

Root Cause Analysis and Productivity Improvement of An Apparel Industry in Bangladesh Through Kaizen Implementation

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PAPER INFO	ABSTRACT
<p>Chronicle: Received: 27 August 2017 Accepted: 20 December 2017</p>	<p>Garments industry is playing the pioneering role in improving Bangladesh economic condition. It was started in late 1970's and now the leading foreign currency earner for Bangladesh. It is no dubiousness to say that, the Bangladesh garment industry is ameliorating garment's service quality and innovative design features to exist in the global competitive market. Global competition in the garment's market is changing day to day. Leading garment manufacturer from all over the world are adopting new innovative features and techniques to sustain global fierce competitive market. However, the point is, Bangladeshi garment manufacturers are not lingered. They are also emphasizing on better service quality by adding latest design features and using the latest technologies to the garments. The sole purpose of this paper is to identify the root causes of sewing defects of an apparel industry in Bangladesh and continuous improvement in reducing the defects through Kaizen (Continuous Improvement) system. In short, productivity improvement of the apparel industry. Our studied garment manufacturing company is "ABONTI Color Tex. Ltd." Pareto Analysis is used to identify the top defect items. Cause-Effect Analysis helped to identify the root causes of sewing defects. Then, Kaizen is used for continuous improvement of the minimization of sewing defects.</p>
<p>Keywords : Kaizen. Productivity Improvement. Pareto. Cause-Effect. Lean Manufacturing.</p>	

1. Introduction

In the era of globalization, Bangladesh garment's industry is recognized as a brand to the worldwide. Many big companies from developed countries are investing in Bangladesh garment's industry. Sufficient manpower, attractive labor market, and geographical location are the main reason of investment. In 1978, there were only 9 factories in Bangladesh and started their journey by earning foreign currency of \$.069 million. In the fiscal year 2012-2013, Bangladesh earned more than \$21 billion by exporting ready-made garments. According to the Bangladesh Garment Manufacturers and Exporters Association (BGMEA), in the fiscal year 2015-2016, the Bangladesh RMG industry earned

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\$28094.16 million [1]. Now the current number of garments factory in Bangladesh is more than 6000. Not only that, Bangladesh occupied second position in exporting the ready-made garments to the worldwide but also opened an opportunity. Till now, “Made in Bangladesh” stickered ready-made garments is exporting to the more than 150 countries. In Bangladesh GDP, Garment’s industry contributes 15% to the overall economy.

In this continuation, many multinational companies are doing business in Bangladesh such as h&m, GAP, Marks and Spencer, TESCO, UNIQLO, li & fung, YKK Bangladesh Pte. Ltd, must Garment Corp. Ltd, Wal-Mart, Next Sourcing Ltd. Etc. Noted that, most of the factories are listed on world famous fortune magazine top 100 list. Two words are very common in RMG sector, backward linkage and forward linkage. Basically, people who are associated with the making of accessories before the making of final products is called backward linkage, and people who are associated with the process of proper packaging to send the finish goods to the customer is called forward linkage. Backward linkage listed companies are avery dennison Bangladesh Ltd, A1 Zipper, YKK Bangladesh Pte. Ltd, etc., and forward linkage companies are maersk Bangladesh ltd, homebound packers and shippers limited, DHL worldwide express (BD) pvt. Ltd, etc. In garments industry, there are lots of people’s are involved to make the garments. For the garments sewing in the production line, many workers are working on the production line. Workers are working on the production line continuously. Therefore, at these moments there can be happened lots of sewing defects. For an example, a worker have target to sew side seam of the 100 pieces of garments.

Garments job is really a high-pressure job. At this situation, any type of sewing defects can be occurred. Therefore, pressure is the main root cause of the sewing defects. For the data of selected garments factory, we have done Pareto Analysis. From the Pareto analysis, we got the results such as broken stitch, open seam, pleat, skip stitch, label missing and point up down are the most happening sewing defects. Broken stitch can be happened for machine problems and workers efficiency problem. Skip stitch happened for the dust in the machine. Therefore, operators need to practice to clean the machine on the regular basis. Label missing is the simple problem. However, it has huge negative impact to view. Most root causes can be easily identified by discussing with the experts and can easily represent with the graphical diagrams, and the last phase, continuous improvement. Kaizen implementation is the vital phase of minimize sewing defects. Kaizen is a Japanese word which means to take something in order to make it better. In here, we are taking sewing defects to reduce the number of sewing defects by using Kaizen method. Kaizen technique is used to continuously improve the sewing defect situation. Kaizen process starts with brainstorming the process and then finally implement the action to get the results.

