator irresponsibility
Machine	Defective machine	Regular maintenance should be carried out
Materials	Dyeing spot	Dyeing should be properly
	Foreign yarn spot	Fabric should be free from foreign yarn
Method	Work area are not clea	Work area must keep clean

Table 04: Suggested Solutions for slub/knot

Cause Types	Causes	Suggested Solutions
Man	Operator careless	Operator should be careful
	Improper seaming	Seam should be properly done
Method	Improper folding	Folding should be carefully done

Table 05: Suggested Solutions for Broken stitch

Cause Types	Causes	Suggested Solutions
Man	Mishandling	Wash hands of operator before starting work and after lunch, establish preventive maintenance.
Machine	Inappropriate thread tension	
Materials	Weak thread	Select good quality thread which is free from flaw

Table 06: Suggested Solutions for oil spot

Cause Types	Causes	Suggested Solutions
Man	Mishandling	Wash hands of operator before starting work and after lunch, establish preventive maintenance.
Machine	Excess oiling in the need beds	Proper oiling need to maintain
Method	Lubricating oils are not washable	Washable oil should be used

Table 07: Suggested Solutions for Skip stitch

Cause Types	Causes	Suggested Solutions
Machine	Defective machine	Timing of hook or lopper with needle should be adjusted properly
	Needle deflection or bending	Use needle which design to facilitate loop formation
Method	Improper thread tension	Should be proper

4.4 Control chart of sewing lines average monthly DHU%

Sewing lines	Sewing lines monthly average DHU	Sewing lines day's repair%	Sewing lines day's rejection %
Line 1	1.81	1.25	0.05
Line 2	3.66	1.77	0.22
Line 3	1.89	1.1	0.16
Line 4	1.82	1.17	0.07
Line 5	2.09	1.3	0.13
Line 6	2.5	1.7	0.17
Line 7	2.7	1.85	0.12
Line 8	4.84	3.91	0.33
Line 9	3.14	9.33	5.33
Line 10	3.81	3.11	0.46
Line 11	2.35	1.97	0.17
Line 12	4.97	26.39	0
Line 13	3.18	25.45	0
Line 14	3.28	2.79	0.25
Line 15	6.69	2.1	0
Line 16	2.76	1.59	0
Line 17	2.88	2.31	0
Line 18	6	2.83	0
Line 19	5.08	3.94	0.27

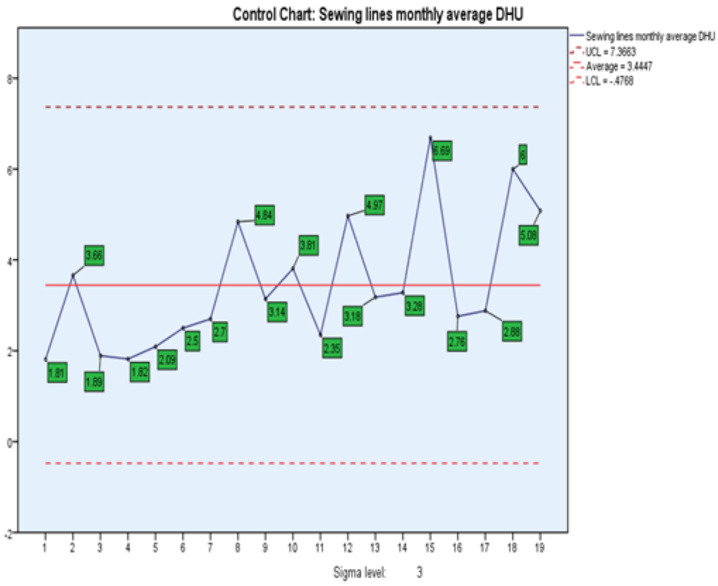


Figure 09: Control chart of sewing lines average monthly DHU

From the above control chart it is obvious that all sewing lines are within the control limit and Line no. 15 is deviated more than the average of all lines and line no. 2, 13 and 14 are more closer to the average control line.

