The application of Lean manufacturing System in garment industry in Sudan

Muy Alshazly Habob[1]; Mohammed A.E. Ali Elgalib[2]; Khalid AA Abakar[3]; El Awad F. Elfaki[4]

Department of Textile Engineering, College of Engineering and Technology Industries Sudan University of Sciences and Technology. Khartoum, Sudan[1,2,4]; Industrial research & consultancy centre (IRCC), Khartoum, Sudan[3]

E-mail:muyhabob124@gmail.com[1];aaljalib@gmail.coml[2];kheloo333@hotmail.com[3];

abuzaid207@gmail.com[4]

ABSTRACT

This study aimed to use and apply lean tools as ways of improving garment manufacturing operations that lead to reduce waste and standardize cycle time .The study focus in all phases of garment manufacturing start from design to packaging. The study used just in time (JIT), 5S , basic quality tools (checklists), quality assurance , Time Study for one piece of men shirt between three workers to calculate the average time and determine the standard time and identified the waste time reason losses in the company and cycle time elongate, the study observed non-value activities such as unnecessary transportation and manual operations, waiting for raw material due to poor layout poor planning and there were also product defects due to poor applying 5S and unqualified the worker. After considering lean tools, using process flow and cycle time analysis, the standard time was determined. Likewise, the non-value added activities were reduced, thus productivity was improved. After lean implementation, the scrape, rejection and defect of production was reduced and the company meeting the customer expectation in the time delivery and quality of product.

Keywords: Quality Tools, Just in Time, Time Study, Waste Time, Quality Assurance and 5s

1. INTRODUCTION

Garment manufacturing in nature is more complicated than many other industries. It involves a number of machines, hundreds of employees and thousands of bundles of sub-assemblies producing different styles simultaneously. In clothing production, garment components are assembled through a sub-assembly process until they are gathered into a finished garment. The production process involves a set of work stations in each of which a specific task in a restricted sequence is carried out[1] (Huiand FrencyNg,1999). Many factors such as the properties of fabrics and human emotions will affect the performance of operatives that ultimately will cause variance on the task time. Personal and delay allowances for the apparel industry are very important. Delays can be broken down into work elements which can be readily measured as fixed or variable and these measurements are then combined into work standards[2]

In today's competitive manufacturing environment, companies are constantly looking for ways on how to improve. Because of this, many companies are striving to practice lean manufacturing, which is a difficult process. Productivity improvement is not a job for specialist only; it should be a part of every job in the organization. It requires the optimal use of all resources like manpower, machinery, money and methods [3]

A lot of studies focus on the lean concepts, and its principle, importance and benefits.[4-7]The use of lean production is now being practiced by organizations which aim to increase productivity, improve product quality and manufacturing cycle time, reduce lead time and eliminate manufacturing waste. To achieve these, the lean production philosophy uses several concepts like Kaizen, Kanban, 5S, Just in Time (JIT), Value Stream Mapping (VSM), etc[8]

Time study is a work measurement technique for recording the times and rates of working for the elements of a specified job carried out under

specified conditions, and for analyzing the data so as to obtain the time necessary for carrying out the job A time study has been carried out for all operations of manufacturing one piece of men shirt by direct observation required time of manufacturing of each stages and observed data. This study clearly applying as attempt the lean manufacturing tools in the local garment factories in the Sudan.

It also addresses the approaches to implement lean practices in apparel and garments manufacturing company specifically. Lean manufacturing strives to improve as much as possible the value.

In this work, attempt has been made to reduce the waste time to each operation in garment manufacturing starting from design to packaging. Also, to study each operation time to establish a standard for garment manufacturing time in Sudan. In addition to identified the main reason of waste time in the company and solving all the reason causes the waste time. Moreover, to eliminate all the traditional and manual of equipments, machines and operations in the company. As well as, to improve human resources.

2. MATERIALS AND METHODS

This study employed lean manufacturing tools(JIT,5S,Checklist,quality assurance) and carried out in all the phase of garment manufacturing from

design to package section to identified the reason of time waste in the company by Time Study for one piece of men shirt between three workers to noticing the change of the time to calculate the average time by using stopwatch timer and identified the waste time reason loses in the company and cycle time elongate, and determine the standard time .The company does not have a standard operation time and the company referrer it as (x1) factory. Similarly, the study observed non-value activities such as unnecessary transportation and determine the standard time in other company referrer it as (x2) factory for first steps of process of garment manufacturing (design, spreading ,cutting)to compression between (x1) factory ,comparison difference time between three workers in(x1) factory for all phases (preparing by fusing ,hand steam iron and preparing by sewing, steps of piecing by sewing, steps of finishing, quality control, pressing and package) to determine standard time, Observing the workers (Tailors ,supervisors) , operations and other factors causes the waste and losses time, Noting the main reason leaded to losses time.

