STUDY ON QUALITY CONTROL IN SPINNING INDUSTRY

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ABSTRACT

The study investigates the usage of six sigma DMAIC approach to reduce defect rates in Jaisar spintex pvt ltd,.This is a systematic approach to defect minimization based on the DMAIC methodology's five phases of Define, Measure, Analyze, Improve, and Control. It focuses on the reduction/elimination of four basic types of defects in the Weaving section of Jaisar spintex pvt ltd., including Starting mark,Knot, Faulty weaving, Missing and double pick/ end. In different phases, different six sigma tools were used. The define phase clearly describe process map, which includes how they used to assess quality of product. In Measurement phase the calculation of level of sigma has been done by calculating number of defects per beam. Continuous evaluation of the weaving process during the analysis phase, with rigorous brainstorming sessions for the cause and effect diagram. Cause and effect analysis was used to discover the root causes of those faults, and Pareto analysis was used to identify the major types of defects. The improve phase focuses on optimizing the critical root causes that effect faults with their variables and levels. A risk matrix table was constructed to depict the risk, likelihood of occurrence, and impact of various scenarios (Table 2). These problems were recognized, and the procedures that could be taken to fix each fault were determined. In control phase, FMEA table has been used to identifying potential failure modes, their impacts and severity, causes, risk priority numbers (RPN), and preventive actions. The result By eliminating three major defects due to loom settings and the other improvement measures, the percentage of B-grade fabric was reduced dramatically than the previous level resulting in improvement in sigma level from 3.1 to 3.5, and increase in profits of 1.23 lakh per month.

Keyword : - *Weaving, Defects, DMAIC, Cause and Effect diagram, Pareto analysis, Risk matrix table, FMEA*

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1. INTRODUCTION

The project is on the textile business, namely JAISAR SPINTEX PVT LTD. This project examines the various issues that arise during yarn manufacturing in various processes, as well as the crucial success criteria that are most important in terms of quality. It also describes the steps taken to avoid a failure. The DMAIC tool is used in the Weaving section by using practical examples that have been used in the field. The objective for picking this project is to reduce the defects in the many processes involved in yarn production. It is a very sophisticated and crucial process, and maintaining quality throughout the process is difficult. The main reason is the raw material, which do not possess good properties such as maturity, degree of reflectance, impurity and fiber strength and shade variation from bale to bale.

The spinning industry is one of the country's largest and oldest industries, as well as the most important in terms of output, investment, and employment. It plays an important function in India since it satisfies people's basic necessities. India's spinning industry occupies a unique position and has shown consistent expansion over the years. This is a self-sufficient and autonomous industry with a wide range of products and applications. After China, India currently has the world's second-highest spindle age. After agriculture, the spinning industry is the second largest sector provide employment The spinning industry can be divided into two groups: organized mills and disorganized or decentralized spinning mills. The mills are the organized segment of the spinning industry. It could be a composite mill or a spinning mill. The spinning, weaving, and processing processes are all housed under one roof in a composite mill.

The three key segments of the decentralized sector are power looms, handlooms, and hosiery. In addition to the aforementioned, the decentralized industry includes readymade clothing and khaki manufacturing operations. By the close of the twentieth century, numerous tiny spinning mills had arrived as a result of the central government's liberalization of economic policies, and we now have a spindle age of yarn overproduction, primarily in south India. JAISAR SPINTEX PVT LTD is a spinning mill (manufacturers f terry towels). Spinning is conversion of fibers in to yarn. These Fibers can be natural fibers(cotton) or manmade fibers(pollster).

Spinning also entails production of manmade filament yarn (yarn that it Not made from fibers). Final product of spinning is yarn. Cotton Value chain starts from ginning that adds value to it by separating Cotton from seed and impurities. Spinning is the foundation process and all the subsequent value additions -Warping, Sizing, Weaving Bleaching Squishing Drier Length Cross (cutting, humming) Packing (Bale, carton box) depend on it. Any variation in quality of spinning product directly affects the entire Value chain.

2. PROBLEM STATEMENT

This research is on the textile business, specifically the production process. This study outlines the various issues that arise during the process of weaving in yarn manufacturing, the DMAIC tool is used to solve them using practical examples from the field. It is a very sophisticated and crucial process, and maintaining quality throughout the process is difficult.

