

**Article Info**

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**Application of DMAIC Tool of Six Sigma in Small Scale Industry***Sahil Kumar\*, Geetesh Goga\*\* and Avtar Singh\*\*\****ABSTRACT**

Different researches are conducted in studying the manufacturing process in different industries like Food Processing, Rolling mill, Grinding process, Distillation unit etc. The applications of 6 sigma has been successful in achieving increased output and better finished products apart from increasing profit margin but none of these researches were conducted in Indian textile industry and application of 6 sigma in improving overall productivity is yet to be implemented. This research is intended to study manufacturing process of Indian textile company Dewan textile located in Meerut and apply 6 sigma tool to improve processes in various departments and also achieve good finished products apart from improving profit margin of company. For any company to have financial gains it is imperative to reduce defect rate and improve yield of product manufactured. Higher defect rates reduce Profit margins therefore companies strive to decrease defect rate of the product during manufacturing to maximum possible extent. This is accomplished by various inspection methods during production cycle and implementing changes as and where necessary. Yarn is manufactured in textile industry by going through number of processes carried out at various departments which raises defect rate to a huge extent. This project studies manufacturing processes involved in various departments of yarn manufacturing process and DMAIC tool of 6 sigma is implemented in winding department to reduce defect rates before finished product goes to customer. Final package is made in winding department from where end product is directly sent to customers and arises possibility of customer complaint.

**Keywords:** DMAIC; 6 sigma; Textile industry.

**1.0 Introduction****1.1 Process introduction**

A yarn is a persistent strand of short broken material filaments turned together or of constant fibers. Out of the three noteworthy common strands, cotton and fleece filaments are short (more often than not between 1 cm. to 10 cm. long) while silk fiber is around 1cm. long. Man-made strands are for the most part delivered as non stop fibers yet might be utilized as staple-this is accomplished by cutting the long fibers into short staple filaments. A lot of these staple strands are mixed with normal filaments and after that the mix is changed over into yarns for texture fabricate. The networks are gathered as fragments which contain the parallelized short strands held together by attachment between the

filaments. They are then exposed to drafting and turning to yield yarns.

Yarns may likewise be produced using constant fibers by gathering various them in parallel setup and acquainting turn with enhance attachment. As appeared in figure 1, the fibers might be utilized as mono-fiber, multi-fiber yarn without contort, turned multi-fiber yarn and wound yarn produced using short, staple strands.

Cotton filaments have been utilized by humankind for more than 5000 years. Much before motorized turning wound up conceivable; yarns were produced using cotton by hand. The high spinnability of cotton is evident by taking a little cluster of filaments and after that moving them one way in the palms of your hands when it gets changed over into a coarse cotton yarn. Since the surface and appearance of a texture is significantly affected by the kind of yarn utilized,

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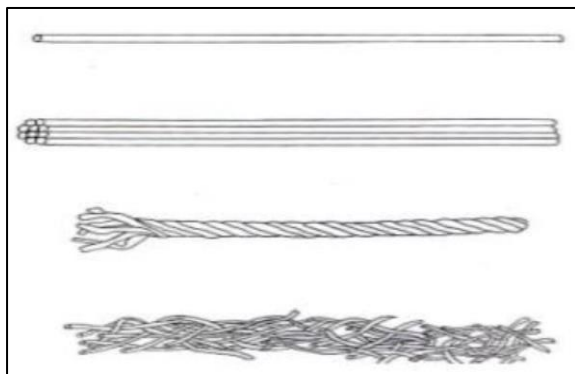
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the investigation of the yarn is of extensive significance. Individuals still utilize their fingers and an axle with a minor snare joined at the best and a plate at the base to turn coarse yarns from cotton. A similar rule shaped the premise of the Indian turning wheel or "charkha" (Fig 1:2) which came up at some point between 500-1000 AD is as yet used to turn cotton.

### 1.2 Six Sigma-a way of working towards perfection [3]

. The Six Sigma is a financial improvement strategy for an organization and now a day it is being used in many industries. This technique is used to improve quality of finished product by defect reduction and improvement of manufacturing process.

**Figure 1: Some Type of Yarns [1]**



**Figure 2: Lady Working with Indian Spinning Wheel**



This increases profit margin and thus financial condition of firm by reducing defect rates of product and increasing customer satisfaction and customer retention.

- Understand the needs and who are your customers, and what is product that you want to provide the customers.
- Review of the data, consumer survey report, and feedback of customers and determine the product standard that we provide and quality service.
- Find out what are the defects are occurring and why these are produce during the manufacturing of process and how to reduce these problems by the different method.
- After implementation of different improvement actions, set up good matrices and follow up these actions and become the new standard of operating process [4].

