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Kaizen in Improving the Productivity of Garment Sewing

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Abstract

One of the most crucial strategies for managing continuous improvement is kaizen. Because lowering cycle times and manufacturing costs is our goal. One of the first steps in that direction is the elimination of bottlenecks in the production line. In order to go toward our goal, a meeting was first scheduled with the production and IE teams to explore potential areas for improvement. Then, using a time study and a capacity graph, we determined the workable area. By videotaping the bottleneck process, analyzing the arrangement of the workstations, and managing the machines, we were able to assess the micro-movements. Then, in order to improve the procedure, we shared the motion economy and point kaizen concepts with the relevant department and scheduled a training session for the staff. We

implemented the improved method on the selected workstations. At last, the follow-up responsibility was handed over to the responsible authority.

Keywords: Kaizen, Improving Productivity, Critical success factors, motion economy principle, Time-study, Bottleneck

Introduction

Manufacturing industries are normally based on providing quality goods at cheaper cost. Reducing manufacturing costs is challenging nowadays as the competition is higher. (Jain A. K., 2013) In garment industries manufacturing costs can be reduced by reducing operation cycle time. In this study, we'll be focusing on reducing the sewing operation cycle time of a sewing line to get a clear concept about how much is it workable. Sewing line chief, supervisor, production manager are normally the responsible person for production of the floor or line & they are experiencing less production problem & ultimately the company is experiencing the excess cost of production. (Karkoszka, 2009)

Due to its reported benefits, kaizen philosophy was applied by a large number of entrepreneur managers; however despite its popularity, kaizen implementations

Due to its reported benefits ,kaizen philosophy was applied by a large number of entrepreneur managers; however, despite its popularity, kaizen implementations in companies had little Success. (García, 2014) The apparel industry is one of the pillar industries of Bangladesh. According to World Trade Reports (2008), Bangladesh is the 3rd largest apparel exporting country in The Readymade Garments (RMG) industry is the largest single economic sector in Bangladesh which contributes to 76% of national exports and the world. 90% of manufacturing goods exports. The garment industry is highly labor-intensive and employs approximately two million workers, out of which 90 percent are women (United Nations Industrial Development Organization, 2009). (Sua´rez- Barraza, 2010) As focused employees stitching up are operations they tend to get injured when there is a lapse in attention. Therefore, Bangladesh has around 70 million of available low-cost workers who could be easily trainable and engaged in the apparel sector. As the garments industries are labor intensive the best utilizing of labors of the industry will assure the highest profit of company. (Key Success Factors and Benefits of Kaizen Implementation, 2019) Lean production is founded on the idea of kaizen or continual improvement. Production involves, motivates and develop employee. (Rivera, 2013)

Lean assures the best utilization of labors. (Puvanasvaran, 2010) Also, in order to increase productivity, the organizations intentionally or unintentionally should use 5s system completely or at least a part of it which small Using lean, done improvement. (Jain S. K., 2014) In addition to this lean SI completely achieve ensure organizations performance of their system. (Md. Abdul Quddus, A Shop-floor Kaizen Breakthrough Approach to Improve Working Environment and Productivity of a Sewing Floor in RMG Industry, 2014) Kaizen is a Japanese word which means to take something in order to make it better. 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. Kaizen is an approach to creating continuous improvement based on the idea that small, ongoing positive changes can reap significant improvements. (Kapuria T. K., 2017) Typically, it is based on cooperation and commitment and stands in contrast to approaches that use radical or top-down changes to achieve transformation. (Omotayo, 2018) Kaizen is core to lean manufacturing and the Toyota Way. It was developed in the manufacturing sector to lower defects, eliminate waste, boost productivity, encourage worker purpose and accountability and promote innovation. (Jacobson, 2009) Kaizen is a compound of two Japanese words that together translate as "good change" or "improvement." However, Kaizen has come to mean "continuous improvement" through its association with lean methodology and principles. (Danieal, May 2021)

Kaizen can be implemented in a seven-step cycle to create an environment based on continuous improvement. This systematic method includes the following steps:

Get employees involved: Seek the involvement of employees, including soliciting their help in identifying issues and problems. Doing so creates buy-in for change. Often, this is organized as specific groups of individuals charged with gathering and relaying information from a wider group of employees. (Fasika Bete georgise, 2020)

Find problems: Using widespread feedback from all employees, gather a list of problems and potential opportunities. Create a list if there are many issues. (Gao Shang, 2013)

Create a solution: Encourage employees to offer creative solutions, with all manner of ideas encouraged. Pick a winning solution or solutions from the ideas presented. (Amit Kumar Arya, 2015)

