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Research Article

Minimizing Reworks, Rejection Rate and Time Waste in a Textile Industry Using Sixsigma Tools

Bharath S[1], Arvind V[2], Prashanth AS[3]

[1]Faculty, Department of Mechanical Engineering, Dhirajlal Gandhi College of Technology, Salem, Tamilnadu, India
[2]PG Scholar, Department of Mechanical Engineering, PSG College of Technology, Coimbatore, Tamilnadu, India
[3]Faculty, Department of Mechanical Engineering, PSG College of Technology, Coimbatore, Tamilnadu, India

***Corresponding author**
Arvind V
Email: arvindveluswamy@yahoo.com

Abstract: The main aim of this project is to minimize the occurrences of rework, higher rejection rate and eliminate time waste in a textile industry using sixsigma tools and techniques. As a result of this project reduction in standard minute value (SMV) is obtained, labor productivity is improved last but not least a considerable improvement in production rate and inline efficiency is achieved. To achieve this target sixsigma tools such as SIPOC diagram, Pareto analysis, brainstorming and fishbone diagram are used.
Keywords: rejection rate, sixsigma, standard minute value (SMV), brainstorming, fishbone diagram.

INTRODUCTION

Textile industry is one of the major industrial sectors of India. Textile industry contribution to nation's economy can't be neglected. Modern textile units have complex processes generating a lot of variation and defects and therefore, posing same challenges as are seen in other industrial sectors. The shortening of product life cycles and increasing demand for just-in-time delivery are just adding to this list of challenges. Thus, a consistent approach to process improvement is essential to make a remarkable leap ahead of your competition. This project is done mainly to improve quality of textile industry. To improve the productivity, inline efficiency, labor productivity is the main objective of the project for this purpose DMAIC approach is followed in the project. Six Sigma is an ultimate quality improvement initiative for improving textile processes by reducing variation and defects. At various stages of DMAIC approach different tools such as SIPOC(Supplier-Input-Process-Output-Customer) diagram, check sheet, Pareto chart, fishbone diagram are used.

LITERTURE REVIEW

As the latest WTO report (2006) states "In no other category of manufactured goods do developing countries enjoy such a large net exporting position" as they do in the textile sector [1]. The global textile industry is likely to grow from USD 309Bn to USD 856Bn [2].

Any specific statistical data is not found about implementation of Six Sigma in Indian Textile Industry, only few are found which are about the scope of implementing Six Sigma in Indian Textile Industry. There are number of research papers were found which tells about the importance of Six Sigma implementation in Textile Industries for improvement in overall production [3]. The various efforts are made to overcome different problems in manufacturing by implementation of Six Sigma such as problem of shade variation of dyed fabrics, yarn contamination reduction, Reduction of Downgrade Losses, are resolved and resulted in increase in the productivity [4].

The research paper by Krishna raj G., Asst. Professor, NIFT, New Delhi [5], shows achievements gained by implementing Six Sigma for Case Study 1:

- Introduction of Quality Checking Systems or Formats and constant monitoring by a trained Quality Inspector has brought about drastic reduction in quality defects level.
- There is a significant decrease in Defects per Million Opportunities (DPMO) in both Jacquard (65.5% reduction) seat covers before and after quality system implementation.

- The Process Sigma level has also improved for both the product types. In percentage terms, there is a jump in Process Sigma level by 22.48% in Jacquard product.
- Estimated increased sale in Jacquard is Rs. 5, 31,028/- per month.

Kaushik & Khanduja applied Six Sigma DMAIC methodology to a specific case of thermal power plant for the conservation of energy. They implemented Six Sigma project recommendations to reduce the consumption of dematerialized (DM) make-up water from 0.90% to 0.54% of maximum continuous rating (MCR) resulting in a comprehensive energy saving of INR 30.477 million per annum [6].

Das *et al* presented a case of a leading textile company facing the problem of shade variation of dyed fabrics leading to an increase in the process cycle time. The company adopted DMAIC cycle of disciplined Six Sigma methodology to resolve this problem. The goal was to reduce the shade matching time in the fabric dyeing process by optimizing the effect of the controllable parameters [7].