The primary cause is the raw material, which lacks desirable characteristics such as maturity, reflectivity, impurity, fibre strength, and shade fluctuation from bale to bale. The main goal of this research is to lower the defect rate as well as the number of fault possibilities in the finished Product. According to Six Sigma methodology, if we reduce the number of fault opportunities in the end product, we can raise the Sigma value, indicating that the process is improving. We also used a simple Six Sigma tool called DMAIC, which highlighted the distinct phases of the tool in terms of process behavior and importance in the yarn manufacturing process.When compared to other departments in the process, the weaving department, where we used the DMAIC tool, is critical since it causes an large in the percentage of flaws in the final yarn output.

3. REVIEW OF LITERATURE

Neha Gupta and Dr. P.K.Bharti [1] presented a quality improvement research based on six sigma methodology that was carried out at a yarn manufacturing company. To streamline procedures and increase productivity, the DMAIC (Define, Measure, Analyze, Improve, and Control) project management technique and other tools are used. In the yarn manufacturing process, the rate of textile product defects is extremely essential from an industry standpoint.

Utilization of six sigma (DMAIC) technique for Reducing Casting Defects was investigated by Virender verma, Amit Sharma, and Deepak juneja [10]. The DMAIC method is a business methodology. a plan for increasing the profitability and efficiency of a business to ensure that all operations fulfil the needs and expectations of customers. The emphasis was placed on lowering the defect rate. (Rough surface, blow holes, misrun, slag inclusion) simply manipulating the settings in the sand castings Using the DMAIC method. The outcome demonstrates that the The number of rejects owing to sand casting flaws has decreased from 6.98 percent to 3.10 percent, saving around Rs.2.35 lac.

Jitender Kumar, Mukesh Verma and Atul Aggarwal do the Implementation of dmaic approach to minimize the defects rate of product in textile plant The paper is about the Yarn Manufacturing Process in the Textile Industry using discarded clothing pieces. This process has a lot of various departments where the cotton goes through different processes, which can affect the quality of the yarn when it gets to the packaging form. In the final packaging of yarn, a thousand faults opportunities arise.As a result, it was determined to undertake the work and adopt the DMAIC technique in the winding departments where the final yarn package is produced. The goal of this research is to eliminate winding problems in the textile industry. Result shows that the defects has been reduced from 13012 to 185. The sigma level has been increased from 3.81 to 5.10.

Implementation of Lean Six Sigma in the Yarn Manufacturing is done by Tarek M. Ibrahim The goal of this research is to look at how a Lean Six Sigma (LSS) project was implemented in the textile sector as a case study. In the meantime, the literature on Lean Six Sigma and its use in the manufacturing business, particularly in the textile industry, has been reviewed. The setup time was reduced from 30 minutes to 5 minutes using lean techniques to increase winding speed, reduce variation between individual production positions (process speed), and give tools for assessing process flow and delay periods. These two accomplishments result in a 50% reduction in WIP. While Six Sigma emphasises the importance of identifying opportunities and eliminating defects in the produced cones (final product of yarn manufacturing) as defined by customers, which improves the quality of the end product significantly and increases productivity by reducing waste yarn by more than 20% depending on the yarn type and raw material.

M.S. Kumaravel1, G.Boopathy, S. Mohamed Iqbal examine the Application of Six Sigma Practice for Quality Improvement in Textile Industry .This article produces valuable improvement research conducted in the textile manufacturing industry for effective and efficient management of the textile industry's internal climate. Using six sigma methodologies, the study will also look for extra products and services that may be offered to the textile sector to make it more profitable. A detailed report has been written to acquire a fresh and distinct perspective on purchasing the supply of quality ginned cotton and other manufactured fibres for the requirements at a competitive rate by identifying areas of inefficiency and acting on performance barriers in the textile industry. It also conducts a survey of areas of dissatisfaction in order to assist management in improving efficiency. The data was analysed, and recommendations were offered to the textile industry's management team for eliminating flaws in the manufacturing, transactional, and product-to-service processes. There were also specific recommendations for improving the spinning mills' operational efficiency.

