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Implementation of Lean Philosophy and Improvement of Sigma Level in Cutting Section according to DMAIC approach

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Abstract

Manufacturing industries like Readymade Garments (RMG) manufacturer are interested in improving their products and process by reducing the variation. Because of global competitiveness, most of the Bangladeshi RMG industries are striving to achieve overall operational excellence in their business. Six sigma is a most powerful methodology for any manufacturing or service organizations and its significance is growing vigorously. Six sigma is a highly disciplined process that focuses on developing and delivering near-perfect products and services. In many organizations, six sigma means a business management process that shows tangible business results to the bottom line by continuous improvement and variation reduction. Six sigma processes is to reduce process variation, so that it will result in no more than 3.4 defects per million opportunities (DPMO). An 'opportunity' is defined as a chance for nonconformance or not meeting the customer requirements. So the objective is to establish the right strategy for never ending continuous process improvement. Six Sigma improves the process performance of the critical operational process, leading to better utilization of resources, decreases variations & maintains consistent quality of the process output. The DMAIC (define-measure-analyze-improve-control) approach has been followed in this paper to solve an underlying problem of reducing process variation and the associated high defect rate in Readymade Garments (RMG) sector and the critical operational process is taken in cutting section.

Keywords: *Six Sigma, DMAIC, Lean, Defects Per Million Opportunity (DPMO), Critical To Quality (CTQ), Voice of customer (VOC).*

1. Introduction

Organizations searching for the ways to improve their production and management processes in order to remain competitive in the market. These requirements push the organization towards the reduction of production cost, enhance productivity and improve product quality. Therefore, to deal with these target organizations must utilize all the available resources efficiently and effectively in order to provide their customers with high quality products at a low price. This is the main theme of six sigma strategy used to improve profitability, to drive out waste, to reduce quality costs & improve the effectiveness and efficiency of all operational processes that meet or exceed customers' needs & expectations. This paper discusses the implementation of six sigma methodology in one process in a readymade garments company. The six sigma Define-Measure-Analyze-Improve-Control (DMAIC) approach has been used to achieve the result. This paper focuses the step-by-step methodology of six sigma implementation in a manufacturing process for improving the quality level by reducing variation. This project is selected by Pareto analysis. Project charter, Voice of customer (VOC), Cost of Poor Quality (COPQ) etc has been done in define phase. As-Is-Process map, SIPOC diagram, Critical To Quality (CTQ) requirement, data collection and measurement, capability analysis etc has been done in measure phase. FMEA, Fishbone diagram, regression analysis etc has been done in analyze phase. 5'S, Kaizen, cycle time reduction etc has been done in improve phase. Control chart, award and various sustaining programs has been done in control phase.

2. Six sigma methodology

2.1Define:

Define phase indicates the goals of the improvement activity. The most important goals are obtained from customers for many areas. At the operations level industrial level, a goal might be to increase the throughput of a production department and reducing the number of defectives.

2.1.1Voice of Customer (VOC)

To drive improvement through continuous improvement projects, it is imperative for practitioners to determine first what is important to the customers who are affected by the process. The objective of VOC is to list the key customer needs in their language. And translate these needs into specific items called critical-to-quality requirements (CTQs).

2.1.2 Project charter

- Our current defect rate is 8.25%. Only scissoring problem is responsible for 5.10%. If we reduce 2% of that 5.10%, then it becomes at 3.10%. That means we can increase our revenue approximately 50 person's working hour per month as well as approximately BDT. 505000 per month.
- Problem/opportunity statement.
  - Current defect rate in cutting department is 8.25% [Too high].
- Goal. Reduce defect percentage by (5.10-3.10) 2% within 6 month (By July, 2012)

2.2 Measure

It is the second step of DMAIC and a key transitional step of the six sigma road. It measures the existing system. Establish a reliable matrix to monitor the progress towards goals defined at the previous step. Data collection from cutting section respectively for various types of defects that shown in table: 2 **[**Sample taken randomly 2000 piece from 10 batches]

DPMO Calculation			
Opportunities	2000	**DPMO**	82,500
Defects	165	**% Defects**	8.25
		% Yield	91.75
		Sigma	2.89

Table: 1

In this paper the main concerned area is cutting section. The defect of cutting section is divided by two segments and the concerned area has been narrowed to the internal defects From DPMO Calculation with respect to the table: 1 it have seen that the current sigma level is 2.89 where defects percentage is 8.25 with respect to the opportunities 2000.

