Advantages of lean techniques application in apparel industry: case study on knit jacket

Abstract

It is proven that by the application of Lean techniques in manufacturing, business can be profited by improvement in the level of productivity and cutting down the processes that is responsible for wastages. In Bangladesh, Apparel industries face a lot of challenges and the most difficult of them is to meet the shipment date. To ensure the products have been manufactured and assembled in due time, manufacturers emphasize on choosing the best method of production process. With the help of Kaizen and 5’s, it is possible to identify non value added processes and eliminate them from the production process. In this paper, we have taken the production data of a knitted jacket and considered the SMV data in two phases, one with the traditional line and the other one is with the implementation of Lean technique to see the differences of SMV data in different stages of production.

Keywords: SMV, lean, kaizen, 5’S, line target, line efficiency

Introduction

Apparel industries from all over the world faced a great deal of negative impact due to the economic recession back in 2008. And because of this the low cost garments had been urged by most consumer bases from all over the world. Then renowned apparel brands have been forced to cut down the prices to keep their products in the market. They have been shifted their vendors to low cost worker countries like Bangladesh to keep the competition worldwide. To meet the global challenge, it is really vital to keep the production process in such a way that will not incorporate any types of waste and non-value added process when apparel production process is carried out with lean approach. The terminology is not that much unfamiliar to the manufacturers but they lack in consciousness about the strategic advantages that can be found while lean technique is used in apparel production which is the purpose of our study as well.1

Objectives of the Study

a. To find out the strategic advantages of lean technique in apparel industry.

b. To compare production data in terms of SMV target fulfilment, line efficiency, bottlenecks, capacity utilization in both cases-traditional production line and lean production line.

c. To compare the productivity factors like transportation, inventory analysis, space utilization, defects analysis in both traditional line and lean line.

Methodology

For comparing productivity, we collected data from sewing floor of Adury Apparels Ltd, a sister concern of Thermax Group. We considered two lines (traditional & lean line) & differentiate between them. To calculate standard time for each operation, time study is conducted in the shop floor. To do this, a knit jacket is selected as a base line because operations differ from style to style and it is difficult to correlate all these operations of individual styles. After that, at least two operators were selected for each operation so that the difference in timing can be cross checked from the observed data of these two operators. To get better results, each operation time is taken for at least 5 cycles. Once time study is made by collecting raw data the performance rating is given to each operator and actual time taken for at least 5 cycles. The difficulty of this the low cost garments had been urged by most consumer bases from all over the world. Then renowned apparel brands have been forced to cut down the prices to keep their products in the market. They have been shifted their vendors to low cost worker countries like Bangladesh to keep the competition worldwide. To meet the global challenge, it is really vital to keep the production process in such a way that will not incorporate any types of waste and non-value added process when apparel production process is carried out with lean approach. The terminology is not that much unfamiliar to the manufacturers but they lack in consciousness about the strategic advantages that can be found while lean technique is used in apparel production which is the purpose of our study as well.1

Objectives of the Study

a. To find out the strategic advantages of lean technique in apparel industry.

b. To compare production data in terms of SMV target fulfilment, line efficiency, bottlenecks, capacity utilization in both cases-traditional production line and lean production line.

c. To compare the productivity factors like transportation, inventory analysis, space utilization, defects analysis in both traditional line and lean line.

Methodology

For comparing productivity, we collected data from sewing floor of Adury Apparels Ltd, a sister concern of Thermax Group. We considered two lines (traditional & lean line) & differentiate between them. To calculate standard time for each operation, time study is conducted in the shop floor. To do this, a knit jacket is selected as a base line because operations differ from style to style and it is difficult to correlate all these operations of individual styles. After that, at least two operators were selected for each operation so that the difference in timing can be cross checked from the observed data of these two operators. To get better results, each operation time is taken for at least 5 cycles. Once time study is made by collecting raw data the performance rating is given to each operator and actual time taken for at least 5 cycles. The difficulty of
Advantages of lean techniques application in apparel industry: case study on knit jacket

e) Select a particular style to develop case study
f) Analysis Lean and Traditional line
g) Collect the necessary data (Figure 1) (Figure 2).

Figure 1 Lean line at adury apparel.

Figure 2 Knit jacket.

Results and discussions

We use time study to balance these sewing lines which is a part of work study. It implements the use of SMV calculation to identify the points where production has gone below the standard level and the places where the production is above the standard. Then it is balanced to remove bottle neck in order to increase productivity. This system was effective and helpful. Considerable improvement observed by using time study as a line balancing technique changing form traditional layout to balanced layout model. The exchanges of work between the operator & helper caused a significant change in line results of reducing wastage of time, minimum no. of worker and which caused high productivity in the manufacturing process. This balancing process also leads to increased output per day, labor productivity, machine productivity and overall line efficiency.