4. RESEARCH METHODOLOGY:

Many failures occur during the production of various operations in the yarn manufacturing process. All of these failures are documented in the manufacturing facility. The highest percentage of faults was found during the winding stage. As a result, it was determined to use the DMAIC tool in this process to minimise a lot of variation.It was concentrated in all three departments, including Quality, Maintenance, and Production, at this time

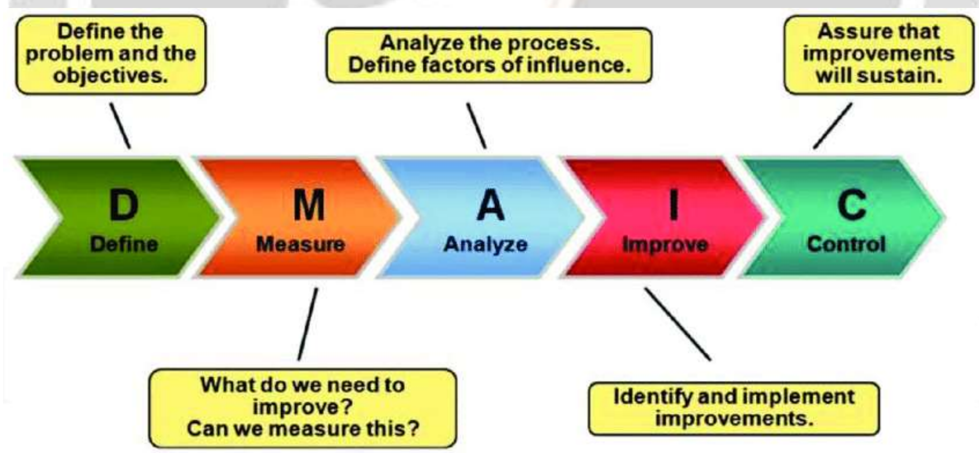

Fig -1: DMAIC Methodology

4.1 Define Phase:

Define the project's goal, scope, and process background for both internal and external clients during this phase. SIPOC, Voice of Customer, and Quality Function Deployment are some of the tools utilised in the define phase [Pyzdek, Thomas. 2003].

Output:

- A thorough understanding of process improvement and how it is measured through the use of various instruments.
- It is possible to obtain a high level of process.
- A long list of successful variables demonstrates what the customer's needs are.

4.2 Measure Phase:

Goal: To find the underlying cause of faults by focusing the data collected from the present process for change. Data analysis can be done in a variety of ways, including sampling, Gauge R&R, and the capability process.
Output:

- a problem statement that is specific to the procedure
- Identify the source of the problem using various data analyses
- Determine whether the procedure is capable or not

4.3 Analyze Phase

Goal: Identify and confirm the root causes of problems through data analysis. Regression Analysis, Design of Experiment, and Process Analysis are some of the methodologies employed in this phase.
Output: What is the optimal environment for process improvement, as well as highlighting the important aspects of the process?

4.4 Improve Phase

Goal: Use diverse tools like FMEA and Pilot Plan to develop solutions to problems in the process.
Output: Identification of planned activities for improvement that should lessen the impact, as well as a proposed solution to the difficulties.

4.5 Control Phase

Goal: To use data to evolve problem solutions and future plans, as well as to maintain the standard operating procedure.
Output:

- Data analysis before and after a process has been completed
- a well-monitored system
- a complete documentation of the process findings

5. DATA ANALYSIS

Introduction:

Each applied step and technique of the Six Sigma methodology in my project has been clarified in details in the next subsections.
The data collection and analysis go through five phases

5.1 Define phase:

The problem, project scope, objective, project team, and work schedule are all defined during the define phase of the Six Sigma process. The study's problem was stated as "a high percentage of B-grade fabric production in the weaving mill due to a high number of fabric flaws." The project's goal was to lower the percentage of B-grade fabric produced. To finish the project, a team was formed that included people from the fabric manufacturing department, quality control staff, management, and the investigators. Yarn is manufactured by yarn manufacturers and purchased by weaving mills for use in fabric production. Yarn is examined for physical and mechanical qualities, as well as any defects, before being used in the weaving machine. Total imperfection (IPI), single yarn strength, CV percent, and count/lea strength product (CLSP) are all key factors in yarn testing for producing high-quality fabrics. After passing all tests, the authorised yarn is delivered to the weaving department to be turned into a weaving beam. The technique of weaving involves placing the requisite quantity and length of yarns on beams to achieve the desired fabric length. The weaving beams are sent to the size section, where sizing chemicals like as starch or polyvinyl co-polymers are used to strengthen the yarns. The yarn from many weaving beams is joined on the sizing beam to achieve the necessary number of total yarns. Drawing-in and fabric weaving follow this stage. Fabric inspection and grading are performed after production according to the grading procedure agreed upon with the fabric customer.