Batch No.	Checked Piece	Fabric stain	Oil marks	Hole	Colar Shading	Foreign fiber	Broken stitch	Skip stitch	Cut stitch	Uneven	Needle damage	Shading problem	Embelishmen problem	Scissoring	Defective Piece
1	200	2	1			1	1		2			1		11	19
2	200			3	2		1	1	1					9	17
3	200	1									3		2	12	18
4	200		1		1	3				2	1		1	8	17
5	200		1				1	1		2				10	15
6	200			1				1			1		1	13	17
7	200	2			2				1			2		7	14
8	200	1		3									1	13	18
9	200		2			1	1			1				9	14
10	200			1					2	2			1	10	16
	2000	6	5	8	5	5	4	3	6	7	5	3	6	102	165

Table: 2

3.3Analysis

Analyze the system to identify ways to eliminate the gap between the current performance of the system or process and the desired goal. Begin by determining the current baseline. Use exploratory and descriptive data analysis to understand the data. Use statistical tools to guide the analysis

3.3.1 Pareto analysis

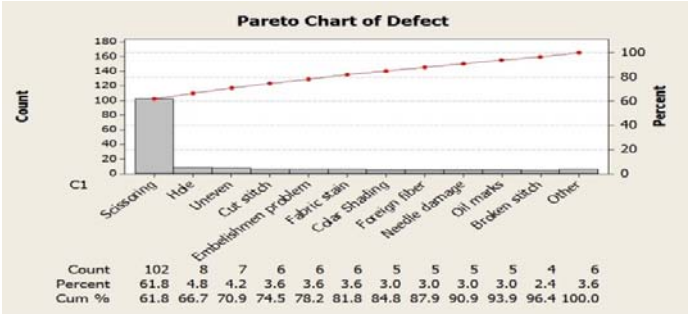

Figure: 1 Pareto analysis

Pareto analysis is a formal technique useful where many possible courses of action are competing for attention. From this analysis it has been seen that the main area for defective product is Scissoring. . From this current data it has been seen that the main area of defective is scissoring and it contributes 61.8 percent of defect from total defects.

3.3.3 Cause and Effect Diagram:

Pareto analysis shows the cause of defect with it level but not identifies the factor behind this defect. The fishbone diagram identifies many possible causes for an effect or problem. It can be used to structure a brainstorming session. In this paper the main concerned area of defective is scissoring. This type of defective is responsible for deviation of measurement from standard during cutting. So for this deviation a cause and effect diagram is drawn bellow-