Lean line operation breakdown (Table 1)

| SL no. | Operation                          | No. of workers | Machine | Standard SMV Manual | SMV M/c | Allowance (12%) | Standard Time (Sec) | Capacity/hr |
|--------|-----------------------------------|----------------|---------|---------------------|---------|-----------------|--------------------|-------------|
| 1      | Pocket Bone Mark & corner cut     | 1              | MNL     | 0.25                | 17      | 1.44            | 18.44              | 195         |
| 2      | Bone Attach for Pocket            | 1              | SNLS    | 0.5                 | 32      | 3.04            | 35.84              | 100         |
| 3      | Body Mark for Pocket & attach pocket | 1            | SNLS    | 0.33                | 18      | 2.16            | 20.16              | 178         |
| 4      | Pocket Cut                        | 1              | MNL     | 0.58                | 35      | 4.2             | 39.2               | 91          |
| 5      | Pocket Top Stitch                 | 1              | SNLS    | 0.4                 | 27      | 3.24            | 30.24              | 119         |
| 6      | Bone Inside Tack & Pocket Top Stitch Lower | 1 | SNLS | 0.8 | 51 | 6.12 | 57.12 | 63 |
| 7      | Pocket Bag Close Both Side(2)     | 1              | OL      | 0.4                 | 27      | 3.24            | 30.24              | 119         |

SMV target fulfillment:

- Lean line: (100-78)/100x100% = 22%
- Traditional line: (100-64)/100x100% = 36%

Basic pace time (B.P.T) = Total time/Total man power = 896.44/35 =25.61sec
Capacity/hr = 3600/B.P.T = 3600pcs /25.61 =140

Traditional operation breakdown of knitted jacket (Table 2)

| SL no. | Operation                          | No. of workers | Machine | Standard SMV Manual | SMV M/c | Allowance (12%) | Standard Time (Sec) | Capacity/hr |
|--------|-----------------------------------|----------------|---------|---------------------|---------|-----------------|--------------------|-------------|
| 1      | Pocket Bone Mark & corner cut     | 1              | MNL     | 0.25                | 17      | 1.44            | 18.44              | 195         |
| 2      | Bone Attach for Pocket            | 1              | SNLS    | 0.5                 | 32      | 3.04            | 35.84              | 100         |
| 3      | Body Mark for Pocket & attach pocket | 1            | SNLS    | 0.33                | 18      | 2.16            | 20.16              | 178         |
| 4      | Pocket Cut                        | 1              | MNL     | 0.58                | 35      | 4.2             | 39.2               | 91          |
| 5      | Pocket Top Stitch                 | 1              | SNLS    | 0.4                 | 27      | 3.24            | 30.24              | 119         |
| 6      | Bone Inside Tack & Pocket Top Stitch Lower | 1 | SNLS | 0.8 | 51 | 6.12 | 57.12 | 63 |
| 7      | Pocket Bag Close Both Side(2)     | 1              | OL      | 0.4                 | 27      | 3.24            | 30.24              | 119         |

SMV target fulfillment:

- Lean line: (100-78)/100x100% = 22%
- Traditional line: (100-64)/100x100% = 36%

Basic pace time (B.P.T) = Total time/Total man power = 1013.88/42 = 24.14sec.
Capacity/hr = 3600/B.P.T = 3600pcs /24.14 =149pcs.

Table 1 Lean line operation breakdown

Table 2 Traditional operation breakdown of knitted jacket

Citation: Hasan SMM, Shanta MDMR, Shams AA, et al. Advantages of lean techniques application in apparel industry: case study on knit jacket. J Textile Eng Fashion Technol. 2019;5(5):252-258. DOI: 10.15406/jteft.2019.05.00210
Table 2 Traditional operation breakdown of knit jacket