4.5 Defining quality assurance system of cutting and sewing processes through Scatter diagram and Regression analysis

4.5.1 Defining the processes through Scatter diagram

4.5.1.1 Cutting section

Table 08: Cutting table average efficiency, average performance and average DHU

Efficiency	Performance	DHU
53.57	53.98	0.98
39.79	40.61	0.95
51.73	51.97	1.31
43.16	43.65	1.5
44.55	45.64	1.16

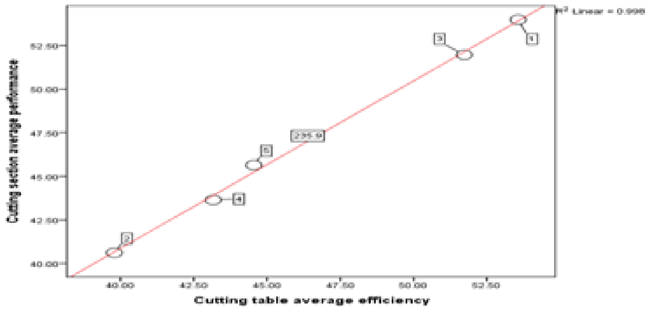
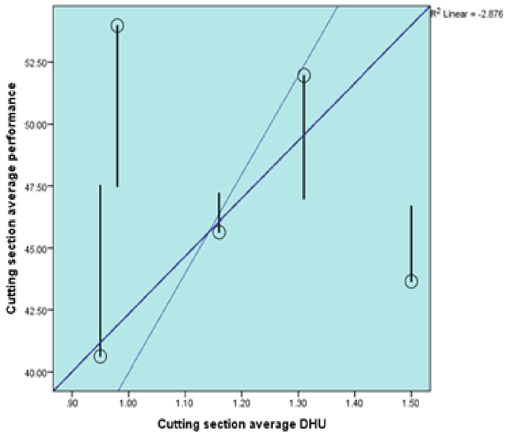


Figure 10: Scatter diagram of performance vs. efficiency of cutting section



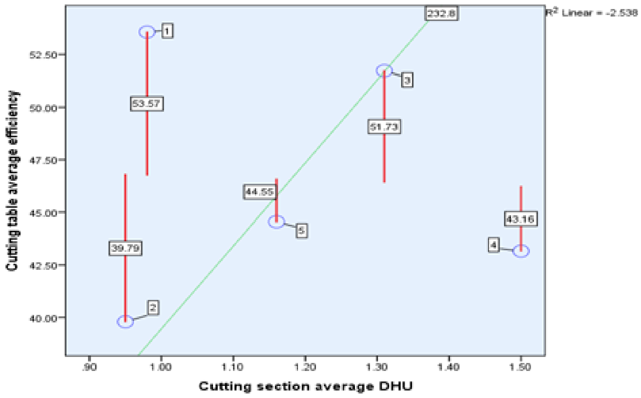


Figure 11: Scatter diagram of performance vs. DHU   Figure 12: Scatter diagram of efficiency vs. DHU

Scatter diagram of Figure10 represents the co-relation status of average performance and efficiency of cutting section reporting that they are almost aligned in a line i.e. quality system of the cutting section is very much better as DHU level is very low. On the other hand scatter diagram of Figure 11 and 12 show that the relationship between performance vs. average DHU and efficiency vs. average DHU have no co-relation which is another proof of better quality system of cutting section.

4.5.1.2 Sewing section

Table 09: Sewing floor average efficiency, performance and DHU

Efficiency	Performance	DHU
53.1	53.2	2.21
45.1	45.1	3.35
36.7	37	3.32
48.3	48.4	4.97
45.2	45.3	3.46

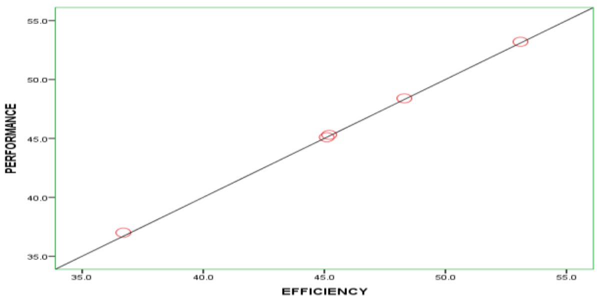
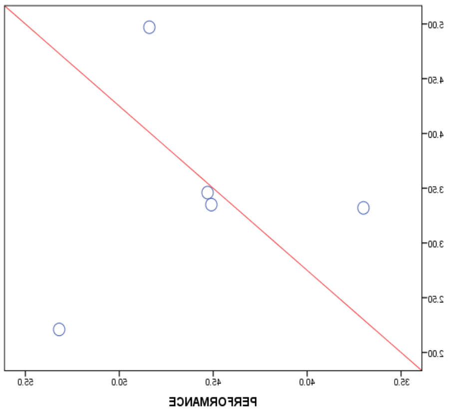


