

Garment Manufacturing Through Lean Initiative-An Empirical Study On WIP Fluctuation In T-Shirt Production Unit

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ABSTRACT

Due to higher manufacturing cost in Garment production, high variation in product mix, it difficult to sustain in the Global Market. This paper will focus on Customized implementation of Lean tool for minimizing the process waste such as Work in progress (WIP), line setting time in a Knitted T-shirt Production Industry which in turn reduces the cost of production.

This is paper based on the two folded objective of investigation of Value stream mapping in existing production line and to alter the same with new cellular based layout. Work in Progress (WIP) will be analyzed in all sewing room production line and the significance of WIP and its fluctuation is investigated through data obtained from sewing room production line.

The proposed Value Stream mapping (VSM) through the support of cellular layout reduces, WIP level significantly which deliver many advantages in garment production system. The reduction in WIP will increase the profit by 20-25 % from the existing level.

This paper will provide the complete feasibility report for implementation of lean to General Garment manufacturing process particularly knitted manufacturing. Since the Garment construction process contains so much internal as well as external process variation .Customization towards the process will enrich the productivity ultimately profitability.

KEYWORDS

Kaizen,
Kanban Cellar Layout,
5S,
Pull Based Manufacturing,
Single Piece Flow Based On The
Product.

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1. Introduction and literature survey

Lean Manufacturing(LM) is defined as systematic approach to identify & eliminate the process wastages through continuous improvement (S S Mahapatra et al). Lean is the Pull based lean manufacturing. Manufacturing approach, also known as the Toyota Production system, which was established in 1970's by Taichi ohno and shigeo shingo at Toyota Motor company(Rajab Abdullah hokoma et al.2010). This results in an integrated and efficient manufacturing environment (Mc Muller Patric R). Lean has been developed and defined as

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elimination of waste (Womack et al 1990). In Lean Philosophy, “value” is determined by customer point of view. It means what the customer is willing to pay for, what creates value for the product which the customer is getting. So lean always Optimize the manufacturing process from the customer point of view. Value stream mapping towards the Value added and non value (NV) added activity is very much essential for manufacture a product from raw material to finished product(Rother and Shook1999).With this understanding we can find out the way to minimize the non value added activity towards the value chain instead replacing the useful value added activity .In a Lean organization people try to minimize the NV continuously (Womack and Jones 1996; McDonald et al. 2000) .Cellular layout divides the manufacturing facilities small groups called cells which will be exclusively utilized for specific task (Nicoletti et al., 1998). A cell contains of equipment and work stations that are arranged to maintain the smooth of product without much of waiting time (Farwaz A Abdulmalek et al). The advantage of this cell based layout is to achieve the Single piece flow and other benefit of implementing the cellular layout is to improve the quality of the product, minimize the WIP, reduce the throughput time reduce the setup time and improve the productivity (Burbidge,1979).In addition to this the cellular layout will minimize the material movement between the production process (Thomopoulos,1986) and create better human relation among the members in the cell(Richard et al,2003).

2. Problem definition

In general, Garment manufacturing is carried out with “progressive bundling system (PBS)”.Each PBS will be setup for exclusive product. Compare to other section in the garment production sewing room contains high skill jobs with high quality requirements.BPS system generates high amount of WIP which is the major issue. Due to high WIP, throughput time as well as the rework time will be very high. Line balancing between the operations is becoming critical task. And defective parts are also hidden in between the products. So that many garment professionals are working like a fire fighters. Secondly this BPS system will not provide flexibility, which is the current requirement for the garment industry because of decreasing the order size and increasing the number of styles so that to meet such requirement product layout should be designed it should hold minimum WIP between the process and gives flexibility to change the order quickly with minimum line setting time.

3. Research Approach

The Present Study consist of detailed value stream mapping(VSM) of existing production facility of T.Shirt Manufacturing units Tirupur based Garment factory in India and understand the root cause which increase the WIP between the process in the present system of VSM. Subsequently to examine some of the suitable Lean tool and technique to adopt and Propose the new system of value stream mapping.. Finally Compare the WIP Variation between the both the systems.

4. Current state value stream mapping

Current VSM has been designed with the support of necessary data collected from the Sewing Room of the Garment factory such as Basic pitch time(BPT) of each operation , Personal fatigue allowance (Pf) between the operator who is performing the particular task in the Product line. Pf is derived concern based on the operation criticality. Time study & Method study were conducted at the floor on each operation in the T-Shirt

production line subsequently hourly production between the operation as well as Total Production for the entire product line for a specified interval time. To get better result, each operation is repeated for at least 15 cycles. With the Support of BPT and pf Cycle time between the operations is found and it is tabulated at Table 1.