Test the solution: Implement the winning solution chosen above, with everyone participating in the rollout. Create pilot programs or take other small steps to test out the solution. (Heru Darmawan, 2018)

Analyze the results: At various intervals, check progress, with specific plans for who will be the point of contact and how best to keep

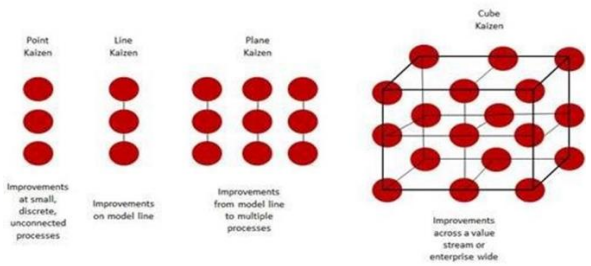
ground-level workers engaged. Determine how successful the change has been.

If results are positive, adopt the solution throughout the organization. These seven steps should be repeated on an ongoing basis, with new solutions tested where appropriate or new lists of problems tackled. Additional approaches to the Kaizen cycle exist, such as one that is condensed into four steps -- plan, do, check, act, or PDCA. It is also known as the Shewhart cycle or Deming cycle. (Danieal, May 2021)

Two functions related to the executable work are distinguished in Japan

Maintenance of the existing condition relying on the operations related to complying with current standard of technology and management; Improvement of the existing condition-kaizen, being the function playing the main role while the procedures and instructions are strictly implemented. (Saima Akter, May 2015)

Types of kaizen: Point kaizen; System kaizen; Line kaizen; Plane kaizen; Cube kaizen



(Hirano, April 27,2009)

Here, we have followed Point Kaizen. It is a quick improvement targeting a specific workstation which helps to get the low hanging fruit in very shorter time period. (Jorge Luis, 20 June 2016) As soon as an error is predicted or is detected in the work process, a solution is implemented. Measures for point kaizen are usually small and easy to implement. (Wittenberg, 1994) Also, they can be connected or not to the whole chain, and can have a huge impact. (Kumar S. , 2018) In manufacturing, Point Kaizen mostly follows the motion economy principles. Motion economy refers to the manner in which human energy is conserved while performing a task. The objective in all areas of the dental office, clinical, business or laboratory setting should be to minimize the number and magnitude of motions and conserve energy while working. The principles of motion economy form a set of rules and suggestions to improve the manual work in manufacturing and reduce fatigue and unnecessary movements by the worker, which can lead to the reduction in the work related trauma.

The principles of motion economy can be classified into four groups:

- Principles related to the use of human body,
- Principles related to the arrangement of the work place,
- Principles related to the design of tools and equipment.
- Principles related to time conservation. (Temitope Omotayo, 2020)

Principle 1 & 2 are used for this project which are use of Human Body:

- The two hands should begin motions at the same time.
- The two hands should not be idle at the same time except during rest periods.
- Motions of the arms should be made in opposite and symmetrical directions and should be made simultaneously (C. BUNGAU, 2014)

Hand motions should be confined to the lowest classification with which it is possible to perform the work satisfactorily:

- Finger motions
- Wrist motions
- Forearm motions
- Upper arm motions
- Shoulder motions

Momentum should be employed to assist the worker whenever possible, and it should be reduced to a minimum if it must be overcome by muscular effort. (Abera, 2015)

Smooth continuous motions of the hands are preferable to zigzag motions or straight-line motions involving sudden and sharp changes in direction.

Ballistic (i.e. free swinging) movements are faster, easier and more accurate than restricted or controlled movements.

Arrangement of the Work Place:

- There should be a definite and fixed place for all tools and materials.
- Tools, materials, and controls should be located close in and directly in front of the operator.
- Drop delivers should be used whenever possible.
- (Silvia Pellegrini, 2012)
- Materials and tools should be located to permit the best sequence of motions.
- Arrange the height of the workplace and chair for alternate sitting and standing, when possible.
- Provide a chair of the type and height to permit good posture.

A bottleneck is a point of congestion in a production system (such as an assembly line or a computer network) that occurs when workloads arrive too quickly for the production process to handle. The inefficiencies brought

about by the bottleneck often creates delays and higher production costs. The term "bottleneck" refers to the typical shape of a bottle and the fact that the bottle's neck is the narrowest point, which is the most likely place for congestion to occur, slowing down the flow of liquid from the bottle. (Barone, 2020)

There are so many reasons to arise a bottleneck in the production line and it is described below.