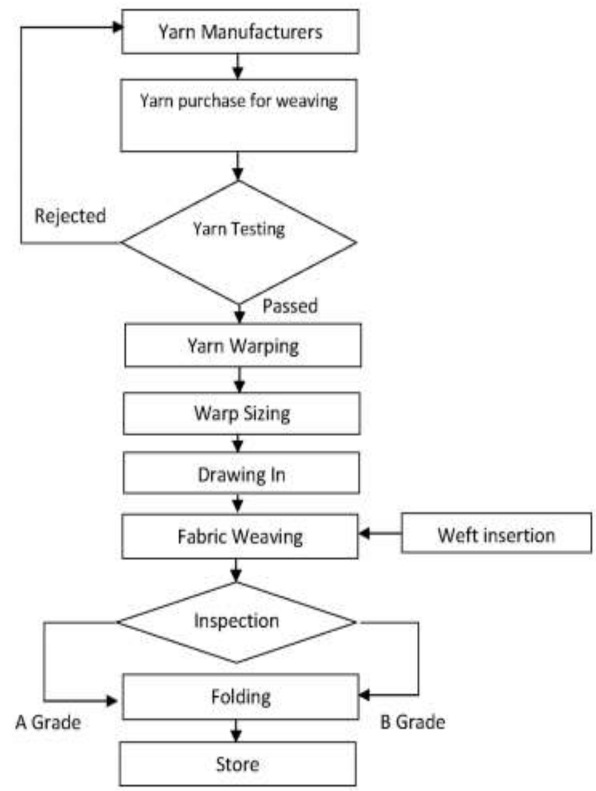

Fig -2: Flow Chart of Process of Company

5.2 Measure phase:

The problem was turned into a measureable form during the measure step. Data relevant to the problem was gathered, and the situation was analysed using the information gathered. Over the course of a month, representative lots of samples were tested for flaws, and the proportion of B-grade fabric produced was calculated.

Fabric grading was accomplished by finding and counting major and minor flaws. The most severe flaws receive the most penalty points and are unlikely to be accepted by the consumer. Minor flaws are ones that are less serious and have a reasonable probability of being accepted by the client.

The sigma level in the weaving process was determined based on the gathered fabric defect data as follows:

The total length of cloth tested was 7500 metres.

There are 276 major faults in all.

The total number of minor flaws is 152.

Defects per unit (DPU) = Total defects/ total length inspected = 428/7500 = 0.057

Hence,

Yield = e-DPU

= e-0.057

= 0.9445

PPM = –ln (yield) × 10,00,000

= –ln (0.9445) × 10,00,000

= 57100

The computed existing sigma level is currently 3.1, according to the table for sigma level

Table -1: Sigma Conversion Table

Six Sigma Conversion Table

Yield	DPMO	Sigma	Yield	DPMO	Sigma	Yield	DPMO	Sigma
6.6%	**934,000**	**0**	**69.2%**	**308,000**	**2**	**99.4%**	**6,210**	**4**
8.0%	920,000	0.1	72.6%	274,000	2.1	99.5%	4,660	4.1
10.0%	900,000	0.2	75.8%	242,000	2.2	99.7%	3,460	4.2
12.0%	880,000	0.3	78.8%	212,000	2.3	99.75%	2,550	4.3
14.0%	860,000	0.4	81.6%	184,000	2.4	99.81%	1,860	4.4
16.0%	840,000	0.5	84.2%	158,000	2.5	99.87%	1,350	4.5
19.0%	810,000	0.6	86.5%	135,000	2.6	99.90%	960	4.6
22.0%	780,000	0.7	88.5%	115,000	2.7	99.93%	680	4.7
25.0%	750,000	0.8	90.3%	96,800	2.8	99.95%	480	4.8
28.0%	720,000	0.9	91.9%	80,800	2.9	99.97%	330	4.9
31.0%	**690,000**	**1**	**93.3%**	**66,800**	**3**	**99.977%**	**230**	**5**
35.0%	650,000	1.1	94.5%	54,800	3.1	99.985%	150	5.1
39.0%	610,000	1.2	95.5%	44,600	3.2	99.990%	100	5.2
43.0%	570,000	1.3	96.4%	35,900	3.3	99.993%	70	5.3
46.0%	540,000	1.4	97.1%	28,700	3.4	99.996%	40	5.4
50.0%	500,000	1.5	97.7%	22,700	3.5	99.997%	30	5.5
54.0%	460,000	1.6	98.2%	17,800	3.6	99.9980%	20	5.6
58.0%	420,000	1.7	98.6%	13,900	3.7	99.9990%	10	5.7
61.8%	382,000	1.8	98.9%	10,700	3.8	99.9992%	8	5.8
65.6%	344,000	1.9	99.2%	8,190	3.9	99.9995%	5	5.9
						99.99966%	**3.4**	**6**

