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THE PRACTICE OF KAIZEN TOOL IN THE APPAREL INDUSTRY OF BANGLADESH FOR PROCESS IMPROVEMENT AND DEVELOPMENT OF ERGONOMICS STANDARD

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Abstract -*Currently the essence of long-term business strategy in Bangladesh, Readymade garments is the largest export industry. Bangladesh's export earnings are mostly determined by the export of readymade garments (RMG) to North American and European countries with 75% of total export earning coming from this sector. It is one of the reasons why reaching tactical and operational goals of the organization together with subjective treatment of employees, with their needs, aptitudes, ambitions and expectations taken into consideration, becomes the fundamental and crucial objective. Ours project represents results of empirical research representing relationships that occur between unremitting improvements of processes in garments industry compliant with Kaizen philosophy against the increase of ergonomic standards levels.*

Key Words: Apparel Industry, Ergonomics, Kaizen, Process Improvement.

1. INTRODUCTION

In 1950, when the government and administration of Japan had a feeling that there was a problem in their existing management system and a pending labour shortage, they offered the concept of kaizen. (15). Kaizen has contributed a significant part to the manufacturing success in Japan (16). Structured and focused improvement project using a team which is cross functional to progress a targeted work area in a quicker timeframe is known as kaizen study (17). Kaizen has played a vital role behind the success of the successful manufacturing in Japan (1, 2, and 3). Since then Kaizen has been used by various other western companies around the world to identify the continuation of enhancement. (18). A few studies can be found on the executions of Kaizen by western companies and Japanese implement of this process. (4, 5, 6, 7) The process of implication of Kaizen can be described shortly as following (8, 19, 20, 21, and 22):

1. Characterization of the area to be upgraded
2. Breakdown and assortment of crucial complications
3. Discovery the root of enhancement
4. Refining venture of application
5. Calculation, evaluation, assessment of outcomes
6. Regulation of structure.

Ergonomic Process: In general ergonomic process works in a cyclical problem deciphering method which includes five overlapping steps those are identification, analysis, solution development, execution, assessment. This problem solving method is similar to the other problem solving methods in different sectors like research (9, 10, 11) and in quality management (12, 13) etc. this problem solving method is referred as an ergonomic process when it is combined with ergonomic interruption (14).

2. METHODOLOGY AND OBEJECTIVES

2.1 Methodology

An Apparel Industry was visited and the whole process of that industry was inspected. We found out that it was very difficult to identify fabric fault in the initial stage which caused rejection of quality number of final products and so there was risk of delivering defective product to the customer. Beside that there was an issue in the Sewing line related to bottleneck. We tried to implement the kaizen tool for process Enhancement and simultaneously development of ergonomics Customary.

2.2 Objectives

•Implementation of cut panel inspection table in the cutting line
•Identify the Fabric fault by means of Kaizen tool to minimize that problem.

•Minimizing the bottleneck and also increasing the workers comfort by implementing ergonomic practice.

3. RESEARCH WORK

Fabric is the main raw material for apparel industry and it takes 60-70% of total garment manufacturing cost. To ensure the quality fabric, the authority took some protective action and developed fabric inspection department's strength with qualified personnel. In spite of all efforts the cut panel inspection process did not justify with 100 percent corrective inspection. There were still some defective fabrics went through further process. When the finished products were checked, some products were rejected due to fabric fault. Upgrading in cut panel review table was done to minimize the blunder in defect identification as much as possible.

3.1 Process before Improvement:

Some problems were identified in existing process. The problems are stated below:

•Low checking accuracy
•Human Error in defect identification
•Low lighting facility
•Movement of worker
•Indiscipline in work piece
•Time deletion
•Less work efficiency
•Stress and fatigue of worker

Figure 01: Checking Process before Improvement

3.2 Development Procedure:

3.2.1 Improvement in Table: A work part was placed on the cutting line table where the cut pieces were to be inspected. Its lower part was plain and upper part was about 150 inclined with respect to the table. The vertical portion which was attached at rear end of the work part was used for holding the defect board and instructions for the Checking Personnel. Two steel rods were attached with the vertical portion holding a light stand. The work part is 4 and ½ feet long and 2 and ½ feet wide. The work part is shown in figure 02.