2. Literature Review

The root cause analysis is an analytical tool which is defined by Wilson et al. [2]. He also mentioned that this tool is very much effective which can be used to perform a corrective and comprehensive system-based review of critical defects. The cause effect diagram actually focuses on identification of the root for the specific defects and contributory factors. It also concern for determining the defect reduction strategies and develop the action plan with measurement strategy which helps to evaluate the effectiveness of the plans. In 2005, Canadian root cause analysis framework, summarized that the most important component for understanding defects in manufacturing is this root cause analysis. They tried to understand the event by reviewing and identifying unanswered questions and information gap. Therefore, root cause analysis has become a powerful tool for finding the root cause for the occurrence of defects in any manufacturing of production especially in garments manufacturing.

Siekannskiski and Borkowski [3] summarized that the usage of cause and effect diagram help to identify the areas especially subjected to defect formation. Pareto diagram, a Statistical control tools, directs to irrevocable separation of main nonconformance in defects. Jadhav and Santosh [4] represented the cause effect diagram as a systematic approach to find the root cause of one of the major defects is needed. Joshi and Jugulkar [5] summarized in their paper that the methodology cause effect diagram is easy to understand causes of defects of production. At first, it follows some easily possible main remedies and hence it reduces the defects as much as possible. Pareto analysis and cause effect diagram are used in a manual foundry to identify the defects and evaluate different defects and with causes for these defects, which are responsible for rejection of produced parts. Juriani [6] suggested various causes and remedial measure in his publication with the help of cause effect diagram. His study was highly useful for minimizing casting defects in foundries. Kamble [7] drawn a cause effect diagram for the defect in a Medium Scale Foundry Industry. Hossen et al. [8] applied Pareto analysis and cause effect diagram (CED) for examining the stoppage losses in a textile factory in Bangladesh. They analyzed and drawn the cause effect diagram for idling and minor stoppage, breakdown losses, and they also made a Pareto analysis where they have founded the major stoppage losses are idling and minor stoppages, breakdown, yield loss, reduced speed etc. They also provided some suggestion for the factory to minimize this loss. Similar to cause effect diagram, an important lean tool is Pareto analysis, which helps us for finding the defects and causes, which should be our main causes.

Chandna and Chandra [9] made a study on forging operation that produces cylinder crankshafts, which are used in buses and trucks. They used Pareto diagrams for finding and identifying critical areas and forging defects of crankshaft. In their study, the corrective measures reduce the rejection rate from 2.43% to 0.21%. Khekale et al. [10] represented another case in 2010 of wastage reduction for a manufacturing industry which produce belt and located in the Virabha, India. This industry produce world class automotive belts and hoses. In 2011, Ahmed and Ahmad, studied on lamp production process and used Pareto analysis and cause effect diagram for minimization of defects. Their target was to aim zero defects and zero waste for zero losses [11]. Pareto analysis was also used on casting defect analysis by Dabade and Bhedasgaonkar [12]. They used design of experiments and computer aided casting simulation techniques. They found their result from their study that the reduction in shrinkage porosity approximately 15% and improvement in yield approximately 5%. Farris et al. [13] has concluded about kaizen in 2008 that it is a project, which focuses, and structures for improvement, it uses a dedicated cross-functional team, which improves the targeted work area and must have a specific goals, in an accelerated timeframe.