5.3 Analyses phase:

During the analysis phase, a cause and effect diagram was created using brainstorming to examine all of the aspects that could affect the woven fabric quality. Figure 3 depicts the cause and effect diagram. It's easier to sort out potential problems and identify areas for improvement when all the causes for a specific impact are listed in a clear, organised manner.

Fabric lots were inspected, and flaws were noted, as well as the causes and severity of the faults. Table 1 shows the information gathered. The total length of inspected fabric was
7500 metres, including 276 severe problems and 152 minor faults.

Table -2: Defects identified after fabric inspection

<table>
<tr><th>Lot
No</th><th>Fabric Length
inspected (m)</th><th>Major Defects</th><th>Reason</th><th>Minor defects</th><th>Reason</th></tr>
<tr><td>1</td><td>862</td><td>34</td><td rowspan="9">Weaving m/c faults, Yarn Thicknes, Uneven tension, Finishing</td><td>16</td><td rowspan="9">Faulty weaving, Yarn thickness, Uneven tension, Sizing, Slub, Oil, Drawing in</td></tr>
<tr><td>2</td><td>798</td><td>23</td><td>15</td></tr>
<tr><td>3</td><td>822</td><td>25</td><td>13</td></tr>
<tr><td>4</td><td>808</td><td>31</td><td>17</td></tr>
<tr><td>5</td><td>874</td><td>38</td><td>21</td></tr>
<tr><td>6</td><td>842</td><td>42</td><td>20</td></tr>
<tr><td>7</td><td>810</td><td>32</td><td>17</td></tr>
<tr><td>8</td><td>863</td><td>27</td><td>18</td></tr>
<tr><td>9</td><td>837</td><td>24</td><td>15</td></tr>
<tr><td></td><td>7516</td><td>276</td><td></td><td>152</td><td></td></tr>
</table>

5.3.1 FISH-BONE DIAGRAM:

In the shape of a diagram resembling the skeleton of a fish, the fishbone analysis systematically organises thoughts into categories to find potential reasons of a problem; it is an efficient tool for continuous improvement. Ishikawa Fish-bone analysis or Cause-and-Effect analysis are two terms for this form of root cause analysis. The problem is at the top of the figure, and the bones represent the many causes. There is a logical categorization of causes, and the most common categories are Manpower, Methods, Machine, Material, and Environment; nevertheless, there are variances in how these categories are chosen. There are causative factors within each of these categories. This tool helps to methodologically reach to the root cause of the problem

