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Production Working Time Expenditure Management and Critical Path Analysis for Men's Casual Wear

KEYWORDS: Apparel production, Time management, Quality control, Production planning

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ABSTRACT *Time management has become a primary aspect in global textile and apparel business. Survival from elimination due to hard competition from global manufacturers has leaded the industries to efficiently organize a timely production process. Time management is a critical factor in production and is related to production, planning and execution. It is directly related to Quality Control, Cost analysis and production efficiency. A well planned production sequence will enable to execute and complete a process in time so as to proceed with a new process. Time management is a continuing process throughout the life span of an industry. Every production operation carries a critical path where in it is necessary to maintain a continuous flow of work and any delay in critical path leads to unimaginable loss pertaining to an imperfect reputation of a concern. This article is about the research that was carried out during the production of men's casual wear. The main aim was to determine the flow of work, time action of each work pertaining to the study based on time study in the production section, critical path analysis in the production process and finally to determine and alternate imperfections in the process flow.*

1. INTRODUCTION

Production is the process of transforming a set of input to a desired output having value and quality. Production is any progress or procedure developed to transform a set of input elements like men, machinery, capital, information and energy into a set of output elements like finished products and services in proper quality and quantity, thus achieving the objectives of the enterprise [1]. Production Department is the heart of the garment industry. The cutting process and sewing is done at the production department. There are wide activities carried out by the production department like cutting, sewing and checking. These activities are carried out by efficient managers, quality controllers, production supervisors and sewing operators. Though there has been tremendous growth in apparel production with the advances in machineries and technicians the faults occurring in production has lead to an unimaginable loss to the industry. The main goal of the study is to identify and analyze the critical stages in the production process, mainly in the apparel production department and have a keen eye on the short time tasks for timely delivery [2].

2. PRODUCTION PLANNING

Production planning is the process of coordinating the demand for finished goods with available resources in a factory. Production planners work many months ahead of planned delivery to ensure that specific materials, production capacity and reliable quality management are available when needed. Planning may be Long term planning and short time production planning. The garment industry production planners analyze sourcing strategies, types of styles in the line, types of fabric, labor intensity of the line, planned volume per style, reorder expectations, expected delivery dates, and the resources available. Factories decide to produce a product line in their own plants to use domestic or international contractors to execute production. Production Planning requires coordinating the factory capacity with style requirements, projected volume, and shipping date [3].

2.1 Work Study

It is based on two factors

- Method Study
- Work Measurement

Work measurement is used to determine the time required to complete one task or one operation and the amount of work that can be performed by one operator in a specific segment of time. The work measurement techniques used by garment manufacturers include time studies, judgment or past experience of the engineer or production manager, predetermined motion/time systems, standard data, operator reporting and work sampling [4]. Time study is a common technique followed in apparel industries to determine the duration required to complete a specific work. The main objective of time study is to develop and check production standards. A time study requires a method describing a specific operation to determine the work elements involved the order or work, time duration, and the rate of operation. The time study preparation involves breaking down the operations in segments. Each segment involves a group of motion with a definite beginning that can be identified and timed. The important elements in a sewing operation may include picking up and positioning parts, matching and aligning parts, positioning parts to the needle or presser foot, sewing, and disposing of parts. Interruptions that occur during production are considered as delay and are compensated through delay allowance. Some machines, like the lock stitch, require more downtime than others for winding and replacement of bobbins.

An advantage of time study comparing to other work measurement techniques is the breakdown and analyze of work into segment prior to time measurement.

Standard allowed minute (SAM)

Standard Time is a time required to complete a job at a Standard performance in a production place. The unit that measures the amount of work to be done in a specific time is Standard time [5]. A worker requires standard experience to complete a given task in standard time.

Measuring Standard Time: There are several methods to determine the Standard Time. The most common method to determine the time consumption is the stopwatch method.

Rating Factor is the assessment of the workers rate of working relative to the observer's concept of the rate corresponding to the standard pace. The actual time (observed time) is multiplied with a factor known as rating factor to get the average time (basic time).

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CASE STUDY
This study was carried out based on a Men's full sleeve casual shirt production process that was carried out in a garment manufacturing unit.

3.1 Program Evaluation and Review Technique
Based on the analysis of the designing and production process, a PERT network diagram has been developed.