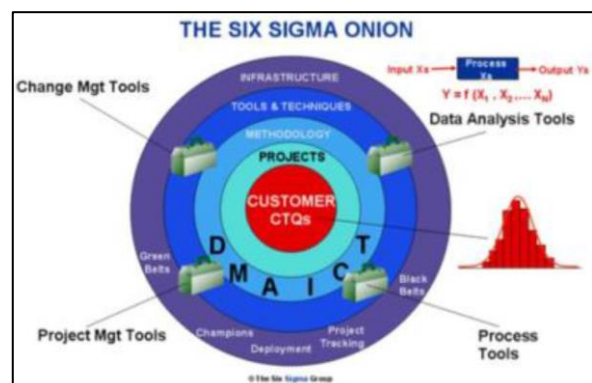
### 2.0 Six Sigma Improvement Approach

The main factor of Six sigma is to taking the present product, method and improves them in an exceedingly higher method. It's a awfully powerful approach to realize the monetary goals for the organization and rising the company's price by the following;

- Information driven.
- Project based mostly.
- Disciplined and systematic.
- Customers centered (Internal & External).

Success of each organization relies on, a way to introduce.

**Figure 3: Six Sigma Onion [5]**



### 2.1 Process capability

Sigma value increases the technique performance in a better way. Another manner of degree the process capability and performance

through the statistical measurements like cp, cpk, pp and ppk. The six-sigma method a three. four percent defects part in keeping with million or yield of 99.9997% (ideal components). Following is the desk of comparison of different sigma values at extraordinary defects part in step with million and functionality of manner here.

**Figure 4: Six Sigma Value Chart [6]**

SIGMA	DPMO	COPQ	CAPABILITY
6 Sigma	3.4	<10% of sales	World Class
5 Sigma	230	10 to 15% of sales	
4 Sigma	6200	15 to 20% of sales	Industry Average
3 Sigma	67000	20 to 30% of sales	
2 Sigma	310000	30 to 40% of sales	Non-competitive
1 Sigma	-----na-----	-----na-----	-----na-----

{DPMO - Defects Per Million Opportunities,  
COPQ - Cost of Poor Quality}

## 2.2 DMAIC methodology

The DMAIC is a simple thing of six sigma methodology- a better manner to improve work process by putting off the defects fee within the very last product. the DMAIC methodology has Five Phases Define, Degree, Evaluation, Development and Control.

### 2.3 Define phase

In this phase, define the reason of project, scope and technique history for both internal and external customers. There are a extraordinary equipment that is utilized in define section like sipoc, voice of purchaser and high-quality feature deployment.

Its various Outputs are:

- A clear knowledge of technique improvement and how is it degree by using the implementation of different gear.
- High stage of process is finished.
- A whole lot of successful elements listing show that what patron requirement.

### 3.0 Measure Phase

Decide the foundation reason of defects, focusing the information accumulate from present

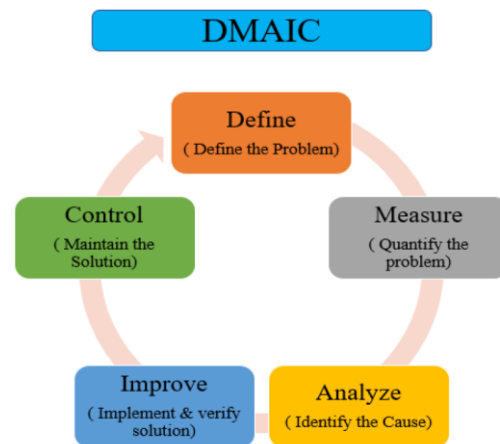
day method for improvement. there are special techniques to analysis statistics by sampling, gauge R&R and functionality process.

- Problem declaration focused within the technique.
- Pinpoint the trouble region due to one of a kind evaluation of statistics.
- What the manner is successful or now not?

### 3.1 Analyze phase

Perceive the root reasons of issues and verify them from statistics evaluation. there are specific techniques used for this segment are regression analysis, layout of experiment and process analysis. Output: What is the satisfactory putting for the development of technique and additionally highlight the big in the process.

**Figure 5: DMAIC Methodology [7]**



### 3.2 Improve phase

Increase the answer of problems within the procedure via implementing the one of a kind equipment like FMEA and Pilot plan. Output: Identification of planned actions which are carried out for improvement and should reduce the impact and additionally proposed answer for the problems.

### 3.3 Control phase

Using statistics, evolution of answer of issues and destiny plan and additionally maintain the standing working system.

Output:

- Analysis of statistics before and after.
- Properly monitored gadget.
- Finished documentation of manner effects.

### 3.4 Objectives of the project

Yarn manufacturing is complicated process and involves various processes. This project is intended to identify identification related to manufacturing of yarn at different process and some critical success factors are also highlighted to improve quality aspect. Apart from this some preventive measures are also stated against any failure. DMAIC tool is applied in last process i.e. winding by practical examples.