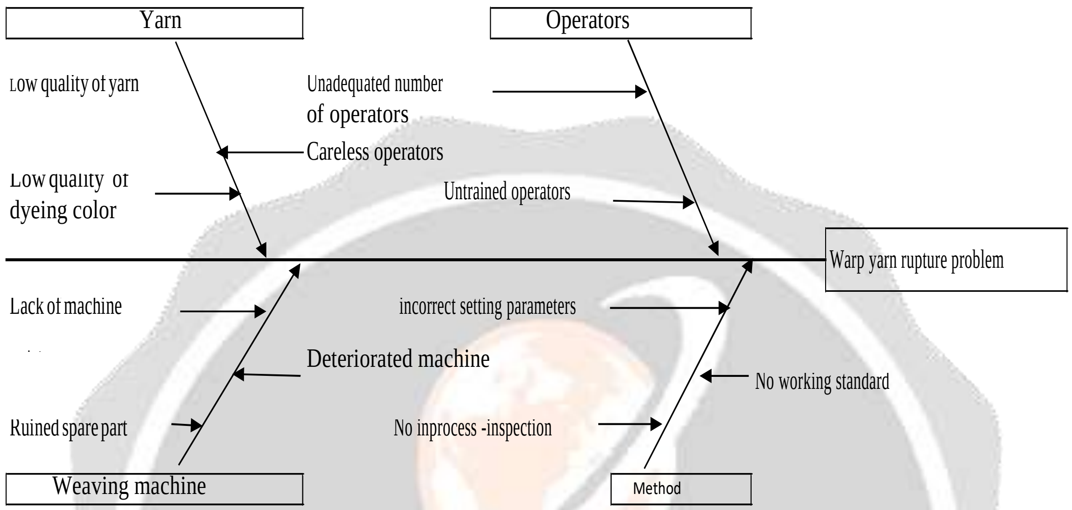

Fig -3: Fish-bone Diagram

the Pareto analysis of the detected flaws. The Pareto analysis aids in the differentiation of the "vital few" from the "trivial many." Figure 3 shows that inappropriate weaving loom settings were responsible for 86 percent of the faults in the weaving section.

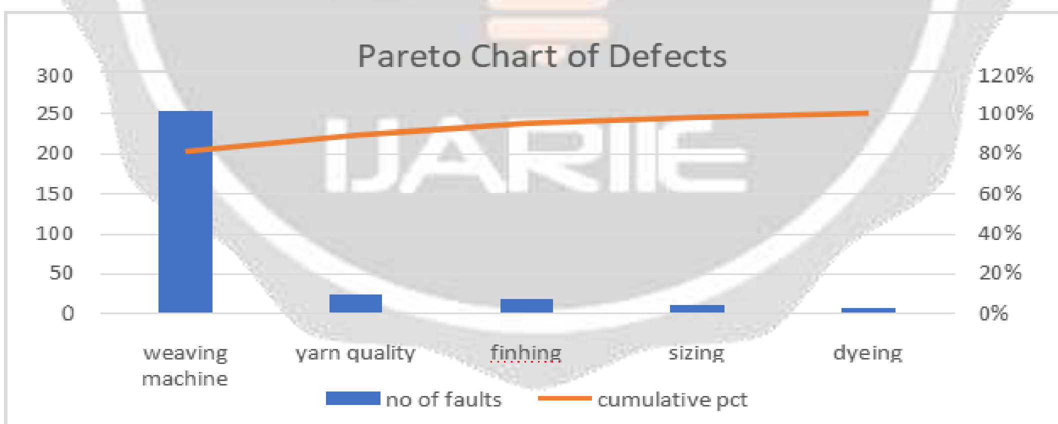

Chart -1: Pareto chart for All Major Defects

Table -3: Defects Percentage Table

Source of faults	No. of faults	Percentage	Cumulative %
Weaving Machine	347	81%	81%
Yarn quality	34	8%	89%
Finishing	26	6%	95%
Sizing	13	3%	98%
Dyeing	8	2%	100%

5.4 Improve phase:

The improve phase entails duties such as identifying and eliminating the problem's root causes, as well as designing and implementing a better method. A risk matrix table was created to show the risk, likelihood of occurrence, and impact of certain situations (Table 4). These issues were identified, and the corrective steps that could be taken for each of the flaws were determined. According to the Pareto analysis, the greatest source of worry was improper loom settings, which resulted in three types of fabric defects: starting markings, double picks, and miss picks. All feasible loom settings corrections were investigated, and those that produced superior results were adopted in cooperation with the loom manufacturer.