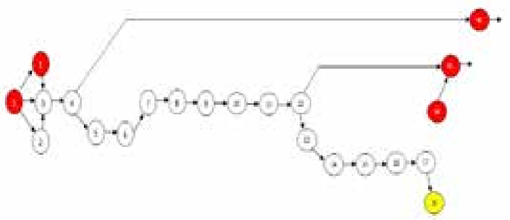

Figure - 1: PERT Network Tasks – Cuff, Collar, Collar Band, Front and Pocket Assembly

The Figure 1 shows the Network diagram for garment parts assembly starting from Cuff stitching which is the initial operation. It can be seen from the network diagram that activity 4 which is trimming and turning cuff followed by creasing is immediately followed by task 48 which is a critical task. Task 48 is attaching cuff and finishing cuff to sleeve. Although cuff stitching begins at the beginning the operation requires 48 tasks to complete before finishing the entire cuff part. In the same manner task 12 which is Trimming and notching collar + Neck band is followed by a dual sequence 13 which is patch pocket creasing and 45 which is attaching collar. Although Collar stitching gets over at task 12 itself, the collar is joined at 45th task only. The task 18 is highlighted to show the beginning of next sequence.

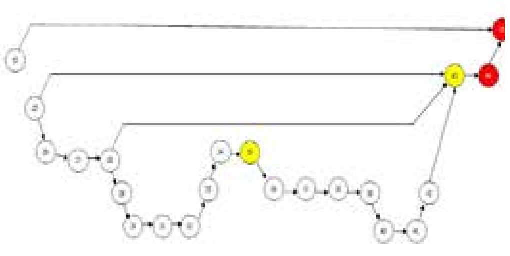

Figure – 2: PERT Network Tasks - Pockets, Front placket, Sleeve, Sleeve placket, Front, Back and Yoke assembly

The Figure 2 shows the Network diagram for garment parts assembly which is the continuation of the Highlighted sequence 18 which is Turn and Stitch Front placket. It can be seen from the network diagram that activity 25 which is Attaching back yoke is immediately followed by dual tasks 26 which is turn and stitch back yoke and task 43 attaching side seams which is a critical task. In the same manner task 28 attaching fusing to sleeve is followed by a dual sequence 29 which is attaching inner plackets and tack at ends and task 43 which is side seam attachment. The task 26 can't be completed immediately after task 25 since 25 is also followed by task 43. Hence to complete the task 43 important tasks has to get stitched.

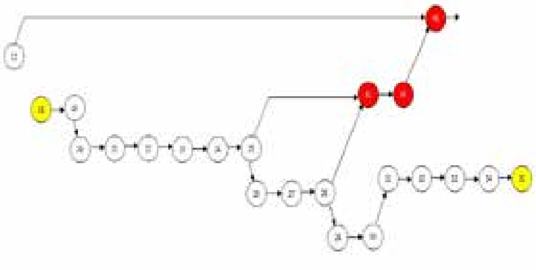

Figure – 3: PERT Network Tasks – Shoulder, Right and Left Sleeves, Side seams assembly

The Figure 3 shows the Network diagram for garment parts assembly which is the continuation of the Highlighted sequence 35 which is Turn and Stitch Shoulders. Task 35 is immediately followed by dual tasks 36 which is sleeve attachment. Task 35 to 43 is a continuous sequence.

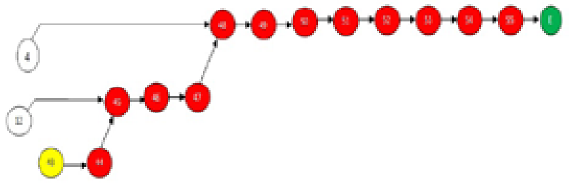

Figure – 4: PERT Network Tasks – Garment parts assembly

The figure 4 shows the Network diagram for garment parts assembly which is the final stage in the garment assembly. E is the end of the Programme Evaluation Technique and the sequence marked in Yellow is the Continuation of previous sequence, the sequence marked in red are the critical tasks and the green marking is the end of the production sequence.

Analysis of the PERT Network for Production
The Network graph allows determining the Critical Tasks in the entire production process. In analyzed Network graph, the entire production process has been segmented into four groups as shown in figure 1, figure 2, figure3 and figure 4, where the following things has been distinguished.

- **Operation Time (OT)** – The actual time required to complete a task
- **Earliest Start Time (EST)** – The time to start a task before the Operation Task
- **Latest Start Time (LST)** – The delay start time permeable
- **Float** – The tolerance level for EST and LST

The PERT network was calculated on a Time Study of ten samples for each single operation and the average time was taken for tabulation. Therefore it is important to determine precisely and follow the duration of each event.

