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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

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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 base 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.[1–8]

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 is calculated for particular operation. Finally the Personal Fatigue and Delay (PFD) component as an allowance is added on the calculated time and the operation time is standardized. For calculation we have used the following formulas:

i. **SMV** =Basic time + Bundle Handling time +Allowance.

ii. **Basic time** = Cycle time × Rating.

iii. **Cycle time** = Pick up time + Stitching time + Dispose time.

iv. **Efficiency% of line**= (Total production × smv × 100)/ (No of operator × working Hour × 60).

v. **Basic pace time (B.P.T)** =Total time / total manpower

Research activities

a) Become acquainted about Lean Technique

b) Vigorous study on Lean manufacturing tools

c) Select a factory for application

d) Observe Lean application on a particular floor

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)

Productivity: output/input x100% =78/100 x100% =78%

SMV: 896.44/60=14.94

Standard SMV: 12.77

SMV increased: (14.94-12.77)/14.94x100 =16.99 %

Efficiency% of line: (Total production SMV x 100)/ (No of Operator x working hourx60) = (78x14.94x100)/ (35x1x60) = 55.49%

SMV target fulfillment: (100-78)/100x100%=100%-22%=78%

Basic pace time (B.P.T): Total time/total manpower =896.44/35 =25.61sec

Capacity/hr: 3600/B.P.T =3600pcs /25.61 =140

Traditional operation breakdown of knitted jacket (Table 2)

Productivity: output/input x100 = 64/100 x100 = 64%

SMV: 1013.88/60 = 16.89

Standard SMV: 15.43

SMV increased: (16.89-15.43)/15.43x100 =9.46 %

Efficiency% of line: (Total productionxsmvx100)/(No of operator x working Hourx60)= (64x16.89x100)/ (42x1x60) =42.89%

SMV target fulfillment: (100-64)/100x100% =100%-36%=64%

Basic pace time (B.P.T) =Total time/total man power = 1013.88/42 = 24.14sec.

Capacity/hr=3600/24.14 =149pcs.

Table 1 Lean line operation breakdown

SL no.	Operation	No. of workers	Machine	Standard SMV		Actual time Sec(Avg.)	Allowance (12%)	Standard Time(Sec)	Capacity
				Manual	M/c				
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	3.84	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

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Table Continues...

SL no.	Operation	No. of workers	Machine	Standard SMV		Actual time Sec(Avg.)	Allowance (12%)	Standard Time(Sec)	Capacity
				Manual	M/c				
8	Pocket Bag Mouth Close & Scissoring	1	SNLS		0.8	49	5.88	54.88	65
9	Pocket Tack	1	SNLS		0.35	21	2.52	23.52	153
10	Shoulder Join (2)	1	OL		0.3	18	2.16	20.16	178
11	Sleeve Cuff Servicing & join	1	OL		0.4	27	3.24	30.24	119
12	Sleeve Cuff Top Stitch	1	FL		0.3	18	2.16	20.16	178
13	Sleeve join	1	OL		0.3	18	2.16	20.16	178
14	Arm Hole TS (2)	1	FL		0.3	18	2.16	20.16	178
15	Side seam join (2)	1	OL		0.55	35	4.2	39.2	91
16	Pannel join at bottom rib (2)	1	OL		0.3	18	2.16	20.16	178
17	Pannel mouth TK (2)	1	SNLS		0.22	11	1.32	12.32	292
18	Pannel TS (2)	1	SNLS		0.3	18	2.16	20.16	178
19	Bottom rib join position mark & Rib join	1	O/L		0.76	47	5.64	52.64	68
20	Bottom rib top stitch	1	FL		0.6	35	4.2	39.2	91
21	Zipper cover mark & cover make	1	SNLS		0.27	18	2.16	20.16	178
22	Zipper cover turn & TS	1	SNLS		0.3	18	2.16	20.16	178
23	Zipper COVER ATT	1	SNLS		0.22	11	1.32	12.32	292
24	Zipper piping (2) operation	1	FL		0.3	18	2.16	20.16	178
25	Zipper edge fold & TK (2)	1	FL		0.2	11	1.32	12.32	292
26	Zipper ATT - Left	1	SNLS		0.4	27	3.24	30.24	119
27	Zipper ATT - Right	1	SNLS		0.4	27	3.24	30.24	119
28	Collar inner part rolling	1	SNLS		0.25	15	3	18	200
29	Collar inner part mark & join		SNLS		0.25	13	1.56	14.56	247
30	Collar mark & join	1	SNLS		0.22	12	1.44	13.44	267
31	Back tape piping	1	F/L		0.22	12	1.44	13.44	267
32	BK Tape top stitch& corner fold	1	SNLS		0.5	30	3.6	33.6	107
33	Final thread trimming	3	MNL	0.5		30	3.6	33.6	107
	Total	35			12.77			896.44	

Table 2 Traditional operation breakdown of knit jacket

SL No.	Operation	No. of worker	M/C	STD. SMV		Actual Time Sec(AVG.)	Allowance 12%	STD. Time Sec	Capacity
				Manual	Manual				
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

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Table Continues...