Table -4: Risk Matrix Table

Activity	Risk	Likelihood	Impact	Level of risk
Yarn quality	Weft with a slubby texture	Possible	Minor	Low
	Yarn with flecks	Rarely	Minor	Moderate
	Count variation	Possible	Major	Extreme
Sizing	Sizing stain	Likely	Major	Moderate
	Sizing balls	Possible	Moderate	Low
	Hard size	Possible	Major	Extreme
Dyeing	Dye spot	Rarely	Major	Extreme
	Increase in width	Rare	Major	Extreme
Weaving machine	Starting mark	Likely	Major	Extreme
	Missing and double pick / end	Likely	Moderate	Moderate
	Knot	Likely	Major	Extreme
	Faulty weaving	Likely	Major	Extreme
	Wrong denting	Rare	Major	Extreme
Finishing	Crease marks	Possible	Major	Extreme
	Arrangement pattern	Likely	Moderate	Moderate
	Drop stitches	Possible	Major	Extreme

All of the machines should have an easing motion, according to the machine maker. This relaxing motion compensated for the extra tension on the warp sheet, resulting in less stressed yarn. Furthermore, the observed starting markers appeared to be open starting marks. These marks were reduced after all of the machines' settings were upgraded. The setting point was altered such that when the machine was re-started, the cloth dropped was set to travel towards the beam, preventing open starting markings. As a result, up to 95% of starting marks were eliminated.

The double picks were found to be entire double picks, which was primarily due to cutters not operating in a timely manner, resulting in missed pick cutting and the manufacture of double picks. All of the cutters were ground, and the damaged blades were replaced, resulting in a reduction of the proportion of double picks to 80% of the prior value. The weaving mill was also discovered to be employing faulty filling detector (FD) cables, which were causing the FDs to malfunction. Weft yarn detection was the responsibility of FD, and its absence resulted in miss picks. The cables were replaced with original FD cables, and during the subsequent fabric inspection, miss picks were decreased by 75% compared to the previous level.

Other corrective actions that could be taken for the faults which are mentioned in the risk matrix table are given as under:

The spinning/yarn manufacturing process might be improved to solve all of the difficulties with yarn quality. Testing the yarn before weaving could also assist in choosing the best quality yarn for the garment. It was possible to determine the level of yarn flaws in order to see if they were within permissible limits.

To avoid sizing stains, the sizing room should be properly ventilated, size boxes should be cleaned, and exhaust fans should be used. Sizing beads and balls can be avoided by using the right sizing recipe and measuring size materials accurately and precisely.

Workforce training could aid in the prevention of any faults that may arise as a result of drawing in.
To avoid starting marks fault, loom beat up, position of fell of fabric, settings from i-board of loom, and tension settings might be changed. The starting marks defect is a serious flaw that affects the majority of fabrics, resulting in fabric rejection.
By eliminating three major defects due to loom settings and the other improvement measures, the percentage of B-grade fabric was reduced dramatically than the previous level resulting in improvement in sigma level from 3.1 to 3.5, and increase in profits of 1.23 lakh per month.
Fabric of A-grade was sold for 500 rupees a metre. Monthly mill output was 1,500,000 metres. Rejected fabric accounted for 2% of the mill's total output, implying that 30,000 metres of B-grade fabric were produced. At 255 rupees per metre, this B-grade fabric was sold out. Rejection was reduced from 2% to 0.75 percent by following the improvement techniques. This improvement resulted in the sale of 10,230 metres of fabric at A-grade fabric prices, i.e. 500 rupees per month, which was previously sold at B-grade prices. By converting B-grade cloth to A-grade fabric, the company was able to generate Rs. 1.23 lakhs each month.

5.5 Control phase:

A process is changed, managed, and regulated in the control phase to ensure that the incorporated improvements are maintained. Control Plan (Poka Yoke), statistical process control (SPC), and failure mode and effect analysis are all tools used in the control phase (FMEA). The project met in the control stage to conduct the FMEA, which included identifying potential failure modes, their impacts and severity, causes, risk priority numbers (RPN), and preventive actions. It was necessary to gather all of the data from previous faults that happened during the entire process flow in order to complete FMEA analysis. Table 3 shows the results of the completed FMEA.