The Critical and important tasks has been shaded in red for operators convenience and the apparel engineers, production supervisors shall have a keen eye on these sewing parts assembly as they have no time bound for Earliest Start or Latest Start. The critical events need to be followed immediately after the previous assembly failing to which there shall be a marginal or heavy delay in production completion. The path for subsequent tasks has been linked with the connectors. Connectors are the arrow lines joining two or more assembly. The connectors must be clear and precise as any wrong marking may turn up with an inaccurate time note.

Table - 1: Garment parts assembly; Task 1 – 4 Cuff Stitching

S. No	Operation	M/c	Time	
1	Cuff mark + Crease	Table-1	0	0
			1	
			0.51	0
2	Cuff Hem	SNLS	0.51	0.51
			2	
			0.61	0
3	Cuff R/S	SNEC	1.12	1.06
			3	
			0.49	0.06
4	Trim turn + crease cuff	Table-1	1.61	1.55
			4	
			0.60	0.06
	Earliest Start Time			
	Latest Start Time			
	Operation			
	Float			

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Table 1 shows the detail PERT network for individual tasks starting from task 1 to task 4 which is cuff stitching. It can be clearly seen that from the Task 4 which is Trim turn and crease cuff which has to be completed within 1.61 mins EST.

Table - 2: Garment parts assembly; Task 5 – 12 Collar Stitching

S. No	Operation	M/c	Time	
5	Collar mark	Table	2.21	2.15
			5	
			0.51	0.06
6	Collar R/S	SNEC	2.72	2.66
			6	
			0.73	0.06
7	Turn + crease collar	Table-1	3.45	3.39
			7	
			0.80	0.06
8	T/S collar	DNLS	4.25	4.19
			8	
			0.76	0.06
9	Attach tape to N/B	SNLS	5.01	4.95
			9	
			0.59	0.06
10	Set collar and NK band	Table	5.6	5.54
			10	
			0.51	0.06
11	Pick Ready	SNEC	6.11	6.05
			11	
			0.81	0.06
12	Trim and notch collar + N/B	Table	6.92	6.86
			12	
			0.51	0.06
	Earliest Start Time			
	Latest Start Time			
	Operation			
	Float			

Table 2 shows the PERT network for individual tasks from task 5 to task 12 which is collar stitching. The Task 12 which is trim and notch collar which has to be stitched within 6.92 mins EST.

Table - 3: Garment parts assembly; Task 13 – 23 Front plackets and pocket stitching

S. No	Operation	M/c	Time	
13	Patch pocket crease	Table-1	7.43	8.91
			13	
			0.84	0.06
14	Patch pocket hem	SNLS	8.27	8.21
			14	
			0.51	0.06
15	Front marking + Placket mark	Table	8.78	8.72
			15	
			0.73	0.06
16	Crease front placket	Table-1	9.51	9.45
			16	
			0.66	0.06
17	Attach front placket + button placket	SNLS	10.17	10.11
			17	
			0.70	0.06
18	T/S front placket	SNLS	10.87	10.81
			18	
			0.51	0.06
19	Finish placket	SNLS	11.38	11.32
			19	
			0.51	0.06
20	Mark and trim pocket + line match	Table	11.89	11.83
			20	
			0.77	0.06
21	Attach pocket	SNLS	12.66	12.6
			21	
			0.56	0.06
22	Attach pocket	SNLS	13.22	13.16
			22	
			0.56	0.06
23	Front checking	Checker	13.78	13.72
			23	
			0.51	0.06
	Earliest Start Time			
	Latest Start Time			
	Operation			
	Float			

Table 3 shows the PERT network for tasks 13 which is patch pocket creasing has to be carried out in 0.84 minutes and task 23 which is Front part checking which has to be carried out within 13.78 mins. Task 15 to Task 19 is placket stitching and placket finishing. The placket stitching begins at 8.78 mins and is finished at 11.38 mins. Hence it takes 2.6 mins approximately to finish the placket. Pocket stitching begins at 11.89 mins and the task is finished in 13.22 mins, and hence the difference is 1.33 mins which is the stitch time for pocket assembly.