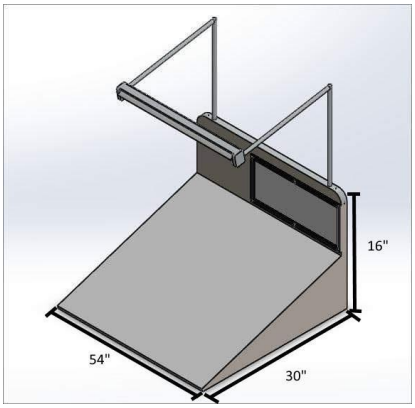

Figure 02: Work Part for Improvement in Table

3.2.2 Introduction of Defect Board: A defect board containing small pieces of fabrics with defects was placed in the vertical portion of the work part. The board was precisely useful for the checking personnel to identify the defects of the fabrics. The green color specifies the minor defects that can be accepted and the red color specifies the major defects to be rejected.

Figure 03: Defect Board Used In Cut Panel Inspection Table

3.2.3 Instruction for Checking Personnel: A paper was glued with the vertical portion of the work part in which proper instructions was written for the checking personnel.

3.2.4 Lighting Facility: A fluorescent tube light (40W-250V, 2800 lumen) was placed above the work part. The high lighting facility gave the worker more flexibility in identifying fabric defects.

3.2.5 Performance Report Board: A board was hanged above the table measuring the performance of the checking personnel. It also helped to identify the percentage of rejected fabrics. The number of cut pieces of fabrics checked

was put as input and number of fabric fault was also counted and put in the report.

Figure 04: Performance Report Board

3.3 Process after Improvement:

The whole improvement process took about 3 months including previous process analysis, problem identification, problem solving and documentation. A pilot run of the new process had been made for 2 months to check the efficiency of the new process.

Figure 05: Process after Improvement

3.4 Improvement Analysis:

The process had been observed for ten months for the improvement result. For the first four months the previous process was observed and in the next six months when the new process had been implemented, data of total rejection and fabric fault in final product had been taken. It has been observed that, in the beginning of the implementation the rejection of final product due to fabric fault has been increased though it was supposed to decrease. But after three months, the fabric fault has been decreased in about 50 percent than of the previous process, which has been a milestone for the industry. All the Tables and Figures are given below:

Month	Year	Total Production	Total Fabric Fault	% of Fabric Fault
October	2014	400386	517	0.13
November	2014	523644	723	0.14
December	2014	476763	558	0.12
January	2015	528210	580	0.11
February	2015	469758	744	0.16
March	2015	565707	1621	0.29
April	2015	478625	508	0.11
May	2015	465209	203	0.04
June	2015	475363	213	0.04
July	2015	491407	201	0.04

Table 01: Monthly Rejection Rate in Total Production Due to Fabric Fault

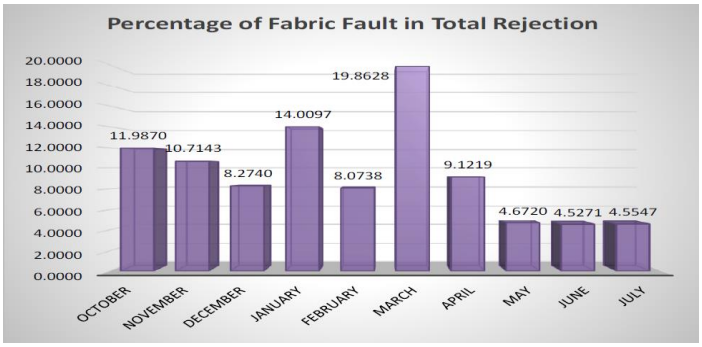

Figure 06: Percentage of Fabric Fault in Total Rejection of Final Product

Month	Year	Monthly Fabric Fault	Total rejection	% of Fabric Fault
October	2014	517	4313	11.98
November	2014	723	6748	10.71
December	2014	558	6744	8.27
January	2015	580	4140	14.00
February	2015	744	9215	8.07
March	2015	1621	8161	19.86
April	2015	508	5569	11.98
May	2015	203	4345	10.71
June	2015	213	4705	8.27
July	2015	201	4413	14.00