Singh and Singh [14] reviewed a number of literatures for Kaizen concept. They make a case studies and survey. From their review, they have concluded that Kaizen is a philosophy, which is widely used in manufacturing industries. Glover [15] analyses, refers that kaizen removes major obstacles from the organizations, and sustains the improvements continuously from the Kaizen event through the time. Kumar [16] explains about the Kaizen philosophy for improvement and assumes that our way of life, i.e. it is our working life, social life, or our home life should be the focus of constant improvement efforts. Barraza and Jose [17] studied and implemented kaizen tool in certain multinational organizations in Mexico. The purpose of their study is to analyze kaizen implementation and compare with the theoretical systems in that field. They made a case study in two multinational companies in Mexico. Mojica and Rivera [18] mentioned the kaizen that it is one the most important methodologies and is very much useful for reducing process time and increasing economic benefits for the company. They represented the critical success factors for kaizen implementation, which results consists of 37 activities and 14 benefits. These results were applied to personnel of 258 for continuous improvement programs. They were allowed to answer on a Likert scale. Sharma et al. [19] stated the kaizen that it is

a simple concept of working which mainly focus on improving the working area. Norhasni [20] used item response theory (IRT) in their study to examine the failure or success of implementation of Kaizen. They used Winsteps 3.6 software for their analysis and implementing in the Malaysian automotive companies. Desta and colleagues [21] implemented kaizen in an Industries of Southern Ethiopia's. Ratnawati [22] implemented the philosophy of kaizen in an Indonesian ISO manufacturing companies for improving the industrial productivity. They use Likert scale and focused on job satisfaction, productivity, corporate culture, and organizational commitment.

3. Research Methodology

Productivity improvement process needs to go through several steps. Our studied garment factory is "ABONTI Color Tex Ltd." We have gathered defect data, done time study, calculate SMV. Table 1 represents the defect data and Fig1 shows the productivity improvement process steps.

Steps in overall productivity improvements:

- step 1. Factory selection
- step 2. Data Collection
- step 3. Pareto Analysis
- step 4. Cause-Effect Diagram
- step 5. Kaizen Implementation



Fig 1. Productivity improvement process.

Kaizen technique implemented by using several steps that are listed below. Fig 2 represents the Kaizen implementation process.

- step 1. Brainstorming
- step 2. Goal set up
- step 3. Data Collection
- step 4. Plan
- step 5. Do
- step 6. Check
- step 7. Action
- step 8. Results

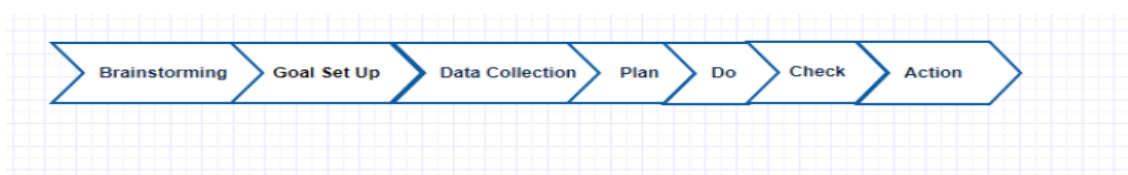


Fig 2. Kaizen implementation process.

Table 1. Summary of defects August, 2017.

No	Defect Name	Total Defects
1.	Broken stitch	9230
2.	Loose tension	658
3.	Hem Length Up down	19
4.	Dirty Spot	85
5.	Down Stitch	2361
6.	Join Stitch	1565
7.	Label missing	4456
8.	Needle mark	18
9.	Oil Spot	198
10.	Open seam	4998
11.	Part shading	368
12.	Pleat	4517
13.	Point up down	2740
14.	Print defect	40
15.	Puckering	890
16.	Tack missing	1236
17.	Skip stitch	4477

4. Findings and Data Analysis

For finding the root cause of sewing defects, we have selected a garment manufacturing company. Our studied organization was “ABONTI Color Tex. Ltd.” We have visited the factory and gathered the defects information. The collected data is for August 2017. The cooperation of management personnel of the selected factory was awesome. He helped a lot to collect the accurate sewing defect data and to identify the exact root cause of the sewing defects. Not only he but also production manager, maintenance management authority, even general workers, assigned industrial engineer helped a lot to identify the exact and accurate root cause. Table 1 represents the summary of defects August 2017.