Pre-Production Stage:

- Sub Standard issue supply or supply in delay from store.
- Sub-standard cut panel supply from cutting
- Wrong pattern supplied from CAD, etc.

Production Stage:

- Worker selection wrong.
- Wrong works flow / sequence of works.
- Non-balance allocation of elements.
- Machine disturbances / out of order.
- Non-serial supplies forward from workers.
- Quality problem. (Jagdeep Singh, 2009)

Diagnostic character of bottleneck:

Direct Observing Method: - Those areas are bottleneck areas where pile of supply is observed. (Anass Cherrafi, 2019)

Hourly Production Report: Supervisors use to record hourly production report of each worker. The record shows the bottleneck point. (Pamela Mazzocato, 2016)

Time Study Method: - By performing cycle check we can realize bottleneck from different of time. We can realize bottleneck at a glance by making graph and it is a best and scientific way to find out the real bottleneck. (Prashar, 2014)

How to reduce bottleneck in apparel industry:

A bottleneck can be solved by increasing the process capacity or adjusting the production level in the sequence where the bottleneck is happening. (Kumar R. , 2019) Following 4 M methodology, this can be solved by:

Man:

- Selecting right person at right process
- Prior skill need assessment and train in advance
- Train worker based on Motion Economy
- Workers must be trained on self-inspection
- Workers must be trained in basic troubleshooting of machine machine

- Selecting proposer machine to perform the job
- Ensure disturbance free machine.
- Preventive maintenance to ensure availability
- Material
- Ensure standard input to the process from previous process
- Supply material is orientation as per process need
- No Sub-standard material should be allowed in process method
- Introduced zig-pattern-fixture to reduce defect generation
- Improve work station layout to reduce micro-motion
- Continuous improvement of work method to reduce non-value added work.
- Balance the work as per worker's capacity
- No backward flow should be allowed in line. (Nguyen, 2019)

Methodology of the Study:

In conducting a study, appropriate instruments of data collection tools should be employed, decided and explained briefly together with the reasons why they are selected. (Daniel Carnerud, 2018) There are different data gathering tools and or techniques used in conducting a study. In this study, direct observation and time study is used. Kaizen is a concept referring to business activities that continuously improve all functions and involve all employees from the CEO to the assembly line workers. (Saima Akter, May 2015)

Direct observation and Time-study:

Observation is the process of recognizing and recording the behavior of people, objects and events. Time study is a structured process of directly observing measuring (using a stop-watch device) human work in order to establish the time required for completion of the work by a qualified worker when working at a defined level of performance. Also, direct observation of the existing manufacturing process can serve as an instrument for collecting data related to the study problem. Within the garment industry time variation is a must since the garments are made by different machine operators. For this reason, emphasizes the need to set a standard target for different products, thereby making time and motion studies mandatory. (Muhammad Saleem, 2012)

As our goal is to solve bottleneck in production & improve productivity, so the first task is to find out the bottleneck points. (Jennifer A. Farris, 2015) To identify bottleneck points of the sewing line a capacity graph of the workers was prepared. From the capacity graph the bottleneck points of the line were identified. (Brian Vo, 2019)

In order to improve the productivity we need to find the strains which can be defined as bottlenecks in the sewing line, at first a detailed work and time study was carried out to prepare a capacity graph. (Cheryl Tanner, 2006) By which we can easily indentify the strains. Then following basic steps were followed to prepare a capacity graph- (Aoki, 2008)

Step 1: Define objective of the study.

Step 2: Observe the cycle time of every operation of both operator and helper by a stopwatch. In this case there were 48 operators and 4 helpers in that line.

Step 3: Calculate the capacity of every workstation from the observed cycle time.

Step 4: Prepare a graph with those data. In this case the capacity graph was prepared with the help of Microsoft excel.

Step 5: Identify the bottlenecks from the capacity graph.

After completing the time study we prepared a capacity graph with the obtained data by using Microsoft excel.

From the graph we can see there are 14 bottlenecks in the line. Now our task is to visit those bottleneck points in the line & observe the workstation in terms of man, machine, material, method & find out what's causing the bottleneck.

Method Improvement:

Method improvement involves the practice of identifying, analyzing and improving existing methods to optimize performance, meet best practice standards or simply improve quality and the user experience for customers and end-users. (MD. Abdul Quddus, 2014)

Observations from the workstations & what we have done to overcome the problems:

Workstation-1: Front & back yoke join

Figure 1. Front & back yoke join

What did we do: Trained the operator to sew steady from needle point to ending point grabbed by the hand to reduce bursts.