Figure 13: Scatter diagram of efficiency vs. performance



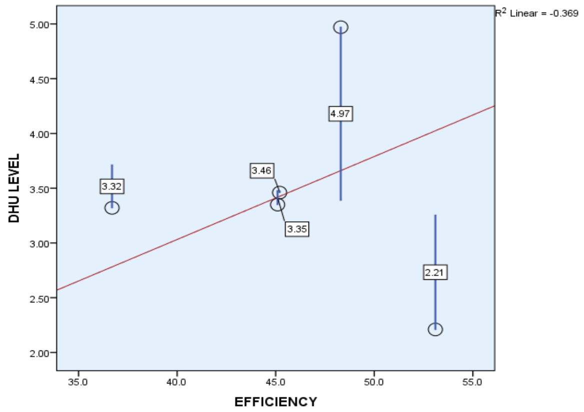


Figure 14: Scatter diagram of performance vs. DHU Figure 15: Scatter diagram of efficiency vs. DHU

Above Scatter diagrams show that there is very strong co-relationship between efficiency and performance and there is almost no co-relationship between performance and DHU, efficiency and DHU which indicates the better quality assurance system of sewing section.

4.5.2 Defining the processes through Regression analysis

For Regression analysis ANOVA test and coefficient test is done. ANOVA or coefficient is significant at the level of 0.005 or less.

4.5.2.1 Cutting section

ANOVA[a] Table 10: ANOVA test for average efficiency vs. average DHU cutting section

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regrssion	.229	1	.229	.005	.948[b]
	Residual	137.073	3	45.691		
	Total	137.302	4			
a. Dependent Variable: Cutting table average efficiency						

ANOVA test is not significant i.e. quality is better as low DHU cannot hamper efficiency.

Coefficients[a] Table 11: Coefficients test for average efficiency vs. average DHU of cutting section

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	47.784	17.561		2.721	.072
	Cutting section average DHU	-1.038	14.660	-.041	-.071	.948

Coefficients test for average efficiency vs. average DHU of cutting table is not significant.

ANOVA[a] Table 12: ANOVA test for average performance vs. average DHU of cutting section

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.497	1	.497	.012	.920[b]
	Residual	126.684	3	42.228		
	Total	127.181	4			
a. Dependent Variable: Cutting section average performance						

ANOVA test for average efficiency vs. average DHU of cutting table is not significant.

Coefficients[a] Table 13: Coefficients test of average performance vs. average DHU of cutting table

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	48.974	16.882		2.901	.062
	Cutting section average DHU	-1.529	14.094	-.063	-.108	.920

a. Dependent Variable: Cutting section average performance

Coefficients test of average performance vs. average DHU of cutting table is not significant.

ANOVA[a] Table 14: ANOVA test for average efficiency vs. average performance of cutting table

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	126.919	1	126.919	1454.808	.000[b]
	Residual	.262	3	.087		
	Total	127.181	4			
a. Dependent Variable: Cutting section average performance						

ANOVA test for average efficiency vs. average performance of cutting table is significant.

Coefficients[a] Table 15: Coefficients for average performance vs. average efficiency of cutting table

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.405	1.181		2.036	.135
	Cutting section average efficiency	.961	.025	.999	38.142	.000
a. Dependent Variable: Cutting section average performance						

Coefficients for average performance vs.average efficiency of cutting table is significant.

4.5.2.2 Sewing section

ANOVA[a] Table 16: ANOVA test for average efficiency vs DHU level of sewing section

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.125	1	4.125	.089	.785[b]
	Residual	139.003	3	46.334		
	Total	143.128	4			

Coefficients[a] Table 17: Coefficients for average DHU level vs. average efficiency of sewing section

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	49.252	12.353		3.987	.028
	DHU level	-1.032	3.458	-.170	-.298	.785
a. Dependent Variable: Efficiency of sewing section						

Coefficients for average DHU level vs. average efficiency of sewing section is not significant.

V. Conclusion

The analysis performed in this study shows that the quality assurance system of the factory is in a better condition. From the analysis of control chart used for sewing section, it can be suggested that to increase sewing section quality assurance system the factory need to take initiative to control sewing line 15 as it is working as the bottleneck point for the overall quality assurance system of sewing section. The outcome of this study might add a degree to the confidence level of the factory about their quality which can contribute to enhance their competitiveness in the global RMG trade.

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