4.1. Pareto Analysis

Pareto is a simple statistical chart also known as Pareto Diagram or Pareto Analysis. This tool is very useful in quality control. By application of this tool means many thing. One of them is “About 20% causes or reasons are responsible for 80% defects in a factory.” It is also known as ABC analysis. Some people also called 80-20 rule. In 80-20 rule, ‘Few’ -20% causes “Vital Few” whereas the rest ‘Many’ -80% causes are known as “Trivial Many.” While vital few occurs frequently, and trivial many occurs infrequently. Fig 3 shows Pareto Analysis for the collected defect data August 2017.

4.1.1. Pareto Analysis Observations

- a) Broken stitch is the most frequent defect with as much as 24% of the total.
- b) Open Seam is the second most frequent defect with 14% of the total. Also, Pleat 12%, Skip stitch 11%, Label missing 12%, Point up down 7% is other defect of the total.
- c) The top defect positions are Broken stitch, Open seam, Pleat, Skip stitch, Label missing and Point up down. These six top defect positions are the “vital few” where 80% of total defects occur.

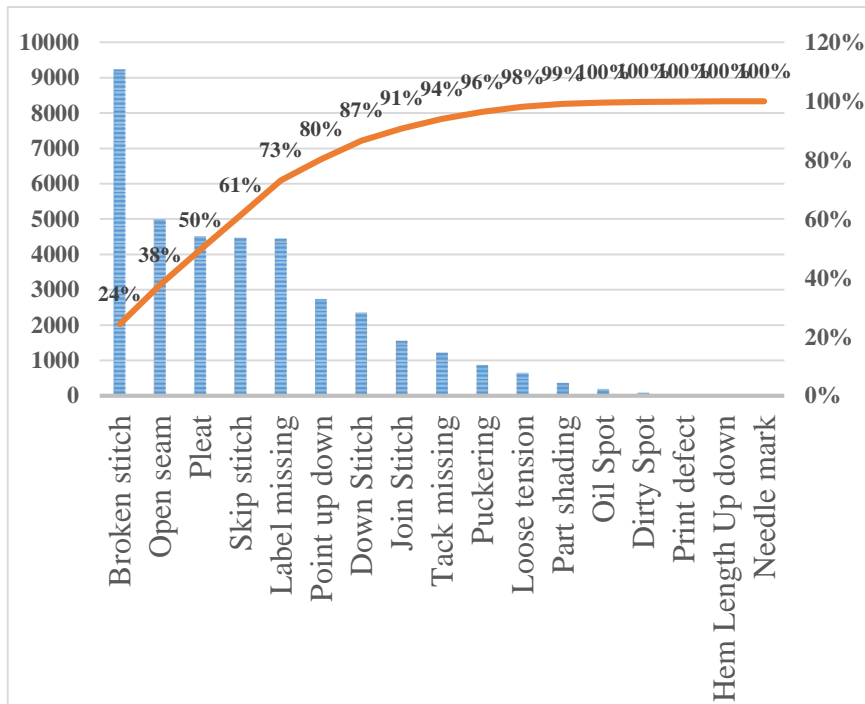


Fig 3. Pareto analysis.

4.2. Cause-effect Diagram

‘Cause’, which ultimately lead to create an adverse ‘Effect’”. Effect is the quality problem. Cause-Effect analysis is a tool for analyzing and illustrating a process by showing the main causes and sub-causes leading to an effect. Sub-branches are known as twiglets. Figure (4-8) represent the cause-effect diagram of Broken stitch, open seam, pleat, skip stitch, label missing and point up down respectively.