(Before)There were a total 14 sewing bursts at the process for which the cycle time of the process was 170.

(After) Sewing bursts were reduced to 8 from 14 as a result the cycle time was reduced to 98.

Workstation-7: Quilting at Front part

Figure 2. Quilting at Front part

What did we do: We increased the machine speed from 1900 to 2600
(Before) Process cycle time was 112
(After) Process cycle time was 82

Workstation-9: Quilting at sleeve

Figure 3. Quilting at sleeve

What did we do: We increased the machine speed from 1900 to 2600
(Before) Process cycle time was 172
(After) Process cycle time was 145

Workstation-5: Basting at Front & Back side panel

Figure 4. Basting at Front & Back side panel

What did we do: Trained the operator to sew steady from needle point to ending point grabbed by the hand to reduce bursts.

(Before) Sewing bursts were 32 times and process cycle time was 132

(After) Sewing bursts were reduced 24 times and process cycle time was 110

Workstation-26: Front side panel & pocket bag join (1*2)

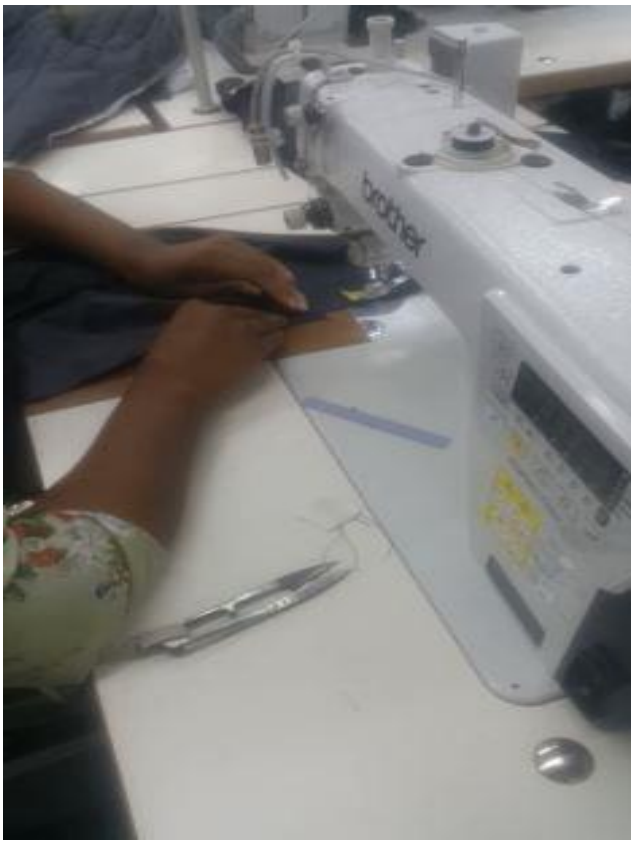


Figure 5. Front side panel & pocket bag join (1*2)

What did we do: Instructed her to mark the pocket bag joining point at the front side panel before sewing it.

(Before) Pocket bag joining seam alteration & process cycle time was 317

(After) No alteration & process cycle time was 239

Workstation- 25: Lining front part & yoke join

Figure 6. Lining front part & yoke join

What did we do: Trained her to match both fabric part with their cut mark position and then sew accordingly.