CASE STUDY

This case study deals with a garment industry located in Salem, Tamilnadu. They are primarily involved in the production of shirts. Marking, cutting, steaming, hemming, folding and inspection operations are performed in this garment. Elimination of bottlenecks and standard minute value is said to be the key objective of the project.

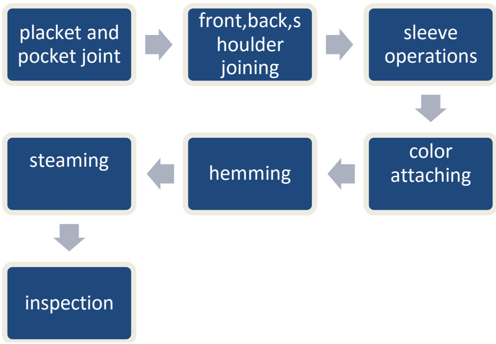

Fig-1: process flow chart

METHODOLOGY

Standard minute value:

Standard Minute Value (SMV) =[(Cycle time (Second) / 60) x Performance rating %] +Allowance %

= [(15/60)* 80/100] + [(15/60)* 80/100] * (20/100) = 0.240 minute

*Performance rating = 80 %

*Bundle allowance, machine allowance & personal allowance = 20%.

Table1: Single minute value table

S.No	Operations	Average cycle time (sec)	SMV (Standard Minute Value)
1	Placket and pocket Position mark	15	0.24
2	Both Placket joint on front body part	54	0.864
3	Pocket joint on front body part	19	0.304
4	Front and back body matching of fabric cloth	15	0.24
5	Shoulder Join on Front and Back body part	21	0.336
6	Thread Cut and fold	12	0.192
7	Sleeve match with body	15	0.24
8	Sleeve joint with body	21	0.336
9	Thread Cut and fold	16	0.256
10	Side Seaming	31	0.496
11	Thread cut ,Body turning and Fold	19	0.304
12	Bottom Hemming	32	0.512
13	Sleeve Hemming	18	0.288
14	Collar attach with body	51	0.816
15	Button Hole	19	0.304
16	Button Attach	21	0.336
17	Trimming	22	0.352
18	Inspection	56	0.896
Total SMV			7.312 minutes

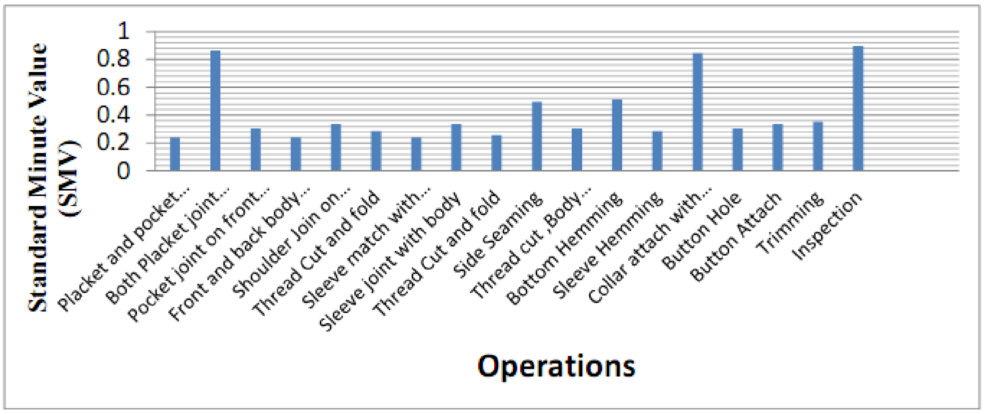

Fig-2: Standard Minute Value Before Implementation

Table 2: Process Information Table

Total output per day Total manpower Working time (Minutes) Standard minute Value (SMV)	680 pieces 23 480 minutes 7.312 minutes
Takt time (minute)	0.318 minute
Target/hour	188 (efficiency 100%)
Target/hour	150 (efficiency 80%) – Benchmark Target
Target/hour	113 (efficiency 60%)
Labor Productivity	29.56
Line Efficiency	45.03 %