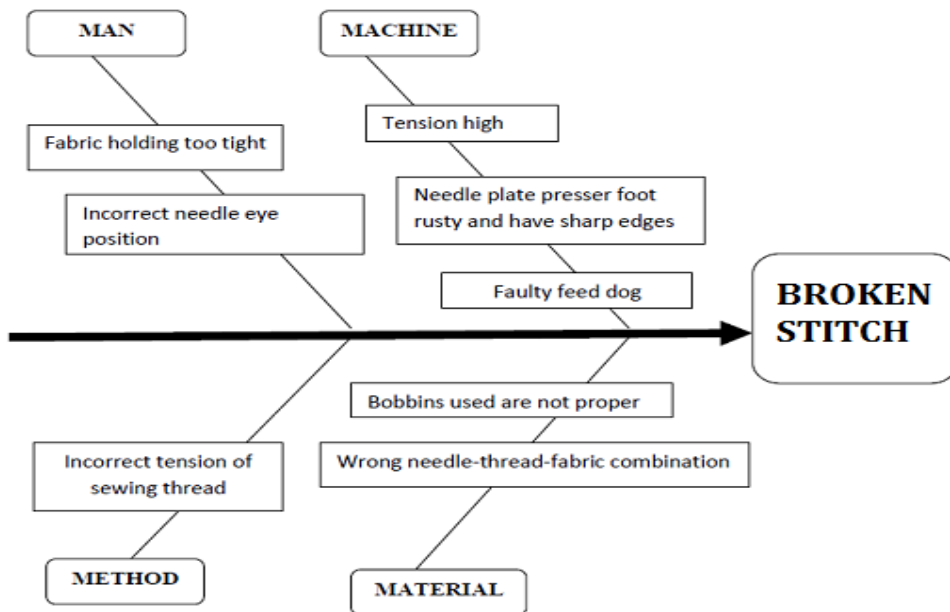


Fig 4. Cause-effect diagram for broken stitch.

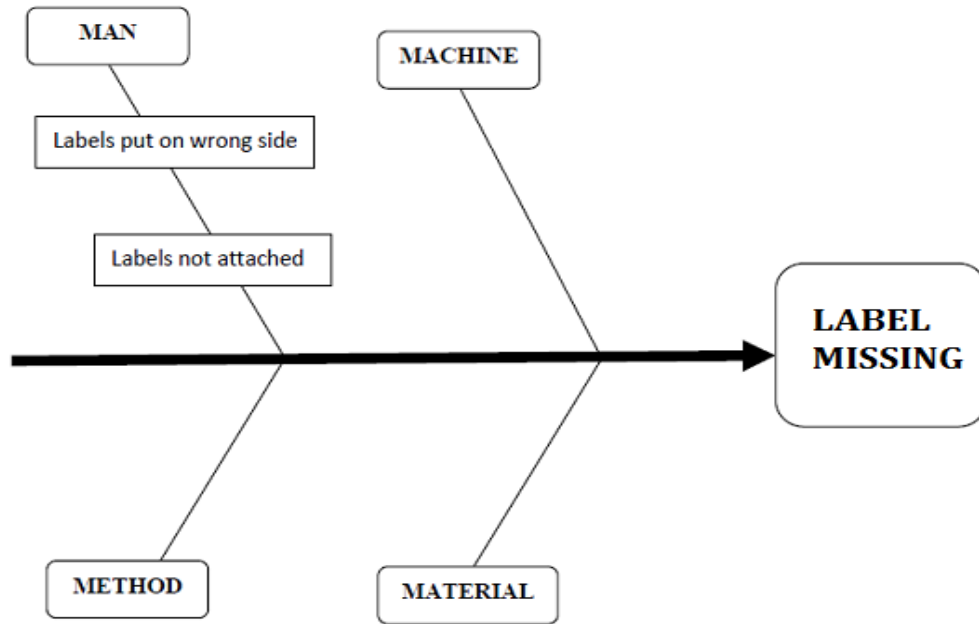


Fig 5. Cause-effect diagram for label missing.