| SL No. | Operation                          | No. of workers | Machine  | Standard SMV Manual | Actual Time Sec(Avg.) | Allowance 12% | Standard Time Sec | Capacity |
|--------|------------------------------------|----------------|----------|---------------------|------------------------|--------------|------------------|----------|
| 1      | Pocket bone mark                   | 1              | MNL      | 0.25                | 17                     | 1.44          | 18.44            | 195      |
| 2      | Bone corner                        | 1              | MNL      | 0.42                | 27                     | 3.24          | 30.24            | 119      |
| 3      | Bone attach for pocket             | 1              | SNLS     | 0.5                 | 32                     | 3.84          | 35.84            | 100      |
| 4      | Body mark for pocket               | 1              | MNL      | 0.3                 | 21                     | 2.52          | 23.52            | 153      |
| 5      | Pocket attach                      | 1              | SNLS     | 0.58                | 36                     | 4.32          | 40.32            | 89       |
|        | **Total**                          | **35**         |          | **12.77**           | **896.44**             |              |                  |          |
Advantages of lean techniques application in apparel industry: case study on knit jacket

| SL No. | Operation                                           | No. of worker | M/C   | STD. SMV  | Actual Time Sec (AVG.) | Allowance 12% | STD. Time Sec | Capacity |
|--------|-----------------------------------------------------|---------------|-------|-----------|-------------------------|---------------|---------------|----------|
|        |                                                     |               |       | Manual    | Manual                  |               |               |          |
| 6      | Pocket cut                                          | 1             | MNL   | 0.67      | 44                      | 5.28          | 49.28         | 73       |
| 7      | Pocket top stitch                                   | 1             | SNL   | 0.4       | 27                      | 3.24          | 30.24         | 119      |
| 8      | Bone inside tack & pocket top stitch lower          | 1             | SNLS  | 0.8       | 51                      | 6.12          | 57.12         | 63       |
| 9      | Pocket bag close both                               | 1             | OL    | 0.4       | 27                      | 3.24          | 30.24         | 119      |
| 10     | Pocket bag mouth                                    | 1             | SNLS  | 0.8       | 49                      | 5.88          | 54.88         | 65       |
| 11     | Pocket tack                                         | 1             | SNLS  | 0.35      | 21                      | 2.52          | 23.52         | 153      |
| 12     | Care label join                                     | 1             | SNLS  | 0.15      | 6                       | 0.72          | 6.72          | 535      |
| 13     | Shoulder join (2)                                   | 1             | OL    | 0.3       | 18                      | 2.16          | 20.16         | 178      |
| 14     | Sleeve cuff servicing                               | 1             | OL    | 0.33      | 21                      | 2.52          | 23.52         | 153      |
| 15     | Sleeve cuff join (2)                                | 1             | OL    | 0.33      | 20                      | 2.4           | 22.4          | 160      |
| 16     | Sleeve cuff top stitch                              | 1             | FL    | 0.3       | 18                      | 2.16          | 20.16         | 178      |
| 17     | Arm hole TS (2)                                     | 1             | FL    | 0.3       | 18                      | 2.16          | 20.16         | 178      |
| 18     | Side seam join (2)                                  | 1             | OL    | 0.55      | 35                      | 4.2           | 39.2          | 91       |
| 19     | Pannel join at bottom RIB (2)                       | 1             | OL    | 0.3       | 18                      | 2.16          | 20.16         | 178      |
| 20     | Pannel mouth TK (2)                                 | 1             | SNLS  | 0.22      | 11                      | 1.32          | 12.32         | 292      |
| 21     | Pannel TS (2)                                       | 1             | SNLS  | 0.3       | 18                      | 2.16          | 20.16         | 178      |
| 22     | Bottom RIB join position                            | 1             | MNL   | 0.3       | 18                      | 2.16          | 20.16         | 178      |
| 23     | Bottom RIB join                                     | 1             | OL    | 0.75      | 45                      | 5.4           | 50.4          | 71       |
| 24     | Bottom RIB TS                                       | 1             | FL    | 0.6       | 35                      | 4.2           | 39.2          | 73       |
| 25     | Zipper cover mark                                   | 1             | MNL   | 0.12      | 6                       | 0.72          | 6.72          | 535      |
| 26     | Zipper cover make                                   | 1             | SNLS  | 0.25      | 17                      | 2.04          | 19.04         | 189      |
| 27     | Zipper cover turn & ATT                             | 1             | SNLS  | 0.3       | 18                      | 2.16          | 20.16         | 178      |
| 28     | Zipper cover ATT                                    | 1             | SNLS  | 0.22      | 12                      | 1.44          | 13.44         | 267      |
| 29     | Zipper piping (2) operation                         | 1             | FL    | 0.3       | 20                      | 2.4           | 22.4          | 160      |
| 30     | Zipper edge fold & TK (2)                           | 1             | FL    | 0.2       | 11                      | 1.32          | 12.32         | 292      |
| 31     | Zipper ATT- left                                    | 1             | SNLS  | 0.4       | 24                      | 2.88          | 26.88         | 133      |
| 32     | Zipper ATT- right                                   | 1             | SNLS  | 0.4       | 24                      | 2.88          | 26.88         | 133      |
| 33     | Collar inner part                                  | 1             | SNLS  | 0.25      | 13                      | 1.56          | 14.56         | 247      |
| 34     | Collar inner part mark                             | 1             | MNL   | 0.25      | 13                      | 1.56          | 14.56         | 247      |
| 35     | Collar 2 part join                                 | 1             | OL    | 0.22      | 14                      | 1.68          | 15.68         | 229      |
| 36     | Collar mark for join                               | 1             | MNL   | 0.22      | 14                      | 1.68          | 15.68         | 229      |
| 37     | Collar join                                        | 1             | SNLS  | 0.5       | 30                      | 3.6           | 33.6          | 107      |
| 38     | BK tape Piping                                     | 1             | FL    | 0.4       | 20                      | 2.4           | 22.4          | 160      |
| 39     | BK tape TS W/corner fold                           | 1             | SNLS  | 0.5       | 30                      | 3.6           | 33.6          | 107      |
| 40     | Final thread trimming                              | 3             | MNL   | 0.5       | 30                      | 3.6           | 33.6          | 107      |