Table -5: FMEA Table

Issues	Potential Failure	Potential Effect of Failure Mode	S	Potential Cause of Failure Mode	0	D	Rpn	Preventive Action
Yarn	Thick-thin lines	Thread with a diameter that is different from the surrounding thread	3	uneven let-off, worn or fractured gear wheel teeth	5	5	75	Proper yarn selection
	Sluby texture	Unattractive appearance	2	Improper yarn selection	1	1	2	Proper yarn selection
	Coarser warp	Stripes that run the length of the fabric are barred and dense.	2	physical properties of fibers, yarn parameters and machine parameter	1	1	2	Better quality yarn selection
Warping	Lot variation	Fabric with various appearances	1	Several lot yarns co-me from different mill	0	0	0	Yarn cone must be tested before Production
Dyeing	Dyeing spot	Fabric with a stain	1	Yarn count & tension variation	2	2	4	Proper yarn count & tension
	Shade variation	The depth of difference in the color	3	Variation in process	1	1	3	Follow same process parameter
Sizing	Ball formation	On the cloth surface, a little spherical fibrous material appears.	2	Fibrous material entangled in the yarn	1	1	2	Less hairy yarn should be used
	Hard size	Yarn breakage	5	Excessive size material & drying temp.	0	0	0	Maintenance of size material & drying temp

Weaving m/c	Wrong denting	Inappropriate weave design	4	Incorrect order of denting	2	2	16	Denting should be done carefully
	Starting mark	Streak on fabric	5	Sudden machine stoppage	14	14	980	Proper machine setting
	Double pick&end	Repping mark	4	Incorrect drawing & cutter malfunction	17	17	1156	Proper drawing & cutter grinding
	knot	On the fabric, there are little, densely twisted knot-like masses.	2	Poor skilled worker	3	3	18	Training to worker
	Miss warp&weft	Streak on fabric	5	Malfunction of warp stop motion and FD	11	11	605	Proper functioning of machine
Finishing	Drop stitches	Stitching in the surface of the fabric	5	one or more yarns are sufficiently damaged	3	3	45	Better quality yarn
	Crease mark	Curling on fabric surface	2	Improper tension on fabric edge	2	2	8	Maintaining proper tension

6. Suggestions and Findings:

The project was started with the goal of minimising textile weaving errors. In order to find a solution to any problem, accurate data collecting is essential. The information was gathered in order to identify the areas that required the most attention in order to attain the intended result. The main goal was to identify all conceivable flaws and the locations that were related with them. The data proved to be quite useful in identifying the problem and developing realistic solutions that resulted in an improvement.

The nature of defects discovered in the analyse phase and corrected in the improve phase were reviewed and disseminated to the entire weaving team so that the corrective procedures could be applied on a constant basis to keep the process under control.

The project team's primary recommendations are summarized as follows:

- Weaving machines regularly monitored if there is any problem or not.
- Weft cutter degree should be checked on a weekly basis, as per machine manufacturer's recommendations.
- Filling detectors (FDs) should be checked daily and replaced immediately if any fault occurs to avoid miss picks.
- The grinding and/or polishing, as needed, of cutter blades should be done after every three months

After implementing the suggestions the re-inspection takes place
Total fabric length inspected = 7,500 m Total major defects = 112
Total minor defects = 68 Total defects = 180
Defects per unit (DPU) = Total defects/ total length inspected = 180/5520 = 0.024
Hence, Yield =e-DPU
= e-0.024
= 0. 9763
PPM = –ln(yield) × 10,00,000
= –ln (0.9763) × 10,00,000
= 23985

Table 6: Defects identified after fabric re-inspection

	Fabric length inspected (m)	Major defects	Reason	Minor defects	Reason
1	838	12	Weaving m/c faults , Yarn Thickness, Uneven tension, Finishing	4	Faulty weaving, Yarn thickness, Uneven tension, Sizing, Slub, Oil, Drawing in
2	830	13		8	
3	822	10		8	
4	816	9		6	
5	864	14		9	
6	852	16		11	
7	815	12		6	
8	824	11		9	
9	845	15		7	
	7506	112		68	

Consulting with the table for sigma level, the existing sigma level calculated as 3.5.

7. CONCLUSIONS

By eliminating three major defects due to loom settings and the other improvement measures, the percentage of B-grade fabric was reduced dramatically than the previous level resulting in improvement in sigma level from 3.1 to 3.5, and increase in profits of 1.23 lakh per month.

By converting B-grade cloth to A-grade fabric, the company was able to generate Rs. 1.23 lakh each month.

According to the findings, finding the exact cures enhanced the manufacturing of higher-quality fabric. The sigma level was 3.1 at the start, but after the preventive measures were implemented, it improved to 3.5, resulting in a larger profit for the company.

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