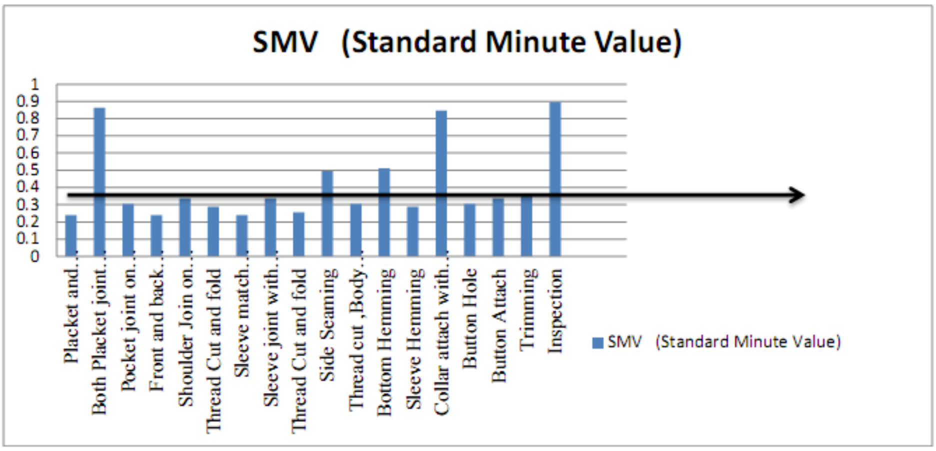

Fig-3: Single Minute Value After Implementation

Define Phase

Table 3: SIPOC diagram

Supplier	***Input***	***Process***	***Output***	***Customer***
***	*Unstitched fabric cloth* *Machinery* *Thread* *Needles* *Button* *Zipper* *Label* *Fabric in roll form*	*Receiving Materials* *Storing and Sorting* *Cutting* *Sewing* *Trimming* *Inspection* *Ironing* *Packing*	*Round Neck T-shirt* *Polo T- shirt* *V-Neck T-shirt*	***

Sewing Defects: These defects are usually caused by errors arising from wrong functioning of sewing machines.

Seaming defects: These defects are usually caused by errors arising from the interaction of the operator and machine in the handling of garment.

Placement Defects: These defects are usually caused by errors arising in marking and cutting as well as sewing operations in the sewing room or a combination of these defects category.

Fabric defects: These defects are caused by errors arising from the fabric processing like knitting and dyeing.

Embroidery defects: These defects are caused by errors arising from the embroidery processing of the garments.

Measure Phase

Pareto has been drawn for the defects obtained in each category.

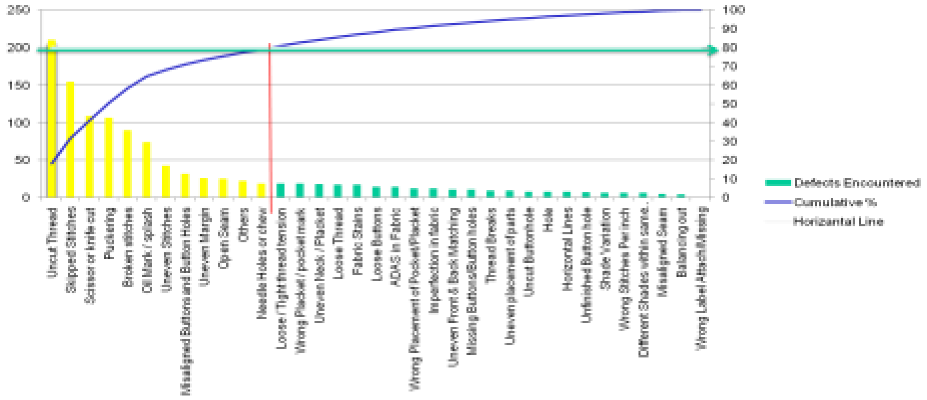

Fig-4: Pareto chart

Major defects:

1. Uncut Thread
2. Skipped Stitches
3. Scissor or knife cut Puckering
4. Broken stitches
5. Oil Mark / splash
6. Uneven Stitches
7. Misaligned Buttons & Button Holes
8. Uneven Margin
9. Open Seam

Analyze phase

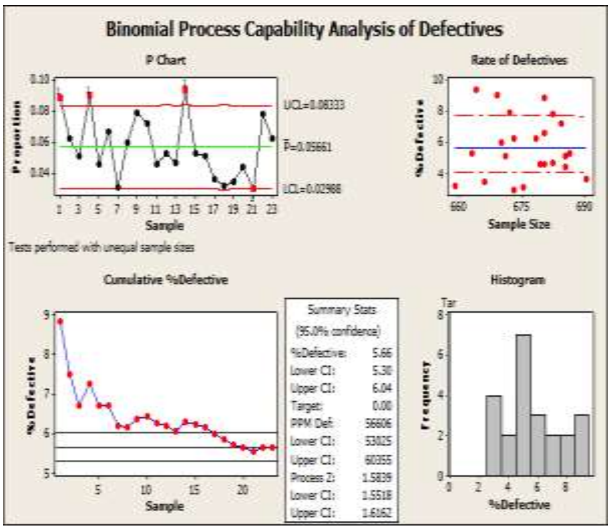

Fig-5: process capability analysis

Table 4: table of inference

S.No	Parameter	*Value*
1	***Total Checked***	*15546*
2	***No. of defectives***	*880*
3	***% defectives***	*5.66 %*
4	***DPMO***	*56609.2009*
5	***Sigma level***	*3.08*
6	***DPO***	*0.056609*

RCA is conducted for all the defects listed above and the suitable remedies are listed below.

Improve Phase

Table 5: Solution stable

DEFECT	*REMEDIES*
Uncut thread	UBT (Under Bed Trimmer) / thread trimmer should be used, Operator training, Provide Good quality thread cutter.
Open Seam	Clear markings for stitch line, Good Quality Threads, Threading, Tension and SPI should be checked often, Operator training, Rectifying patterns.
Puckering	Operator training, combination of needle-thread-fabric should matched correctly, UBT trimmer should be used, Constant pressure to foot
Broken Stitches	Use good quality threads, needles. Proper alignment of needle, combination of needle-thread-fabric should matched correctly,
Oil mark / splash	Clean Workplace, operator cleanliness, regular maintenance of machine, lubricant free threads.
Skipped Stitches	Operator training, Timing of loop and hooker adjustment, maintain machines, Adjust gap between presser foot and needle plate hole, Adjust needle and thread size.
Scissor or Knife cut	Operator training, Provide good quality thread trimmers, UBT machines should be used, Provide adequate light source for thread trimming and cutting.
Uneven Stitch	Control the speed of machine, use right needle and correct feed control, Improve the skill of operator, use good quality sewing thread, Never pull on the fabric while sewing, let it be taken up by the machine.
Misaligned Buttons & Button Holes	Proper marking of Button and holes, Match the Button and button holes properly, Provide adequate light, Provide training

Control phase

The types of machines and working method utilized in the bottleneck process and balancing process should be similar. The proposed method follows the modular system in which one worker works more than two processes to eliminate the bottlenecks from the sewing section. The SMV has been reduced from **7.312 minutes to 6.571 minutes**, labour productivity has been increased from **29.56 to 35.55** and finally line efficiency has been increased from **45.03 % to 48.66 %** which increased the productivity of **31 pieces per day of 8 hours shift**.

CONCLUSION

The Check sheet was used to capture the defects encountered in the sewing section. Then Pareto Analysis was performed to identify the top **11 defects types**. Those identified 11 top defects are categorized and the main causes for the defects are shown using the Cause-Effect Diagram. Finally we have given suggestions for those causes so that it can be applied to them minimize the frequency of those defects encountered. The total defective percentage was **5.66 %** and it can be reduced to **3 %** by implementing the remedial actions. Thus we can effectively minimize reworks, rejection rate and waste of time that will ultimately improves productivity.

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