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SMV and Lead Time for T-Shirt Manufacturing

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ABSTRACT : *This study tries to measure the time required for a T-shirt in cutting, sewing and packing section of the garments industry and relate to the SMV (Standard Minute Value). This will help the garments industry to understand and develop the proper time and action calendar in their department. Key part of this study is to determine the time in different sections of garments and make a prediction of the time required from the SMV of the T-shirt and estimate the lead time. Our study relates the actual time required in the industry and then it is adapted to be usable form by SMV. Garments industry may use this type of study in their departments and may build up a proper planning.*

Keywords*–SMV, cutting, sewing, packing, lead time.*

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I. INTRODUCTION

If the factory makes standard product, capacity can be expressed in terms of number of pieces. However, if there is a huge variation in the products produced, then the unit of measure should ideally be number of minutes produced. This is summation of each garment produced multiplied by its standard minute value. Again the lead time is the time period between the placement of an order and the shipment of the completed order to the customer. A short manufacturing lead time is a competitive advantage; many customers want the delivery of their products as soon as possible following the placement of the order. Lead time consists of waiting time before or after actual manufacturing and throughput time. There has been a huge demand to reduce lead times for quicker reach of the product to the market. As, still now garments industry use SMV only to know the efficiency of the garments section in which cutting and packing department are not included, this study will help to improve the time study techniques in the industry. In this study, it is observed that cutting section and packing section of the garments industry use 7% and 29% time in compared to the sewing time. This will help us to estimate the total lead time in these three sections. The main objective of this study is to estimate lead time in the garments industry from the SMV of T-shirt which is considered as sample style in this experiment. It is done after calculation of the actual time and then compared with the SMV. IE tools like time study and method study is used to determine the time required in the cutting, sewing and packing section of garments industry. Then the time is compared among these three departments. Finally time is calculated from the SMV to determine the lead time in these sections.

II. LITERATURE REVIEWS

Most labor intensive part of garments industry is joining together of components called sewing. Due to having priority to some works before assembling, the structure became more complex [1]. So, planning is important for the proper sequential production [2] As a consequence, to increase the efficiency and quality of production, good line balancing and planning are required [1-3]. The production process includes a set of workstations (employees, bundles of sub-assemblies for producing different styles simultaneously) [1]. An assembly line is defined as a set of distinct tasks which is assigned to a set of workstations linked together by a transport mechanism under detailed assembling sequences specifying how the assembling process flows from one station to another [4]. In a detailed work flow, synchronized line includes short distances between stations,

low volume of work in process, precise of planning of production times, and predictable production quantity [5]. Nowadays, shorter fashion cycle requires shorter lead time with smaller order. This demands flexible layout with efficient and quick response production system. This is to manufacture products in smaller and smaller batches[6]. For this reasons, new demand is to keep product lead times (both development and manufacturing times) as small as possible. Again, increased product customization needs more number of parts in a product family. As a result batch sizes have reduced and continue to shrink [7]. Thus, sometimes a unit might need to produce multiple orders in a single day. This calls for higher flexibility in terms of volume and style change over [8]. It corresponds to the time required to go from the end of the last good part from one batch to the time when the first good part of the new style is produced [9]. To achieve this approach, work-time study, assembly line balancing and simulation can be applied to apparel production line to find alternative solutions to increase the efficiency of the sewing line [10].

Garment manufacturing units in India are embracing and adopting the various new manufacturing concepts like 5S, Kaizen, Poka Yoke, SMED (Single Minute Exchange of die), DMAIC analysis etc. All these efforts are to reduce the through put time of a garment which includes cutting, sewing and packing. With the lead time getting shorter and order quantity getting smaller it has become imperative for manufacturing units to develop flexible production systems and quick change over systems from one style to another. Quantities and complex design the production line setup has shrunk to such level that sometimes a unit might need to produce multiple orders in a single day. This calls for higher flexibility in terms of volume and style change over [7-8]. Therefore, garment production needs properly rationalized manufacturing technology, management and planning [11]. In garment production, until garment components are gathered into a finished garment, they are assembled through a sub-assembly process [12].

Overall, the important criteria [11] in garment production are-

- Whether assembly work will be finished on time for delivery,
- How machines and employees are being utilized,
- Whether any station in the assembly line is lagging behind the schedule and how the assembly line is doing overall

In garment production there are some important criteria which affect the flexibility and also the overall planning like right time delivery, utilization of machine and manpower, overall performance of assembly line. In assembly line planning set up time is a vital issue which means the time required for starting the first item of new batch after accomplishment of last item of last batch, as new setup is applied in this case [13-14]. In this case, SMED (Single-Minute Exchange of Die) is applied to reduce the lead time as well. Assembly line configuration is dependent on capability of producing the variety of product such as single model, mixed model and multi-model for single, multiple and sequences of batches respectively [15-17]. But, assembly line balancing problems are to be removed for minimizing the number of workstations, labor costs, spaces required, cycle time to maximize production rate and workload smoothness for a given number of workstations for increasing efficiency [18-19]. The effective factors behind the production efficiency are machine problem, sewing problem, shade variation, late come, size mistake, cutting problem, accessories problem, delay input, 5S, 7 Wastages, salary based/piece rated operator and power failure [20]**.**Here, this study is to help the production and planning department to understand the smooth flow of work in cutting, sewing and packing sections.

I. OBJECTIVES OF THE STUDY

- Study the actual time in cutting, sewing and packing.
- Calculate time required in these sections for the style
- Estimate the lead time using this time study from SMV.