4.1 Cycle time

It is defined as how frequently a finished product comes out from the production facility (Rother et al.,1999).Cycle time includes all types of delays occurred while completing a job.Here cycle time is calculated by multiplying the pf and BPT.

5. Future state value stream mapping with cellular Layout

The future VSM has been developed for the same product by segregating the similar operation together .By keen observation on the current VSM it is understood that many of operation are Non value added (NV) activities .As much as possible those NV activities have been eliminated from this new VSM. In addition to this looking at the current state map (a) large inventories which nearly 400 in No's(b) Higher production lead time nearly 2 days require to deliver the first piece from the supply chain. Inventory and Lead time may be viewed as two related issues(Farwaz et al. 2006).For creating new ideal VSM cellular layout is utilized. Unlike PBS system the cellular layout is like a U shaped modular. As the figure -1. BPT and pf Cycle time between the operations is found for this revised VSM and it is again tabulated at Table 2,3,&4.

5.1 Grouping the Manufacturing operation

The first step is the new VSM is grouping the similar operation with respect to the other product families .Here there are 3 different cells were created 1.Shoulder joining cell 2. Neck attachment cell 3.sleeve and hem attachment cell.In general any garment contains these three important function where as the style between the function may differ drastically .So these 3 cells can be utilized to prepare any kind of knitted men's Top garment

5.2 U shaped Cellular Layout

- Since the current PB'S system creates higher WIP critical analysis has done on minimizing the WIP ,which inturn affect the internal inventory as well as the manufacturing cost subsequently.As the per the earlier literature U shaped Celluar layout minimize the WIP significantly .So the Researcher adopted this tool on the above 3 different groups of operation in customized way.
- In New cellular layout some of the operations were removed from the existing layout .First Quality check point were removed because the initial operator should be aware of quality standard. On need basic some of the operation are combined in this new layout Eg In current layout there would be two operation like front & back matching and Shoulder joining where as in the new layout which is combined to form a single operation
- This will eliminate movement from preparatory to assembly. In this layout no need of WIP storage area. Operators are not allowed to built WIP, rather they should change their operation

immediately if WIP seems increasing. Quality checkers were completely removed from the operation so that the operator will be solely responsible for their quality as well.

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5.3 Work balancing between operators

After defining work flow balancing the work load between the operator is a big challenges. Each operator should be given equal amount of work to achieve this few key changes were made.

- All sitting operations were converted in to stand up operations or rotary sitting chair has been utilized. This will help to travel between machines easily so that operator can handle multiple operations.

- Operator should trained 3 to 4 operations of their respective workcell.This will help the operator to rotate the between the operations which is called cross training.

- To create pull based system .Which means the capacity of the final cell is marginally higher than the other cells so that naturally other cells are producing more.

- Number of operation are less than the work station this will help the balancing the work load between the operator by rotating the operator & Floating balance

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6. Result & discussion

Implementation of Lean approach to production process in a T-Shirt based Garment industry has reduced the WIP Significantly .10 cycle reading were taken at various level of the cellular layout is shows that nearly 70% to 80% WIP has reduced from the PB's Layout to Lean based cellular layout has graphically represented in figure-2. By reducing various Non Value activities in the Cellular layout the production lead time has reduce from 2 days to 20 min ,which would enhance the manufacturer to go with short term order quantity also. Since this cellular layout ensure the floating balance the change in pitch time is around 69% as compared with the PBS type of Layout.

Conclusion

This Lean manufacturing implementation technique to the Garment sector has adopted in customized way has reduced the WIP drastically .High WIP is a big concern for the apparel manufacturers in india .This study carries evidence of genuine ad vantages of applying lean principles to Apparel industry.It is concluded that Lean initiative has addressed the present manufacturing issues like minimizing WIP & Pitch time,cost of manufacturing and Manufacturing lead time .