Table - 4: Garment parts assembly; Task 24 – 32 Back yoke, Sleeve Placket assembly

S. No	Operation	M/c	Time	
24	Prepare and tack hanger loop	SNLS	14.29	14.23
			24	
			0.73	0.06
25	Attack BK yoke	SNLS	15.02	14.96
			25	
			0.59	0.06
26	T/S BK Yoke	DNLS	15.61	15.55
			26	
			0.56	0.06
27	Sleeve placket open + mark	27	16.17	16.17
			27	
			0.66	0.06
28	Sleeve fusing attach	SNLS	16.61	16.55
			28	
			0.60	0.06
29	Attach inner placket & tack @ ends	SNLS	17.21	17.15
			29	
			0.67	0.06
30	Crease outer placket	Table-1	17.88	17.82
			30	
			0.84	0.06
31	Attach outer placket	SNLS	18.72	18.66
			31	
			0.61	0.06
32	Attach outer placket	SNLS	19.33	19.27
			32	
			0.61	0.06
	Earliest Start Time			
	Latest Start Time			
	Operation			
	Float			

The back yoke and sleeve placket assembly has been shown in Table 4. The assembly begins at task 24 which is preparing and tacking hanger loop at the centre back yoke is stitched in 14.29 min. Task 26 is turning and stitching back yoke is stitched in 15.61 mins and the difference between task 24 and task 26 is 1.32 mins which is the time required to complete yoke part. Task 27 is sleeve placket opening and mark-

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ing which is done at 16.17 mins and task 32 is attaching outer placket which is stitched at 19.33 mins and the difference between task 27 and 32 is 3.16 min. Hence it takes 3.16 mins to stitch sleeve placket.

Table - 5: Garment parts assembly; Task 33 – 55 Front, Back, Sleeve, Collar, cuff and button

S. No	Operation	M/c	Time
33	Set Front & BK & SLV	SNLS	19.94	19.88 33 0.51	0.06
34	Join Shoulder	SNLS	20.40	20.39 34 0.61	0.06
35	T/S Sh	DNLS	21.06	20.9 35 0.51	0.16
36	Attach Sleeve	Table	21.57	21.41 36 0.56	0.16
37	Attach Sleeve	SNLS	22.13	21.97 37 0.56	0.16
38	T/S Arm hole	SNLS	22.69	22.53 38 0.70	0.16
39	Attach side + T/S	Table-1	23.39	23.23 39 0.77	0.16
40	Attach side + T/S	SNLS	24.16	24 40 0.77	0.16
41	In + out and crease	SNLS	24.93	24.77 41 0.66	0.16
42	Attach Side Seam	5tO/L	25.59	25.53 42 0.44	0.16
43	Attach Side Seam	5tO/L	26.03	26.03 43 0.44	0
44	Attach W/C Label	SNLS	26.47	26.47 44 0.51	0
45	Attach Collar	SNLS	26.98	26.98 45 0.77	0
46	Mark and attach label	SNLS	27.75	27.75 46 0.51	0
47	Finish Collar	SNLS	28.26	28.26 47 0.84	0
48	Atch cuff & finish cuff	SNLS	29.1	29.1 48 0.73	0
49	Top stitch cuff	SNLS	29.83	29.83 49 0.50	0
50	Top stitch cuff	SNLS	30.33	30.33 50 0.50	0
51	Bottom gathering	SNLS	30.83	30.83 51 0.61	0
52	Bottom Hem	SNLS	31.44	31.44 52 0.84	0
53	Bar tack	BT	32.28	32.28 53 0.61	0
54	Mark and sew BH	BH	32.89	32.89 54 0.84	0
55	Checking	Checker	33.73	33.73 55 0.59	0
	END		34.32	34.32 END 0	0
	Earliest Start Time		
	Latest Start Time		
	Operation		
	Float		

The garment parts assembly Front, Back, Sleeve, Collar, Cuff Button and button hole has been shown in Table 5. The assembly begins at task 33 which is setting front, back and sleeve is done in 0.51 min. Task 54 is marking and sewing button hole which is the last assembly task carried out at 33.73 mins, and the difference between task 33 and task 54 is 13.79 mins which is the time required to assemble the garment parts together.

Critical paths

The critical path is the path with the longest span of time and this is the path which requires extreme care of. The critical task is the final garment assembly tasks shown in table 5.

Critical Tasks

The critical tasks have been shown in Figure 1, Figure 2, Figure 3 and Figure 4. All the tasks which are marked in Red color are the critical tasks that is, tasks S, 1, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54 and 55.

CONCLUSION

Program evaluation and review technique is the most accurate means of setting standards upon which production planning and control takes place. There will be no tolerance to waste in any form, whether material, time effort or human ability. It leads to work simplification by enabling a medium skilled employee to work efficiently. It is the basis for increase in productivity and avoids overtime cost. It will lead for timely delivery and increase in the quality and quantity of the product delivered resulting in higher profit. Proper time management carried out using program based evaluation technique method ensures smooth operation function without a break due to continuous orders. Thus PERT is an effective tool followed in apparel production to monitor and evaluate critical tasks to be carried out smoothly.

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