3. RESULTS AND DISCUSSION

As the result shown in table (1) and figure (1) the reasons of deference time of first steps of processes of garment manufacturing between x1 and x2 factories were:

Table 1: Variation in time of first processes in two factories x1, x2.

NO	The process	The time of process in x1 (min)	The time of process in x2 (min)	The different time (min)
1	Design	110	60	50
2	Spreading the lays of fabric	95	30	65
3	Cutting fabric	99	30	69
4	Design draw interlining (thick and thin) for collar- stand collar- cuff- belt loop cover pocket	55	15	40
5	Cutting interlining(thick and thin) for collar- stand collar- cuff- belt loop cover pocket	97	40	57

- The Level of technology using in x1 factory in design ,spreading ,cutting phase (medium and traditional technology)
- In the design phase the different time was (50) min, the main reason in thex1factory the design make pattern way was traditional and

by the hand, and in x2 factory by CAD&CAM
- In the spreading phase the different time was (65) min, the main reason in thex1factory the spreading method was traditional and by the hand also, and it required number of five

workers as minimum and in x2 factory the spreading method by new technology machine and it required one worker only.

- In the cutting phase the different time was (69) min, the main reason in the x1factoryin the cutting phase used manual method by used electric equipment by hand, in x2factory used electric equipment by CAD&CAM

- In the design phase of interlining the different time was (40) min, the main reason in the x1factory make pattern design of interlining was traditional by hand in comparison to x2factory the design interlining by CAD&CAM

- In the cutting phase of interlining the different time was (57) min, the main reason in the x1factoryused by electric equipment for fabric manual by hand to cutting interlining, in x2factory used especially electric equipment by CAD & CAM.

From above mentioned the major noticed that the reasons of deference time of first steps of processes of garment manufacturing between x1 and x2 factories were the level of technology used inx1 factory (medium and traditional) and multi manual operations.
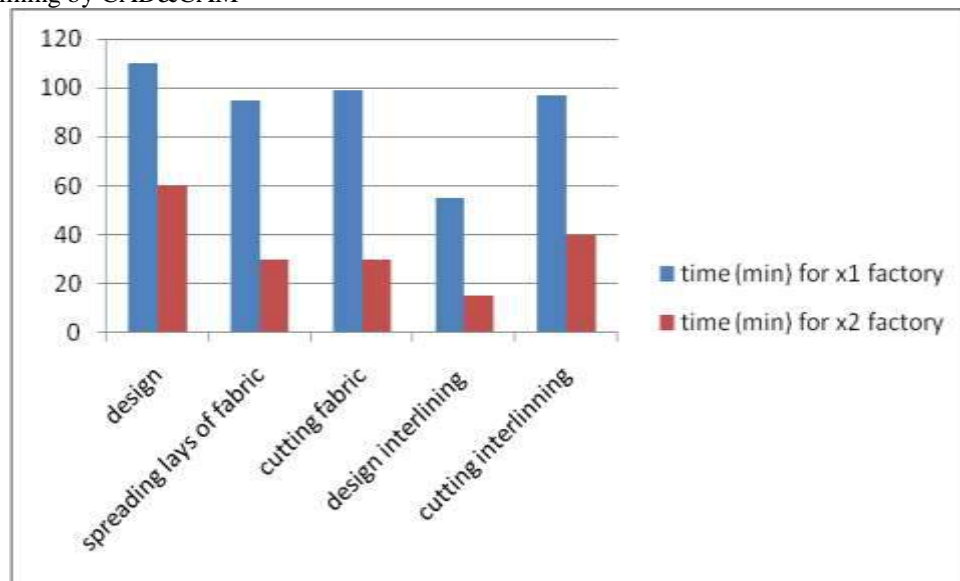

Fig 1 variation in time of first processes in two factories x1, x2

AS A results shown in table (2) the reason of variation in time for manufacturing one shirt by three workers using continues system in factory x1 was:

- In the item 3.2 the different time was (12.5)sec, and in item 3.3 the different time was (18)sec, the main reason occur due to the empty bobbin from thread and the process was stopped and the tailor filled the bobbin with sewing thread from another machine

- In the item 3.6 sewing cuff (sewing –turn over cuff- 6ml in cuff) the different time was (31) sec the main reason Un qualified tailor.

- In item 3.9 sewing cover pocket (sewing – turn over – ml) the different time was (12) sec the main reason occur due to Knot in sewing thread the tailor was spent long time to treated the knot.