| Total  | 42 | 15.43 | 1013.88 |

Table Continues...

Citation: Hasan SMM, Shanta MDMR, Shams AA, et al. Advantages of lean techniques application in apparel industry: case study on knit jacket. J Textile Eng Fashion Technol. 2019;5(5):252-258. DOI: 10.15406/jteft.2019.05.00210
Transportation Analysis (Table 3) (Figure 3)

Table 3 Transportation analysis

| KPI         | Unit of measure | Traditional line | Avg. | Lean line | Avg. | Improvement |
|-------------|-----------------|------------------|------|-----------|------|-------------|
| Transportation | Feet            | 351              | 145  | 350       | 143  |             |
|             |                 | 348              | 144  | 350       | 143  |             |
|             |                 | 349              | 144  | 349       | 142  |             |

Figure 3: Transport analysis traditional vs lean line.

WIP Analysis (Table 4) (Figure 4)

Table 4 WIP analysis

| KPI            | Unit of measure | Traditional Line  | Avg. | Lean Line | Avg. | Improvement |
|----------------|-----------------|-------------------|------|-----------|------|-------------|
| Inventory/WIP | Quantity        | 815               | 400  | 810       | 398  |             |
|                |                 | 812               | 402  | 816       | 396  |             |
|                |                 | 810               | 402  |           |      |             |

Figure 4: WIP analysis traditional vs lean line.

Space utilization analysis (Table 5) (Figure 5)

Table 5 Space utilization analysis

| KPI     | Unit of measure | Traditional line | Avg. | Lean line | Avg. | Improvement |
|---------|-----------------|------------------|------|-----------|------|-------------|
| Utilization | Minute            | 5.77             | 4.62 |           |      |             |
|          |                  | 5.6              | 4.5  |           |      |             |
|          |                  | 4.96             | 5.55 | 4.45      | 4.52 | 18.55%      |
|          |                  | 5.1              | 4.62 |           |      |             |
|          |                  | 5.55             | 4.6  |           |      |             |

Citation: Hasan SMM, Shanta MDMR, Shams AA, et al. Advantages of lean techniques application in apparel industry: case study on knit jacket. J Textile Eng Fashion Technol. 2019;5(5):252–258. DOI: 10.15406/jteft.2019.05.00210
Figure 5 Space utilization traditional vs lean line.

Workstation analysis (Table 6) (Figure 6)

| KPI           | Unit of measure | Traditional line | Avg. | Lean line | Avg. | Improvement |
|---------------|-----------------|------------------|------|-----------|------|-------------|
| Work station  | Quantity        | 25               | 11   | 12        |      |             |
|               |                 | 23               | 12   | 12        |      |             |
|               |                 | 24               | 9    | 11        | 54.16% |             |
|               |                 | 22               | 10   |           |      |             |
|               |                 | 26               | 12   |           |      |             |

Defects Analysis (Table 7) (Figure 7)

| Defects               | Traditional line | Lean line |
|-----------------------|-------------------|-----------|
| Seam Puckering        | 30                | 18        |
| Slipped stitch        | 27                | 9         |
| Staggered stitch      | 18                | 5         |
| Thread Breakage       | 16                | 8         |
| Variable Stitch density | 27               | 11        |