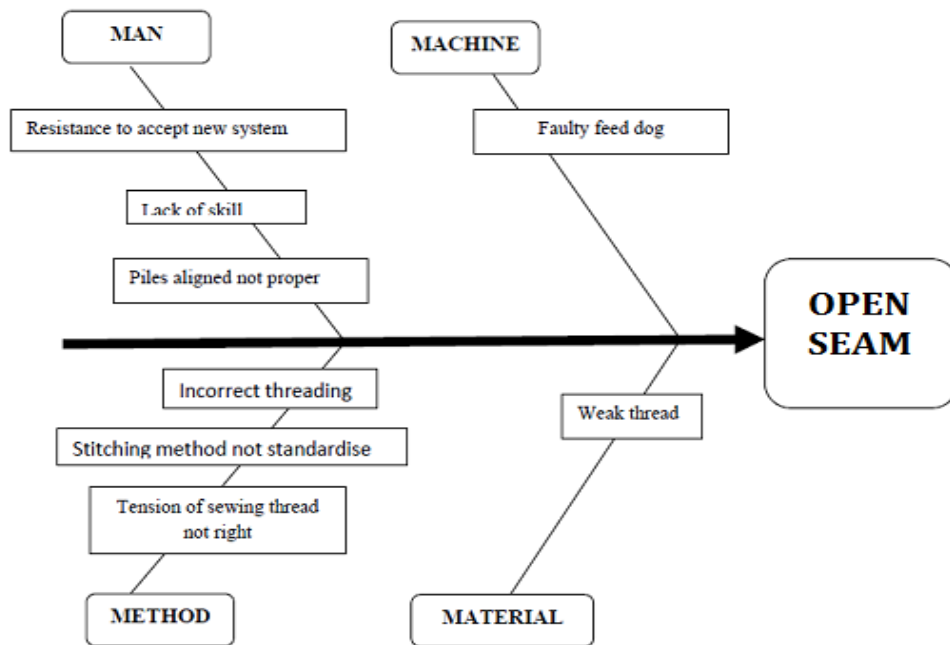


Fig 6. Cause-effect diagram for open seam.

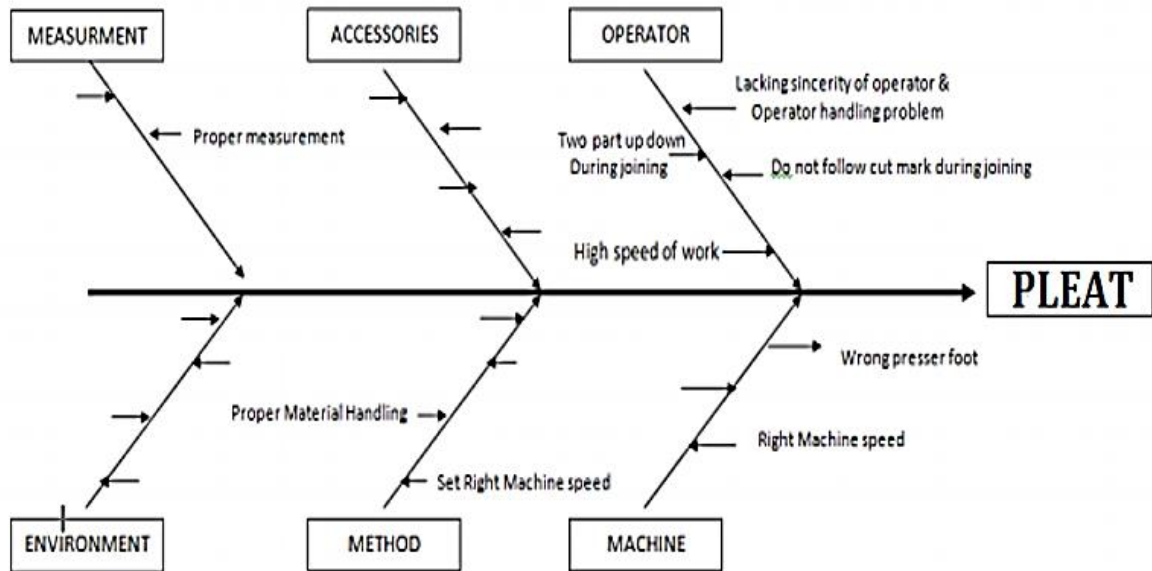


Fig 7. Cause-effect diagram for pleat.