- In item 4.3 Sewing the ml on the back the different time was (14.5) the main reason occur due to the Knife in sewing machine

was not sharp the tailor used cutter to cutting sewing thread

- In item 4.9 attaching cover for front pocket the different time was (6) sec the main reason the sewing Thread prepackage and the tailor entered thread into needle again.

- In item 4.10 the different time was (29)sec, Join the front facing for button and front facing for button hole on back the main reason Needle break aged replaced the needle

- In item 4.11 Top stitch the shoulder (sewing ml) the different time was (16)sec the main reason empty Bobbin filled bobbin with sewing thread from other machine

- In item 4.12 sewing tape on sleeve (placket)the different time was (40.5) sec the main reason sewing Thread break aged the tailor entered sewing thread into the needle again

- In item 4.14 attaching belt loop in two sides of shoulders the different time was (20.5

)sec the main reason occur due to Knot in sewing thread Un qualified tailor.

- In item 4.17 sewing 6ml on sleeve the different time was (24) sec the main reason of different time Unqualified tailor.
- In item 4.18 Attaching the cuffs in right and left sleeve the different time was (69.5) sec the main reason empty Bobbin filled bobbin with thread from other machine.
- In the item 4.19 Attaching collar first step different time was(14.5)sec the main reason un qualified Tailor
- In item 4.20 Close the collar and attaching size and label the different time was (22.5) sec the main reason of different time UN qualified tailor.
- In item 4.21 hemming the different time was(56.5) sec Un qualify tailor to using automation machine
- In item 5.2 sewing button hole the different time was (26.5) the main reason Un qualified tailor
- In item 5.4 attaching button the different time was(31.5) sec the main reason of different time was empty bobbin with thread and stopped the process to filled bobbin with sewing thread from another machine
- In item 6.1 remove the sewing thread from final product the different time was(130) sec the main reason of waste time the final product fill with sewing thread because the knife of the machine not sharp and the cutter not sharp also in additional to un qualified the worker.
- In item 6.2 quality control to detected the defect, the different time was (64) sec, the main reason unqualified the worker.
- In item 7.3 iron complete one piece the different time was(17.5)sec the main reason un qualified the worker

- In item 7.4package many of sets of product in carton the different time was(17.5) the main reason unqualified the worker
  The reason of difference time for manufacturing one piece of men shirt by continues system production in x1 factory between three workers was:

❖ Poor quality of raw material (fabric and accessories)

❖ Poor applying tool 5S and poor layout to spent long time when transportation material from first step to last step because the machine sequencing irregularly and this require the tailors assistant also defects being disappearance to eliminated.

❖ Poor planning (waiting long time to waiting raw material to reach the place of production this lead to daily in time delivery for the customer

❖ Continuously Deactivate in machine and un corrective system of maintenance applying in (treated maintenance)and the maintenance operator un qualified

❖ UN qualified and UN trained tailor to use the machine.

❖ Poor qualified of production supervisors

❖ Method of management quality system applying to detect defect in final product don't using quality assurance tool which prevented defect during process

❖ Medium and traditional technology and manual operations using

❖ Poor work environment lead to continually absence the workers. this finding agreed with Hassall, al et study[9-11]

❖ Disputes between the internal customers

❖ unconformity every workers to performance his main function.

Table 2: variation of time for manufacturing shirt by continues system in factory x1

NO	Manufacturing steps For men shirt in X1 factory	Time consumption (sec) from Worker			Average	Time wasted per sec
		A	B	C		
1	Preparing by Fusing machine					
1.1	Fusing interlining to collar	7	8	9	8.5	1.5
1.2	Fusing interlining to stand collar	6	7	8	7.5	1.5
1.3	Fusing interlining to the cuff	1	2	3	2.5	1.5
1.4	Fusing interlining to the belt loop	3	3	3	3	-
1.5	Fusing interlining to the cover pocket	2	4	4	4	2
	Total	19	24	27	25.5	6.5
2	Preparing by steam ironing					

2.1	front pocket for write side (by patron)	13	14	16	15	2
2.2	pen pocket (by patron)	9	11	13	12	3
2.3	Back	9	11	14	12.5	3.5
2.4	front facing for button	13	15	17	16	3

Table 2 continue..