Comparing key productivity metrics

We have used time study to balance these sewing lines which is a part of work study. It implements the use of SMV calculation to identify the points where production has gone below the standard level and the places where the production is above the standard. Then it is balanced to remove bottle necks in order to increase productivity. Considerable improvement observed by using time study as a line balancing technique changing from traditional layout to balance layout model (Table 8) (Table 9).

| Topics       | Unit of measure | Traditional line | Lean line | Improvement |
|--------------|-----------------|------------------|-----------|-------------|
| Inventory    | Quantity        | 813              | 400       | 50.79%      |
| Transport Analysis | Feet   | 345              | 143       | 58.55%      |
| Space utilization | Min    | 5.55             | 4.52      | 18.55%      |
| Work station  | Quantity        | 24               | 11        | 54.16%      |

Citation: Hasan SMM, Shanta MDMR, Shams AA, et al. Advantages of lean techniques application in apparel industry: case study on knit jacket. J Textile Eng Fashion Technol. 2019;5(5):252-258. DOI: 10.15406/jteft.2019.05.00210
Table 9 Productivity analysis

| Topic                        | Traditional line | Lean line |
|------------------------------|------------------|-----------|
| Productivity                 | 64%              | 78%       |
| Line efficiency              | 42.89%           | 55.49%    |
| SMV increased                | 9.46%            | 16.99%    |
| SMV target Fulfillment       | 64%              | 78%       |
| No of worker                 | 42               | 35        |
| Bottlenecks                  | 2                | Nil       |
| Capacity/hr utilization      | 149pcs           | 140pcs    |

Conclusion

For a jacket, using traditional system our input was 100pcs/hr and output was 64pcs/hr with a productivity of 64%. But when we applied lean system then our input was same but the system was so efficient that we got an increase output of 78pcs/hr. This is a clear indication for increasing productivity. Lack of knowledge, specifically in production systems and resources management of the operations manager of Garments, resulted to the low productivity and efficiency of manpower. The lean manufacturing system is a continuous improvement method; thereby, its implementation helps the company minimize waste, enhance quality of products and definitely create its sustainability. Lean manufacturing tools contribute to the productivity of both workers and the company. The Time Study monitoring system, an output of the study, is an effective and efficient tool to enhance productivity in the entire sewing section, whose benefits extend to the whole organization.

Findings

Though the lean technique is new for most of the apparel industry in Bangladesh but if a industry implement this technique it helps them to increase their overall productivity. Key findings are:

a. Best utilization of man, machine, materials
b. Increasing productivity
c. Reduce lead time
d. Reduce wastes
e. Ensure just in time shipment

Recommendations

i. Though the lean floor consists of cutting, sewing and finishing section, there should be minimum waiting time in fabric cutting section before bulk production starting. It is important to establish traffic light system to reduce the unnecessary transportation.

ii. There should be re-layout of lean floor to reduce the transportation time and also reduce the excess inventory in the line.

iii. Unnecessary movement of man, machine and materials should be avoided to reduce the unwanted motion.

iv. Pattern should be cut as per sewing floor requirements otherwise there may be over production.

v. Reduce the number of process in a line to eliminate the possibility of over-processing as well as eliminate cost due to over-processing.

Acknowledgments

None.

Funding

None.

Conflicts of interest

The authors declare that they have no competing interests.

References

1. Monden Y. Toyota production system: an integrated approach to just-in-time. Institute of Industrial Engineers: CRC Press; 2012.
2. Peter H, Anders B, Jensen PL, et al. Lean and the working environment: a review of the literature. International Journal of Operations & Production Management. 2012;32(7):829–849.
3. Rachna S, Peter T Ward. Defining and developing measures of lean production. Journal of Operations Management. 2007;25(4):785–805.
4. Silva SKPN. Applicability of value stream mapping (VSM) in the apparel industry in Sri Lanka. International Journal of Lean Thinking. 2012;3(1).
5. David McBride. The 7 manufacturing wastes. EMS Consulting group Inc; 2003.
6. Naresh Paneru. Implementation of lean manufacturing tools in garment manufacturing process focusing sewing section of men’s shirt. Master’s thesis, Autumn 2011 Degree Programme in Industrial Management Oulu University of Applied Sciences; 2011.
7. Md. Mazedul I, Adnan MK, Md. Monirul I. Application of lean manufacturing to higher productivity in the apparel industry in Bangladesh. International Journal of Scientific & Engineering Research. 2013;4(2).
8. Afhsan H, Talha J, Kamruzzaman K, et al. Prospect of implementation of lean manufacturing for apparel industries in Bangladesh. American Journal of Engineering Research (AJER). 2017;6(9):86–96.