### 3.5 Motivation

The reason for choosing this project is to provide a better analysis on different processes in yarn manufacturing. The manufacturing process of yarn has complication and achieving quality in every process is tough task. Raw material doesn't possess essential properties like maturity, maturity, degree of reflectance, impurity and fiber strength and shade variation from bale to bale.

### 4.0 Conclusions

For better understanding of process and analysis of data of different departments for the improvement of process, DMAIC methodology is a best technique which is using for analyze the process by the using of different tools like X-Y matrix, FMEA etc. Improving quality and continuous improvement can be done by the implementation of six sigma methodology. It is not only used for improvement of quality rather it is also use as a business management strategy or improvement of financial condition of organization. Winding department where we have applied DMAIC tool is vital as compared to alternative departments within the method because it causes a rise defects rate proportion in the final product of yarn. Application of DMAIC tool in winding section is highly preferred for reduction of defects in this last section of yarn manufacturing process. Improving the yield standard or defect reduction is not possible after this section.

- The blow room department studied shows that critical success factor is cleaning efficiency and fiber growth.
- In carding section, critical success factors play a very important role to enhance the

quality of yarn such as cleaning of material, %age of neps removal, grains (wt.) per yard and also CV of output material.

- In draw frame section critical success factors are Auto leveler gauge setting, C.V% of output sliver, grains per yard.
- In combing section critical success factors are Noil percentage (shortfiber %age), top comb penetration, the number of needle in top corn, total draft between carding and combing action, short fiber content in material, fiber fineness.
- In roving frame section critical success factors are the amount of twist and compactness of the roving, linear density and uniformity of the twist, CV% of roving.
- In ring spinning section critical success factors are material and type of traveller, wear resistance, lubrication of fiber, smooth running, speed of traveller.
- After applying DMAIC tool of 6 sigma in winding section, it is found that Scan-Cuts and Disk life in winding section are most important factors. They need to be controlled to achieve optimum results best Scan-Cuts.
- SPC studies have shown that process is under control and there is not any point in which is out of control limits.
- Speed of different yarn count on winding machine should be designed in different standard. The training of operators should also conduct for the understanding of speed limits of different product.
- As our practical experience in yarn manufacturing plant, it is imperative to reduce or eliminate the defects in ever department to achieve the required specification laid down by customers in the final yarn end product. For any organization to capture market product should have good quality and good services. Therefore 6 sigma methodology could be applied to various other industries like.
  - a. Automobile sector.
  - b. Educational institutions.
  - c. Pottery, Handicrafts etc. for analysing manufacturing process of various departments.
- Using this methodology particularly for small scale industries and farming sector could help

poor section of India to improve profit margin to a good extent. The full potential of Six Sigma has not been realized so far and the extent of profitability of Six Sigma in various different sectors is yet to be explored. This is because numerous competent small to medium level enterprises are yet to implement Six Sigma programs.

- Usually the enterprises have all the resources for the implementation of Six Sigma initiatives, but they are wary of the final certification, as they believe that Six Sigma is beneficial only for large organizations. The future is bright for Six Sigma programs with the increasing awareness in small and medium enterprises regarding the potential benefits of implementing the Six Sigma initiatives.
- Six Sigma is different from other quality management tools such as TQM or Kaizen Events although it may appear similar. Implementation of other quality management programs often leads to a stage after which no further quality improvements can be achieved while focus of Six Sigma is on taking quality improvement processes to the next level.
- Six Sigma can be applied to every business process of an organization. This clearly suggests that scope of Six Sigma is much broader than other quality management programs and it may outlast them in the future.
- Six Sigma is likely to remain as one of the key initiatives for improvement of management process. Six Sigma professionals are trying to integrate Six Sigma with other existing innovative management practices to make Six Sigma method even more attractive.
- Integrating Six Sigma with Total Quality Management, Human Resource Functions, Lean Production, ISO 9000, ISO 9001, and the capability maturity model is one of the key areas of interest for researchers and practitioners to maximize the positive effect of the Six Sigma method.

## References

- [1] [www.articletrade.com](http://www.articletrade.com).
- [2] RK Sambhe, RS Dalu. Evaluating Six Sigma Implementation in Medium Scale Indian Automotive Enterprises| International Journal of Engineering Science and Technology (IJEST), 3(3), 2011, 1790-1796.
- [3] SN Teli, UM Bhushi, VG Surange, Assessment of Cost of Poor Quality in Automobile Industry|, International Journal of Engineering Research and Applications (IJERA), 2(6), 2012, 330-336.
- [4] [www.sixsigmagroup.co.uk](http://www.sixsigmagroup.co.uk)
- [5] J Antony, M Kumar, MK Tiwari. An Application of Six Sigma Methodology to Reduce the Engine-Overheating Problem in an Automotive Company| Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture, 219, 2005, 633-646.
- [6] [www.sixsigmaspc.com](http://www.sixsigmaspc.com)
- [7] [www.igneousesolutions.net](http://www.igneousesolutions.net)