NO	Manufacturing steps For men shirt in X1 factory	Time consumption (sec) from Worker			Average	Time wasted per sec
		A	B	C		
2.5	front facing for button hole	14	14	16	15	1
2.6	Cover pocket	9	10	12	11	2
2.7	front pocket for left side(by patron)	13	15	16	15.5	2.5
2.8	Sleeve	12	12	12	12	-
2.9	tape for placket	15	16	18	17	2
	Total	107	118	162	141	19
3	**Preparing by sewing**					
3.1	sewing collar (turn over collar- 6ml on collar)	43	46	50	48	5
3.2	sewing stand collar	30	42	43	42.5	12.5
3.3	sewing stand collar on collar	30	34	62	48	18
3.4	sewing belt of bird the belt make ten bird(cutting balance- sewing)	105	111	117	114	9
3.5	sewing tape of placket	7	8	9	8.5	1.5
3.6	sewing cuff(sewing –turn over cuff- 6ml in cuff)	54	62	108	85	31
3.7	sewing pen pocket in left side sleeve (hemming)	14	16	17	16.5	2.5
3.8	sewing belt loop(sewing – turn over-6 ml)	49	56	63	59.5	10.5
3.9	sewing cover pocket (sewing – turn over – ml)	74	82	90	86	12
3.10	sewing cover pocket for front pen pocket (sewing – turn over – ml and Para tacking)	35	37	44	40.5	5.5
	Total	441	494	603	548.5	107.5
4	**Steps of assembling men shirt by sewing**					
4.1	Marker for attaching pocket	21	30	42	36	15
4.2	Join the yoke on back	30	38	39	38.5	8.5
4.3	Sewing the ml on the back	37	43	60	51.5	14.5
4.4	Sewing front facing for button	45	51	59	55	10
4.5	Sewing front facing for button hole	9	14	30	22	13
4.6	attaching front pen pocket	27	31	38	34.5	7.5
4.7	- attaching front pocket	60	67	71	69	9
4.8	attaching cover for pen pocket	24	27	30	28.5	4.5
4.9	attaching cover for front pocket	15	20	52	21	6
4.10	Join the front facing for button and front facing for button hole on back	56	73	97	85	29
4.11	Top stitch the shoulder (sewing) ml	31	32	62	47	16
4.12	sewing tape on sleeve(placket)	26	53	80	66.5	40.5
4.13	attaching pen pocket in sleeve	33	37	45	41	8
4.14	attaching belt loop in two sides of shoulders	25	32	59	45.5	20.5

4.15	attaching bird	12	14	16	15	5
4.16	attaching sleeve in arm hole	19	20	35	27.5	8.5
4.17	sewing 6ml on sleeve	63	69	105	87	24
4.18	Attaching the cuffs in right and left sleeve	55	97	152	124.5	69.5

Table 2 continue..

NO	Manufacturing steps For men shirt in X1 factory	Time consumption (sec) from Worker			Average	Time wasted per sec
		A	**B**	**C**		
4.19	Attaching collar first step	21	31	40	35.5	14.5
4.20	Close the collar and attaching size and label	26	30	67	48.5	22.5
4.21	Hemming	21	33	41	72	56.5
	Total	647	842	1220	1051	402.5
5	**Steps of finishing**					
5.1	button hole marker	13	17	20	18.5	5.5
5.2	making button hole	37	44	73	63.5	26.5
5.3	button marker	32	37	39	38	6
5.4	attaching button	33	54	75	64.5	31.5
5.5	Partaking	56	63	65	64	8
	Total	171	215	272	248.5	77.5
6	**Quality control**					
6.1	remove threads from final product	90	180	260	220	130
6.2	Quality control(detected defect)	61	75	139	107	64
6.3	open button hole	26	30	39	34.5	8.5
6.4	close button	19	22	30	26	7
	Total	196	307	468	387.5	209.5
7	**Pressing and package**					
7.1	iron side of piece	18	22	25	23.5	5.5
7.2	Irion whole piece	30	42	53	47.5	17.5
7.3	package one set	14	15	15	15	1
7.4	Package many of sets in one item of package carton	30	35	60	47.5	17.5
	Total	92	114	153	133.5	41.5
	Total	28 (min)	35 (min)	48 (min)	42 (min)	14 (min)

4. CONCULUSION

This study investigates study time in garment manufacturing in Sudan focus on all phases of garment manufacturing starting from design to packaging, by applied lean tools such as (JIN, 5S, Quality assurance, Check lists) as ways of improving garment manufacturing systems that lead to shortening the cycle time of production, Improving productivity and profitability, Reduce the cost, meeting the customer expectation in the time delivery , improving quality, After lean tools using this study observed non-value activities such as unnecessary transportation and determine the standard time in other company referrer it as (x2) factory for first steps of process of garment manufacturing (design, spreading

,cutting)to compression between (x1) factory also, comparison difference time between three workers flow and the standard time was determined by time measurement studies between three workers in the phase of preparing ,piecing by sewing ,finishing ,pressing and packaging. Likewise, after study finding and advice to factories top manager, the non-value added activities were reduced, thus the scrape, rejection and defect of production was reduced and work flow should be organized and all the reason which causes the waste time being clearly determined and solved and prevented.

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