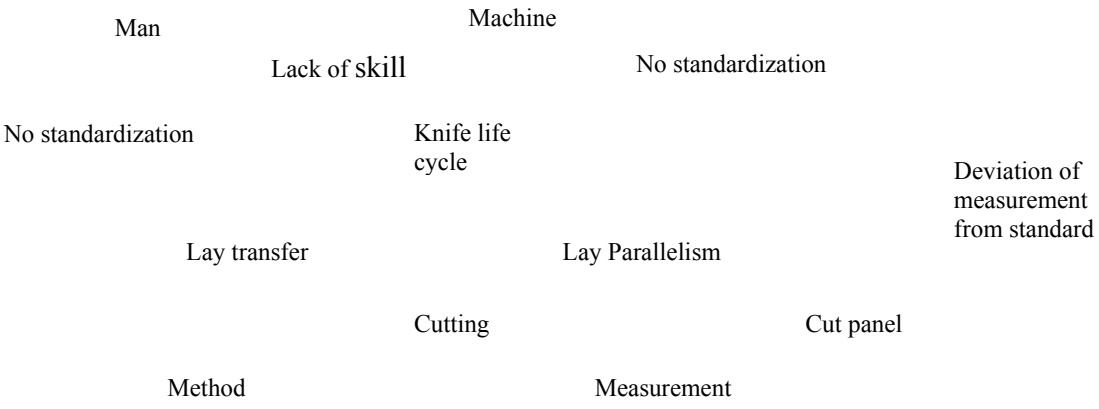

Fig: 2 Causes and Effect Diagram

3.4 Improve:

In improvement stage, be creative in finding new ways to do things better, cheaper, or faster. Use project management and other planning and management tools to implement the new approach. Use statistical methods to validate the improvement. So the project team needs to develop ideas to remove root causes, test solutions, and standardize solution/measure result.

3.4.1 **Standard Operating Procedure (SOP) implementation.**

Standard operating procedures (SOP) are a detailed explanation of how a policy is to be implemented. The details in an SOP standardize the process and provide step-by-step how-to instructions that enable anyone within your operation to perform the task in a consistent manner.

The SOP document serves as an instructional resource that allows employees to act without asking for directions, reassurance, or guidance. The step-by-step written procedure can also help hold employees accountable because employee expectations are documented and their actions can be measured against the SOP.

Grasp the cutter handle by one hand & puss the lay by other hand	Set the cutter edge to the line of the marker.	Press the cutter handle and run the cutter according marker line
		
Puss the marker carefully during turning the cutter	Separate the cutted lay in a distinct area	Take the cutted lay to resize according to marker line
		
Resize the lay according to marker line	Store the off-cut in a specific place	Take away the cut panel in a specified location
		

Fig: 3 Standard Operating Procedure (SOP)

3.4.2 Action plan to improve the process:

Based on the cause effect diagram, Pareto analysis and Standard operating procedures (SOP) action plan has been set to improve the situation and implement the plan.

Categories	Causes	Effects	Actions
Man	Lack of skill	**Measurement Variation during cutting.**	a. Standard Operating Procedure (SOP) making b. Visual Management System establishment c. 5'S implementation.
	Lack of motivation		a. Incentive system development b. Support and encouragement c. Job empowerment.
Machine	Knife life cycle		a. Knife life time standardization b. Precession requirement according to buyer c. Knife storing system.
Method	Visual Management System	**Measurement Variation during cutting.**	a. Poster making b. Photo and symbol attaching. c. 5'S map development. d. 5'S slogan development.
	Clamping method		a. Standard Operating Procedure (SOP) making b. 5'S implementation. c. On the job training.
Measurement	Lay parallelism		a. Visual measurement techniques b. Developing a check list.
	Marker		a. Visual measurement techniques b. Developing a check list.

Table: 3 Action plan

Based on the cause effect diagram and Action plan and SOP, the operators are trained in all aspects of their job and after taking the remedial action we have checked the defects and again calculate the sigma level. Our maximum pain area was Scissoring. After implementation of this methodology we able to reduce the Scissoring problem.