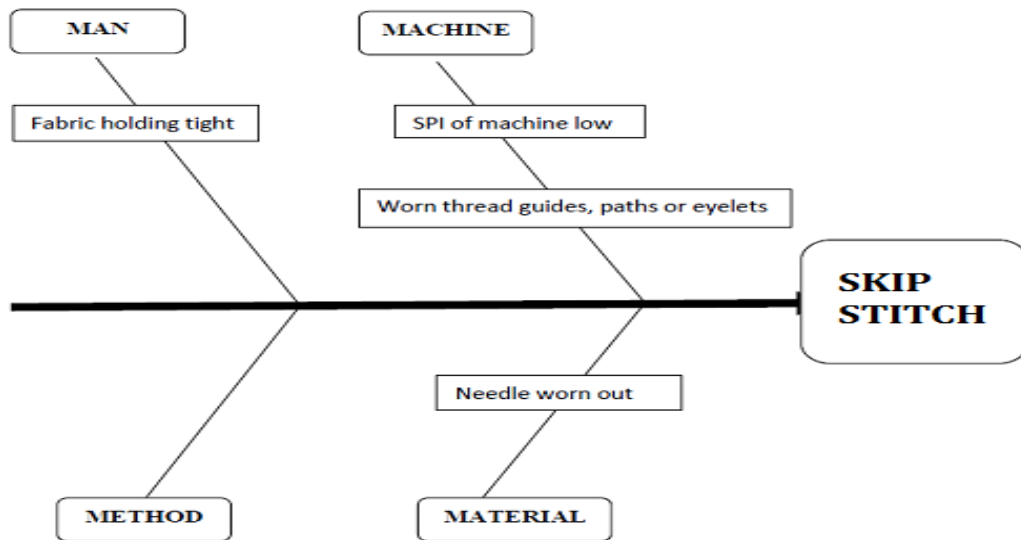


Fig 8. Cause-effect diagram for skip stitch.

4.1.2. Root Cause Identification

1. Broken Stitch

- a) Fabric holding too light.
- b) Incorrect needle eye position.
- c) Tension high.
- d) Needle plate presser foot rusty and have sharp edges.
- e) Faulty feed dog.
- f) Incorrect tension of sewing thread.
- g) Bobbins used are not proper.

h) Wrong needle-thread-fabric combination.

2. Label Missing

a) Labels put on wrong side.

b) Labels not attached.

3. Open Seam

a) Resistance to accept new system.

b) Lack of skill.

c) Piles aligned not proper.

d) Faulty feed log.

e) Incorrect threading.

f) Stitching method not standardize.

g) Tension of sewing thread not right.

h) Weak thread.

4. Pleat

a) Proper measurement.

b) Two part up down during joining.

c) High speed of work.

d) Lacking sincerity of operator & operator handling problem.

e) Do not follow cut mark during joining.

f) Proper material handling.

g) Set right machine speed.

h) Wrong presser foot.

5. Skip Stitch

a) Fabric holding tight.

b) SPI of machine low.

c) Worn thread guides, paths or eyelets.

d) Needle worn out.

4.3 Kaizen Implementation

Kaizen is a basic scientific analysis, in which we analyze the elements of a process or system to understand how it works. Lean production is founded on the idea of kaizen. The small, gradual, incremental changes applied over a long period that ass up to a major impact on business result. There are several targets of Kaizen, such as quality of products, quality of equipment, quality of process, quality of human and quality of system. Kaizen benefits a company by eliminating the hidden costs that resulted from the 8 types of waste. Kaizen improves the value added operations in the production process. A kaizen event allows major changes to be made in particular areas quickly and with minimum loss of production time. Kaizen event also provides the opportunity to work with your teammates to improve your working environment together. Kaizen also helps to eliminate wasted motions and delays in work. Kaizen implementation process and results are shown below to reduce the sewing defects.

I. Brainstorming

First step of kaizen implementation process is brainstorming about the problem to solve it. Here our purpose is to reduce the root cause of sewing and improving the productivity. We implemented kaizen method by respecting some initial factors, such as man, machine, material, method, environment, etc. This step totally planned how we can implement kaizen method to the system. In short, Brainstorming encourages making the overall continuous improvement plan.

II. Goal Set Up

Goal is already fixed. We are implementing Kaizen method to reduce the number of percentage of sewing defects from the production line to improve productivity. We already got the main root causes of sewing defects and trying to maximize it as much as possible.