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 &	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	

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Transportation Analysis (Table 3) (Figure 3)

Table 3 Transportation analysis

KPI	Unit of measure	Traditional line	Avg.	Lean line	Avg.	Improvement
		351		145		
		350		143		
Transportation	Feet	348	345	144	143	58.55%
		350		143		
		349		142		

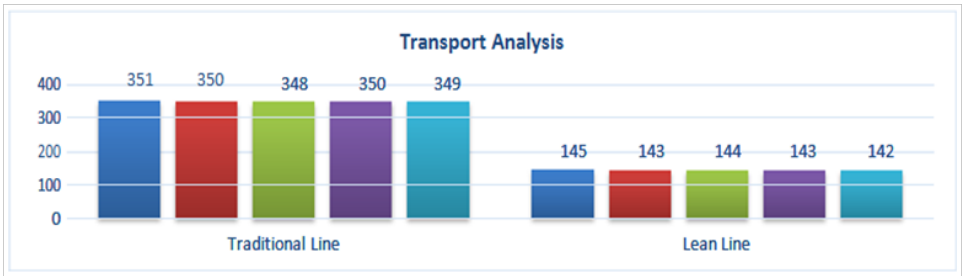

Figure 3 Transport analysis traditional vs lean line.

WIP Analysis (Table 4) (Figure 4)

Table 4 WIP analysis

KPI	Unit of measure	Traditional Line	Avg.	Lean Line	Avg.	Improvement
		815		400		
		810		398		
Inventory/WIP	Quantity	812	813	402	400	50.79%
		816		396		
		810		402		

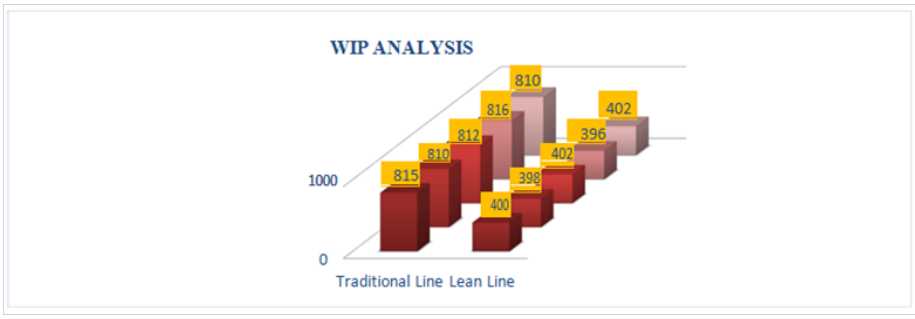

Figure 4 WIP analysis traditional vs lean line.

Space utilization analysis (Table 5) (Figure 5)

Table 5 Space utilization analysis

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

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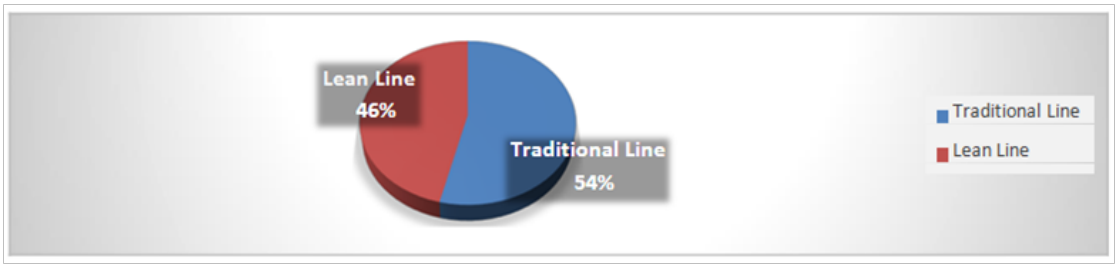

Figure 5 Space utilization traditional vs lean line.

Workstation analysis (Table 6) (Figure 6)

Table 6 Workstation analysis

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

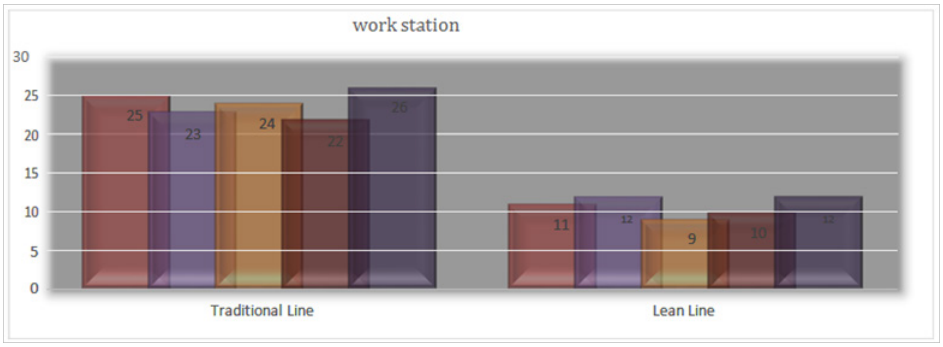

Figure 6 Work station traditional **vs** lean line.

Defects Analysis (Table 7) (Figure 7)

Table 7 Defects analysis

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

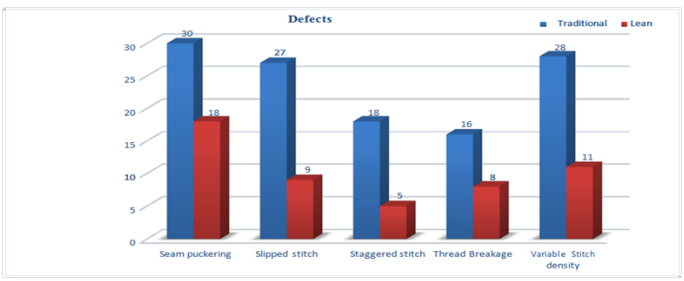

Figure 7 Defects in traditional vs lean line.

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).

Table 8 Comparing key productivity indicator

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%

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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.

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Conflicts of interest

The authors declare that they have no competing interests.

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