Table 02: Amount & Percentage of Fabric Fault in Total Rejection of Final Product

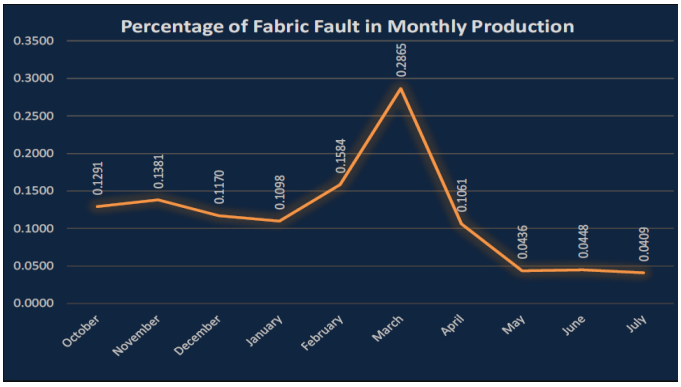

Figure 07: Percentage of Fabric Fault in Final Product

In the table 1 & 2 the process is shown for ten months started from October 2014 to July 2015 where from the month of October'14 to January'15 data from old process has been characterized and from February'15 to July'15 data from the process after development in the cut panel inspection table has been shown. In the first three months the improvement produced worse result than the previous process due to the checking personnel's failing to adopt with the new process. But after three months when the checking personnel adjusted with the new process the percentage of fabric fault in final product was below .5 percent and percentage of fabric fault in total rejection of final product was also below 5 percent.

4. IMPLEMENTATION OF HANGER BOX AND SHOULDER PAD GADGET IN THE SEWING LINE FOR MAINTAINING ERGONOMICS STANDARDS AND WORKERS COMFORT:

4.1 Hanger Box:

A garment hanger is a hanger that is used to hang garments. There are many varieties of garment hangers. For example, wood hangers, plastic hangers, wire hangers etc. For reducing movement of the worker, maintaining discipline in the workplace and most importantly for greater work efficiency the idea of hanger box is generated.

4.2 Process before Improvement:

In the old process workers were to take hangers from a basket, where these were kept in much inadvertent way. Many problems were faced during this process. These are:
•Hangers were not in arranged.
•Workers stress and fatigue were increased.
•Dilation of time.
•More space required.
•Decreased workers concentration.
•Decreased workers efficiency.
•Low capacity of hangers.
•Fewer users friendly.

Figure 08: Process before Improvement

4.3 Development procedure:

4.3.1 Design of Hanger box: Several sketches of the hanger box were made and among them the most appropriate one was selected. Virtual design is made using the solid work software.

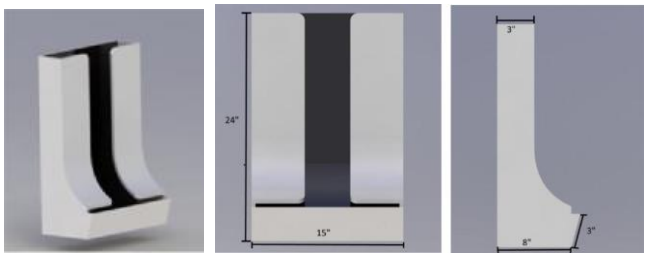

Figure 09: Front View, Right Side View & Isometric View of Hanger Box

4.3.2 Prototype Making: After completing the design successfully, a prototype of hanger box I was made.

Figure 10: Prototype of Hanger Box

4.3.3 Hanger Box: After constructing the prototype successfully, the hanger box was given to use.

Figure 11: Hanger Box

4.4 Process after Improvement:

The basket holding hangers which were in an unmanageable way was substituted by the hanger box. There is a hanger box holder for holding the box right now. Workers feel very comfortable in taking hangers and efficiency is highly increased in the new process