III. Data Collection

Table 1 represents the defect data and Table 2 is showing the day by day observed output of the line. Noted that kaizen process starts from the 1 September 2017, and Total output per day per line = 1534 pcs, SMV = 3.46 min, Total manpower per line = 25 person, Total operating minute = 8 hours or 480 min. Also,

$$\text{Efficiency} = \frac{\text{Total output per day per line} * \text{SMV}}{\text{Total manpower per line} * \text{Total operating minute}} * 100 \quad (1)$$

By using Eq. (1), we got the efficiency before implementing Kaizen process is 44.24%.

Table 2. Day by day observed output of the line.

Day	1-Sep, 2017	2-Sep, 2017	3-Sep, 2017	4-Sep, 2017	5-Sep, 2017
Output	1534	1672	1770	1825	1900

IV. Plan

Here are the plan for the kaizen implementation.

- a) Appropriate stitching is needed.
- b) Achieving the zero defects benchmark.
- c) Strictly following the stitching guideline. To keep seam on line.
- d) The operator or worker should do it.
- e) Appropriate stitching should be done during the sewing.

V. DO

Kaizen process implementation according to:

- a) Worker's make setup, adjust and use the sewing machine appropriately.
- b) Assigning skilled operator or manpower to the production line.
- c) High quality sewing thread, best supported equipment, good needle should be used.
- d) Workers should hold the fabric properly during the seaming.
- e) Maintaining proper time for each operation.
- f) Awareness about the defects.
- g) Proper training.

VI. Check

- a) Start inspection of the process.
- b) Monitoring the planned implementation process.
- c) Measure the process if they are working or not.
- d) Periodically check if defects are reduced or not.

- e) If the defects are not occurring or reducing then continue the action of the process successfully.

VII. Action

If defects positions are still occurring or not reduced at a certain level, will come back to the plan stage, develop and add some more ideas for reducing or minimizing the defects and go through the cycle again. Take action that is help to gain the desired continuous improvement. If there is a defect problems, then start the plan to economical it.

VIII. Results

Finally, I am showing the results after implementing Kaizen. Total output per day per line = 1900 pcs, SMV = 3.46 min, Total manpower per line = 23 person, Total operating minute= 8 hours or 480 min. Now by using Eq. (1), we get efficiency 59.55%. Similarly, the calculated efficiency of each day of the week is given below in Table 3. Therefore, using kaizen defects rate are reducing and efficiency of the line is increasing.

5. Limitations and Recommendations

There are some shortcomings of this kaizen implementation process. Production lines are always busy. Therefore, it is always difficult to do time study to calculate SMV. In addition, Factory personnel are very busy in their assigned work. Sometimes, they cannot response quickly due to their busy working schedule. For the running production line, there is also risk to implement kaizen because of the fear of the production stoppage. After doing this study, i just realized that proper training and awareness among workers is the best possible solution to reduce the defect numbers. In case, factory owner can encourage workers by giving extra bonus, food, gratuity, leave, and polite behavior. For getting proper training to the worker, factory owner can take help from BKMEA.

6. Conclusions

The continuous improvement process started from a small area to improve the overall productivity, efficiency, and quality. Proper teamwork and collaboration with team members break through the benchmark in the factory shop floor. The results before implementing Kaizen implementation and after kaizen implementation is really fruitful. Here by implementing Kaizen process, factory increased efficiency of the production line from 45% to 60%. It is really economical to a factory. Sewing defects are minimized significantly. Also working environment of the factory is improved as well. For future purposes, a 15 day improvement plan will be introduced to get better results. Factory owner could be introduced motivating plans such as incentives, prizes to encourage the workers. In addition, they can arrange training program or can send operators to an institute to develop themselves as a skilled manpower. Appropriate training on sewing, machine maintenance, lean manufacturing, Kaizen and 5s training should be adopted. However, it is a matter of concern that most of the factories in Bangladesh are not adopting these techniques. Not even, they do not know how to implement Kaizen continuous improvement technique, 5s. Bangladesh garment industry have low cost labor, but they could not make the highest profit. Therefore, Bangladesh garment-manufacturing companies are badly needed these techniques.

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