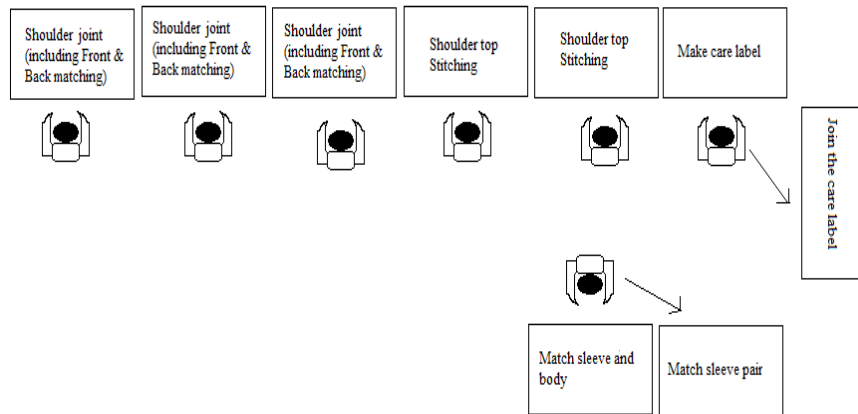


Figure 1-Shoulder making cell (U shaped Layout)

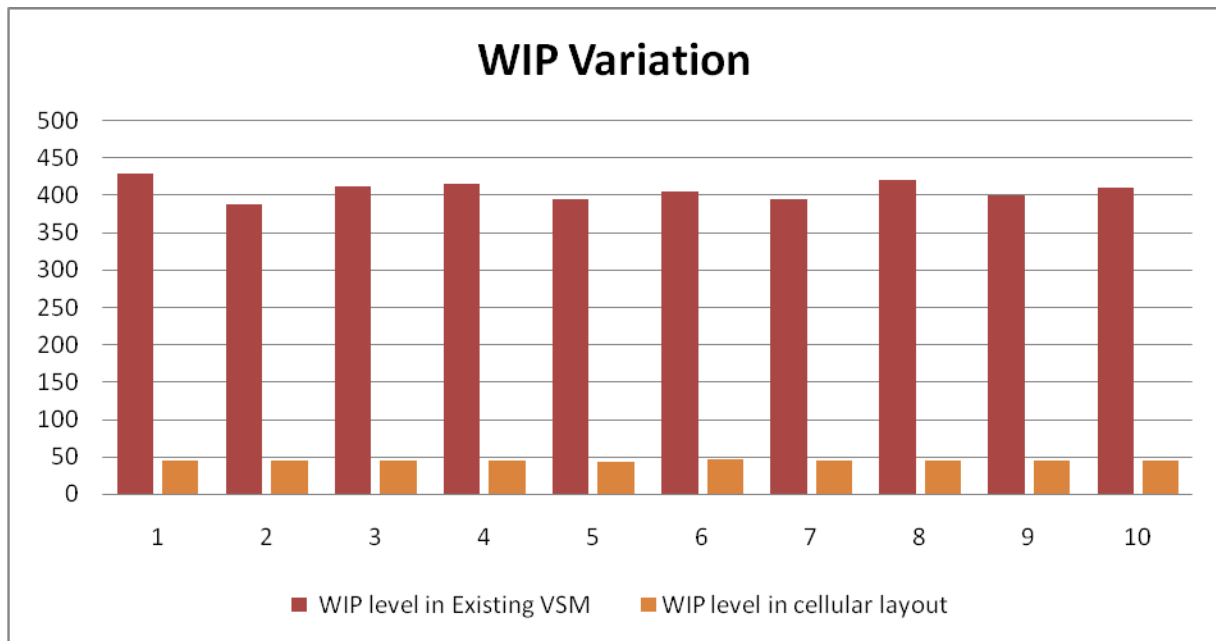


Figure 2-WIP variation between Existing VSM & New cellular layout

Table 1-Value Stream of Existing T.Shirt Production line

S.No	Process	Types of Sewing Machine	Operator	Helper	Machine/hel per	Basic Pitch time	Allowance	Cycle Time	Capacity/Hour	WIP between operation
1	Front back Matching			2	2	0.81	20	0.972	61.72839506	14
2	Shoulder joint	5 Thread O/L	1		1	0.273	15	0.31395	191.1132346	15
3	Shoulder cut mark			1	1	0.205	20	0.246	243.902439	13
4	Shoulder top Stitching	Flat Lock	1		1	0.238	20	0.2856	210.0840336	14
5	Thread cut			1	1	0.228	20	0.2736	219.2982456	10
6	Make care label		1		1	0.128	20	0.1536	390.625	15
7	Join care label	SNLS	1		1	0.153	20	0.1836	326.7973856	15
8	Neck Rib make width	5 Thread O/L	1		1	0.192	20	0.2304	260.4166667	14
9	Neck Rib Fold tack	SNLS	1		1	0.222	20	0.2664	225.2252252	14
10	Neck Joint	SNLS	1		1	0.25	15	0.2875	208.6956522	17
11	Thread cut			1	1	0.228	20	0.2736	219.2982456	12
12	Cut twill tape			1	1	0.193	20	0.2316	259.0673575	10
13	Back neck elastic tape joint	SNLS	1		1	0.326	20	0.3912	153.3742331	16
14	Back neck Elastic Top stitch	SNLS	3		3	0.903	20	1.0836	55.3709856	14
15	Main label position mark			1	1	0.207	20	0.2484	241.5458937	14
16	Main & co label position			1	1	0.214	20	0.2568	233.6448598	14
17	Match sleeve pair			1	1	0.141	20	0.1692	354.6099291	16
18	Match sleeve and body			1	1	0.158	20	0.1896	316.4556962	13
19	sleeve joint	5 Thread O/L	2		2	0.828	15	0.9522	63.01197227	18