Batch No.	Checked Piece	Fabric stain	Oil marks	Hole	Colar Shading	Foreign fiber	Broken stitch	Skip stitch	Cut stitch	Uneven	Needle damage	Shading problem	Embelishmen problem	Scissoring	Defective Piece
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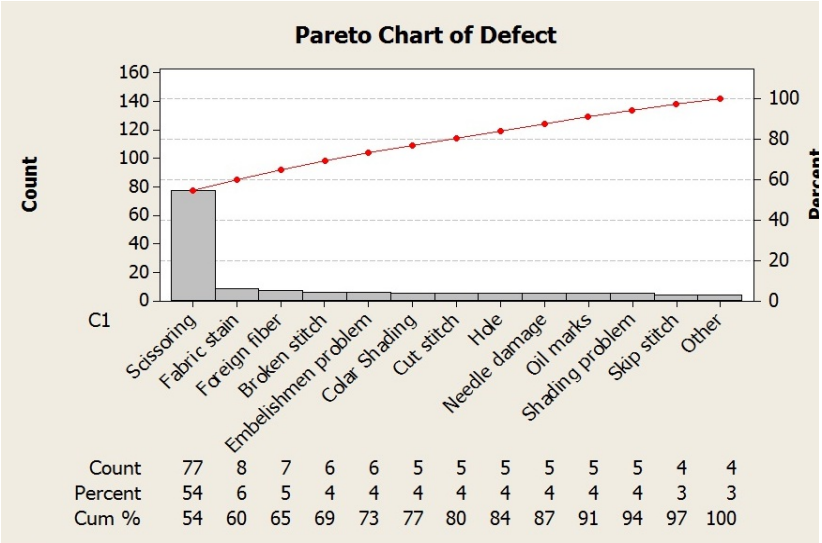
5	200		1		1		1	1		1				10	15
6	200	2		1			2				1	2	1	5	14
7	200				2			2	1			2		7	14
8	200	1		1		1							2	8	13
9	200		2				1		1	1				9	14
10	200	3		1		2			2				1	6	15
	2000	8	5	5	5	7	6	4	5	4	5	5	6	77	142

Table: 4 Result analyses



DPMO Calculation	
Opportunities	2000
Defects	142
DPMO	71,000
% Defects	7.10
% Yield	92.90
Sigma	2.97

Table: 5 Result analysis for sigma

Figure: 4 Pareto analyses after improvement

3.5 Control

This is about holding the gains which have been achieved by the project team. Implementing all improvement measures during the improve phase, periodic reviews of various solutions and strict adherence on the process yield is carried out. Once the improvement has been made and results documented, continue to measure the performance of the process routinely, adjusting its operation. Institutionalize the improved system by modifying compensation and incentive systems, policies, procedures, budgets, operating instructions and other management systems. Without control efforts, the improved process may well revert to its previous state. There is various ways to sustain the improvement like Awards and Bonus Program When an employee identifies is doing well in this DMAIC process he/she should rewarded with a bonus check. In some cases the bonus check is a fixed amount. In other programs the bonus may be a small percentage of the potential direct cost but may be large effect for overall development. Creating such environment that is consistent with the desired system and improving production process & equipment to sustain the improvement.

Discussion and recommendations

3.1 Discussion:

Six Sigma provides a great opportunity to become business leaders with the strategy, methods, tools and techniques to their organizations. Six Sigma as a powerful business strategy for achieving and sustaining operational effectiveness, producing significant savings to the bottom line and thereby achieving organizational excellence. If implemented properly with total commitment & focus, Six Sigma can put industries at the forefront of the global competition. Implementation of six sigma methodology has resulted in large financial savings for the company. Due to reduction in measurement variation as well as reduction in rejection and rework, the approximately savings from this project was $75750 per annum.

3.2 Recommendations

The Sigma level achieved after implementation of DMAIC Six Sigma methodology can be further improved by considering every small and large defective area that are not considered in this paper & new performance standards can be realized. It can be incorporate other various types' tool and also algorithm to this work to increase the reliability of the acquired result. So it can be integrated effectively in every company for maintaining & further improving the improved performances.

Conclusion

This case study has demonstrated that the integration of Lean-Six Sigma can be an effective and useful approach to eliminating inefficiencies and inconsistencies in garments industries. The researchers highlighted a number of questions regarding the implementation of DMAIC. The main thing of this paper is to reduce the defects rate and also reduce fault opportunities in the final garments; we have worked in every department to reduce these opportunities and gave a solution in the form of preventive action in the cutting section of this garments industry.

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