Figure12: Process after Improvement in Using of Hangers

4.5 Usage of Shoulder Pad Gadget:

Shoulder pad is a type of fabric-covered padding used in men's and women's clothing to give the wearer the illusion of having broader and less sloping shoulders. A shoulder pad gadget is equipment used for holding shoulder pads in a disciplinary and worker friendly way. Shoulder pads are made in shoulder pad making section according to the buyer order and Comes to sewing line when production starts.

4.6 Process before Improvement:

During the old process, shoulder pads were kept in a transparent bag beside the left foot of worker who joint the pads with processing garments like suits, jackets and overcoats etc. The problems with this process are stated below:

- Time dilation
- Indiscipline in work place
- Increased stress and fatigue of worker
- Difficulty in size selection of shoulder pads
- Error in size selection
- Low work efficiency
- Low production rate.
- More space required.

Figure 13: Shoulder Pad Holding Process before Improvement

4.7 Development Procedure:

4.7.1 Frame Making of A Shoulder Pad Gadget: A frame was made for holding shoulder Pads. The frame was made of steel having length of 27 inches, height of 40 inches and width of 12 inches. There were three segments of boxes in the frame where in each segment shoulder pads are kept according to their size (small, medium, large). The capacity is 420 pair of shoulder pads.

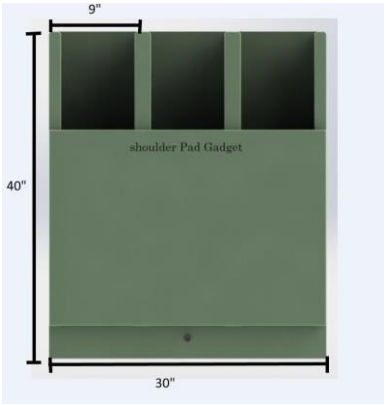

Figure 14: Frame of Shoulder Pad Gadget

4.7.2 Air Filled Cylinder: A cylinder filled with air was jointed with the frame through a pipe. The cylinder was 40 inches in height having a diameter of 10 inches. It had a piston in the top for controlling air pressure.

4.7.3 Mechanism of Shoulder Pad Gadget: At first shoulder pads are kept according to their size (small, medium, large) in the frame. Using the piston air was pushed on to the frame until when the weight of shoulder pads and air pressure are in equilibrium. When a worker takes pair of shoulder pad from the gadget the next pair is automatically pulled up due to air pressure.

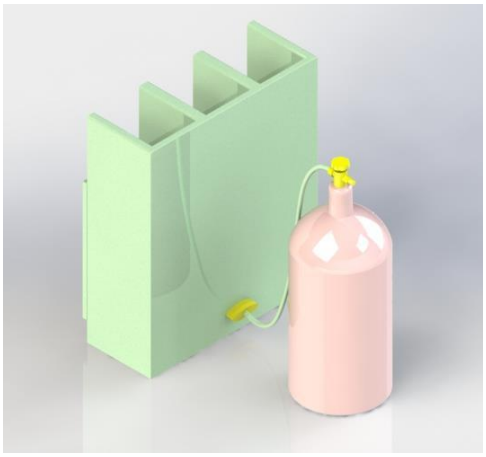

Figure 15: Air Filled Cylinder

4.8 Process after Improvement:

The whole improvement process took about 5 months including previous process analysis, problem identification, problem solving and documentation. A pilot run of the new process had been made for 1 month to check the efficiency of the new process. The workers now take one pair of shoulder pad for each operation instead of taking a handful pairs from the bag and putting them here and there beside the sewing machine