(Before) Process cycle time was 93

(After) Process cycle time was 59

Workstation-10: Quilting at hood

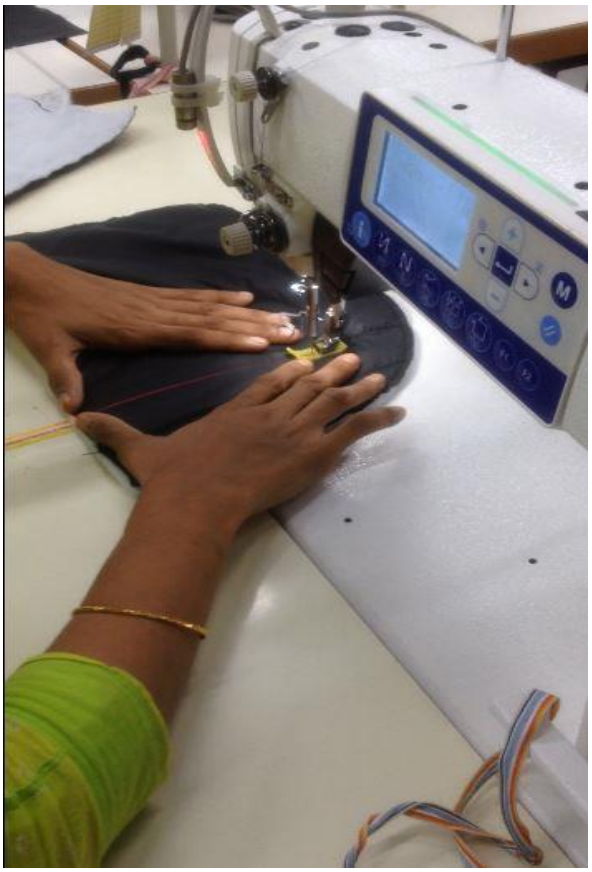


Figure 7. Quilting at hood

What did we do: Trained the operator to sew steady from needle point to ending point grabbed by the hand to reduce bursts.

(Before) Sewing burst was 20 times and process cycle time was 108

(After) Sewing burst was reduced to 15 times and cycle time was 97

Workstation-36: Shell lining join at center front

Figure 8. Shell lining join at center front

What did we do: Trained the operator to sew steady from needle point to ending point grabbed by the hand to reduce sewing bursts as much as possible.

(Before) Sewing bursts were 18 times and process cycle time was 266 (Cardoso, July - September, 2018)

Productivity Calculation:

Here,

Total cycle time: Total cycle time can be defined as the sum of all the individual process cycle time.

Basic pitch time = Total cycle time ÷ Total manpower

Worker potential = 3600sec ÷ Basic pitch time

$$Production\ per\ hour = \frac{\text{Produced garment in a shift(8 Hrs)}}{\text{8 Hours}}$$

$$Productivity\ gap = \frac{(\text{Production per hour} - \text{Worker Potential})}{\text{Worker potential}}$$

$$Worker\ potential = \frac{3600}{\text{Basic pitch time}}$$

$$Basic\ pitch\ time = \frac{\text{Total cycle time}}{\text{Total manpower}}$$

(Mohd Norhasni Mohd Asaad, 2015)

Cost Saving Calculation:

Here,

Worker salary per month = 9500TK

Working day in a month = 26 day

Working time in a day = 8 hours

So, worker payment per second (W.P.P.S) = 9500÷26÷8÷60÷60 =0.013tk per sec

Order quantity (O.Q) = 2200pcs

(Jesus Mendez, 2018)

Table 9. Savings calculations

Process	Cycle time		Cycle time saved	Implemented stations (I.S)	Cost saved per sec {(Saved C.T×W.P.P.S) × I.S ×O.Q }
	Before	After			
FRONT & BACK PANEL BASTING (1*4)	132	110	22	1	629.2
QUILTING AT SLEEVE	172	145	27	2	1544.4
SHELL LINING JOIN AT CENTER FRONT	266	192	74	2	4233
QUILTING AT HOOD (1*2)	108	97	11	1	315
LINING FRONT PART & YOKE JOIN	93	59	34	1	972.4
FRONT SIDE PANEL & POCKET BAG JOIN (1*2)	317	239	78	1	2230.8
QUILTING AT FRT	112	82	30	2	1716

So, Total cost saved= BDT11640

Result & Discussion:

Input Output Analysis:

Table 10. Input & Output analysis

Input	Throughput	Output
48 operator + 4 helper+ 1 line chief + 1 input supervisor + 1 output supervisor	46 processes for both operator & helper	Padded jacket
Padded fibre + fabric	Sewing of the garment	
51 different types of sewing machines		

(Bashar, August 1,2018)

Final Results:

The order we've worked on for this project is from the brand CRAGOPPHERS. The quantity for this order was 2200pcs. We were able to reduce 430sec of cycle time from the sewing line which results in saving a total BDT 11,640/- in that particular line. The factory consists of 42 sewing line. The improved method is applicable in any sewing method. If they roll out within 42 sewing lines then the expected cost savings would be BDT 4,88,880/-. (Basu, April, 2012)

Findings:

We implemented motion economy principle 1 & 2 for this study. If we can implement principle 3&4 also, better result can be achieved.

Conclusion

We implemented motion economy principles 1&2 to solve bottleneck which does not requires any extra cost and time. (Mehdi Shojaei, 2019) It only requires engagement of associated persons, some training and follow up the improvements to achieve the desired output. (C.P. Carvalho, 7.10.2017) As this method does not requires any extra cost, further study can be carried out to find the impact of other two principles. Our expectation from this project was to reduce manufacturing cost & increase productivity which is fulfilled. (Jose Arturo Garza-Reyes, 2020) So, we can say that if we follow these steps to all the sewing line of the factory, the result will be remarkable. (Hagos)

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