20	Body turn			1	1	0.242	20	0.2904	206.6115702	12
21	Side seam	5 Thread O/L	2		2	0.834	15	0.9591	62.55864873	15
22	Body folding after side seam			1	1	0.167	20	0.2004	299.4011976	10
23	Bottom hem tack	Flat Lock	1		1	0.226	20	0.2712	221.2389381	16
24	sleeve hem tack	Flat Lock	1		1	0.224	20	0.2688	223.2142857	15
25	sleeve hem	SNLS	2		2	0.588	17	0.68796	87.21437293	14
26	churi hem raw edge cut			2	2	0.825	20	0.99	60.60606061	12
27	Bottom hem	Flat Lock	1		1	0.222	17	0.25974	231.000231	14
28	bottom hem raw edge cut			1	1	0.238	20	0.2856	210.0840336	16
29	security tack	SNLS	1		1	0.272	20	0.3264	183.8235294	14
30	Thread cut body turn			1	1	0.276	20	0.3312	181.1594203	13
		Total	21	16	37	10.011			Mean WIP	419

Table 2.Revised Value Stream Mapping through Cellular Layout/Modular –T-shirt Production Line

S. No	Operation	Process	Types of Sewing Machine	Operator	Inspector	BPT	Allowance	Cycle time	No of Machine Available in the Cell	Capacity/Hour	Total WIP Between the operation
1	1	Shoulder joint(including Front&Back matching)	5 Thread O/L	1		0.89	10	0.979	3	183.8610827	2
2	2	Shoulder top Stitching	FlatLock	1		0.42	10	0.462	2	259.7402597	3
3	3	Make care label	SNLS	1		0.128	10	0.1408	0.5	213.0681818	3
4	4	Join care label	SNLS	1		0.153	20	0.1836	0.5	163.3986928	2
5	5	Match sleeve pair			1	0.141	20	0.1692		354.6099291	2
6	6	Match sleeve and body			1	0.158	20	0.1896		316.4556962	3
								Total M/c in the cell	6	Mean WIP in the cell	15

Table -3

S.No	Operation	Process	Types of Sewing Machine	Operator	BPT	Allowance	Std Pitch Time	No of Machine Available in the Cell	Capacity/Hour	Total WIP Between the operation
1	1	Neck Rib make width	5 Thread O/L	1	0.192	10	0.2112	1	284.0909091	2
2	2	Neck Rib Fold tack	SNLS	1	0.222	10	0.2442	1	245.7002457	3
3	3	Neck Joint with thread cut	SNLS	1	0.38	10	0.418	1.5	215.3110048	4
4	4	Cut the twill tape with Back neck elastic tape joint	SNLS	1	1.032	10	1.1352	3.5	184.9894292	2
5	5	Main label position mark & attachment	SNLS	1	0.207	10	0.2277	1	263.5046113	2
6	6	Main & co label position	SNLS	1	0.214	10	0.2354	1	254.8853016	3
							Total M/c in the cell	9	Mean WIP in the cell	16

Table-4

S.No	Operation	Process	Types of Sewing Machine	Operator	BPT	Allowance	Std Pitch Time	No of Machine Available in the Cell	Capacity/Hour	Total WIP Between the operation
1	1	sleeve joint	5 Thread O/L	1	0.41	10	0.451	2	266.075388	2
2	2	Body turn +Side seam+Body folding after side seam	5 Thread O/L	1	0.802	10	0.8822	4	272.0471548	3
3	3	Bottom hem tack +Sleeve Hem tack	Flat Lock	1	0.45	10	0.495	1	121.2121212	2
4	4	sleeve hem +Bottom Hem	SNLS	1	0.471	10	0.5181	2	231.6155182	2
5	5	security tack	SNLS	1	0.272	10	0.2992	1	200.5347594	3
6	6	Thread cut body turn+hem raw edge cut			0.456	10	0.5016	2	239.2344498	3
							Total M/c in the cell	12	Mean WIP in the cell	13

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