Figure16: Isometric View of Shoulder Pad Gadget & Keeping Shoulder Pads in the Gadget

5. IMPROVEMENT OF ERGONOMICS STANDARD:

5.1 Provided Instructions and Present Condition: To minimize fatigue and discomfort, the checking personnel was instructed to adopt as near to a neutral standing position, by standing with ears, shoulders, and hips in the same plane and the spine erected. Arms remained close to the body, with the elbows at the sides. When working in a standing position for extended periods, either one foot or the other was supported on a short foot stool. Besides that anti-fatigue mats have been employed.

The checking personnel right now feels comfortable and faces less fatigue and stress in movement.

5.2 Challenges: The main challenge was to adopt the checking personnel with this improvement. A worker who was working in a same way may refuse to adopt a new process even the process is more working friendly. This is a very common problem in the garments industries. Proper counseling and convincing are needed to motivate the worker. We have tried our level best to counsel these workers.

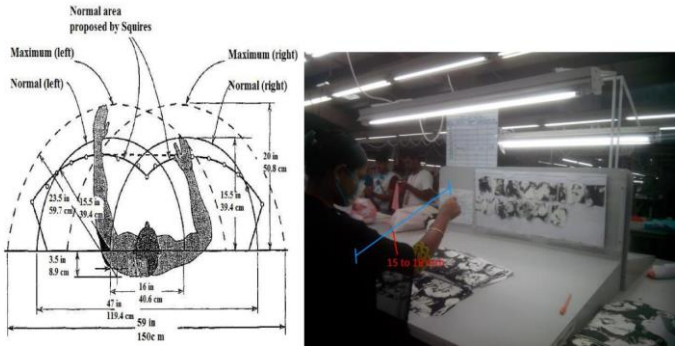

Figure 17: Normal & Maximum Working Areas (in inches and centimeters) Proposed by Barnes and Normal Work Area Proposed by Squires. (Sanders and McCormick 1993.)

6. FINAL RESULTS AND DISCUSSIONS:

6.1 Ergonomically Fit: Both hanger box and shoulder pad gadget are designed to minimize workers fatigue and stress. They are designed in such a way that they maintain the horizontal and vertical limit of ergonomic standards.

Figure 18: Comfortable Zone for Work Proposed by NIOSH in Respect to Hanger Box

6.2 Increase in Productivity:

After implementing shoulder pad gadget & hanger box the productivity has been simultaneously increased. It has been identified that production rate is increased about 60 pieces per day. Data have been taken for a week to observe the improvement (table 03)

Sewing Line	Production before improvement		Production after improvement		Efficiency Improvement
19	Daily production	Hourly production	Daily production	Hourly production	%
day 1	509	51	571	57	12.1807
day 2	517	52	565	57	9.2843
day 3	498	50	588	59	18.0723
day 4	507	51	567	57	11.8343
day 5	487	49	564	56	15.8111
day 6	511	51	578	58	13.1115
Total	3029		3433		13.3377

Table 03: Weekly Production Improvement of a Swing Line Due to Hanger Box & Shoulder Pad Gadget

6.3 Minimization of Bottleneck: By implementing these improvements, bottleneck in the sewing line has been vastly reduced. The capacity of the whole sewing line has been increased. It also reduces operator's idle time by increasing Operator utilization by getting extra pieces from the same resources in defined time.

7. CONCLUSIONS

Our research works certainly entitle that Kaizen method bring many benefits like increase in productivity, quality, promptness, dropping production cycle time, increasing safety, convenience and comfortable use, allow to keep health and well-being, help to fulfill the needs and expectations of employees. When implementing solutions, which result in improving economic results it is crucial to assure that the equipment and processes have ergonomic features as it is easier to deal with worker's resistance to change due to assuring working comfort.

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