II. SIGNIFICANCE OF THE STUDY

- This study will help the industry to estimate the time required in the cutting, sewing and packing section.
- This will help the planning and production department to know the lead time required in their department for different styles.
- To ensure the perfectly satisfy the customer by delivering the product on time.

III. Problem Statement

SMV is used to set the planning in sewing department only. But, cutting and packing is not considered as time study is not used in a proper planned way so that it can be linked to the sewing department. Hence, it is crucial to establish time required among these department of the garments industry and estimate the lead time required in these sections.

IV. RESEARCH DESIGN AND METHODOLOGY

4.1. Research Design

In this study a target production line of 10020 pieces of T-shirts is selected for time study using stop watch tools to take the time required for each operation in cutting, sewing and packing sections. Time measured in cutting section: In cutting section the fabric is laid in layers and cut different sizes of garments pieces at a time. Then bundling and numbering are performed. To get the time for one piece, the total time required for cutting is divided by the number of pieces cut and the number of workers used. Time measured in sewing section: In sewing department time is taken for each operation and actual SMV is calculated according to the following formula for each piece of garments. Time measured in cutting section: In packing sections garments are being packed into the cartoon. So, the total time required for cartooning is divided by number of worker engaged and the number of pieces packed. Finally the total time used per pieces in the cutting, sewing and packing is calculated and the overall efficiency achieved in comparison to the SMV of the garments is measured. Then, the target working days required are measured which is the main objective of this study.

4.2. Methodology

a. Study of the productivity of factories
b. Operation breakdown for selective style in manufacturing department so that process and manpower required for each could be established
c. Analysis of the activity with time line and noting down all the value added, non-value added and necessary non value added elements.
d. Comprehensive detailing of manpower required for each operation and establishing a standard ratio based on the study
e. The comparison would involve the following-

- Manpower requirement and machinery required in the styles
- Operation productivity comparison chart
- Time required for each operation
- Implementation and suggestions [21].
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4.3. Scope

This study will give an idea how the lead time in garments section can be utilized from the SMV of the specific styles. This will facilitate the planning in the industry for quick style change and sequential production planning.

4.4. Limitations

- Only one style of garments is considered in this study.
- The assumption is derived from the actual time required in the production floor.
- Only cutting, sewing and packing sections are considered in this study which does not represent the actual lead time. But, this is a part of the whole.
- Here, the skills of the operators are assumed same throughout the study. But, this will certainly vary according to their experiences, learning skill, motivation and for other reasons.

4.5. Tools for collecting data

The collection of data is done through direct observation time and method study of the different operations to manufacture a T-shirt of cutting, sewing and packing department.

4.6. Methods for analysis

- Comparison with standard
- Time study
- Efficiency and man power study
- Lean manufacturing techniques.

V. RESULTS AND DISCUSSION

Table 1: Time required in cutting section

Operations	Man power	Time required in sec.	Time required in Min.
Layer	4	12.87	0.21
Cutting	2	3.82	0.06

Numbering and bundling	3	14.08	0.23
Total Man power	***9***	***Total time in min. per pc.***	***0.51***

From table 1, in cutting section total 9 man power were used, and the time per pieces of product required is 0.51 min.

Table 2: Time required in sewing section

Name of Operation	**Machine Type**	**Standard Time (SMV)**	**Balanced man power req. for 100%**	**Actual Time in min per operation**		
				Obs-1	Obs-2	Obs-3
Care Label Tack at back part	Single Needle	0.23	1	0.33	0.30	0.28
Front and Back part Sticker Match	Manual	0.25	1	0.40	0.33	0.30
Shoulder Joint and half fold	Over lock	0.40	2	0.63	0.53	0.50
Neck Make	Single Needle	0.20	1	0.32	0.30	0.32
Neck Joint	Over lock	0.26	1	0.42	0.40	0.37
Back Tape binding	Flat lock	0.22	1	0.35	0.33	0.32
Back Tape topstich	Single Needle	0.33	2	0.53	0.55	0.45
Sleeve and body Sticker Match	Manual	0.24	1	0.38	0.33	0.35
Sleeve joint	Over lock	0.50	3	0.80	0.83	0.77
Side seam joint	Over lock	0.75	4	1.20	1.13	1.08
Thread cut, Sticker remove & Turn Body	Manual	0.26	1	0.42	0.38	0.37
Body Hem	Flat lock	0.25	1	0.40	0.42	0.38
Bottom hem thread cut & arrange body	Manual	0.23	1	0.37	0.35	0.38
Sleeve Hem	Flat lock	0.40	2	0.63	0.67	0.62
Sleeve hem thread cut	Manual	0.26	1	0.42	0.40	0.38
	SMV	***4.78***	***26***	***7.60***	***7.27***	***6.87***
Avg. actual min required per piece						***7.24***

From table 2, the SMV of the t-shirt is 4.78 and the actual average time used per piece is 7.24 min where, to balance the line to achieve target production man power used 26.

Table 3: Time required in packing section

Name of Operation	**pcs.**	**Time per pc. (sec)**	**Time (min)**	**Man Power Used**
Ironing	10020	42	0.70	3
Checking & Measuring	10020	17	0.28	2
Hangtag	10020	3	0.05	1
Final Checking	10020	14	0.23	1
Folding	10020	12	0.20	0.5
Poly Packing	10020	9	0.15	0.5
Cartooning (P1)	6020	15	0.25	1.5
Cartooning (P2)	4000	12	0.20	1.5
Total min. per pc.			***2.07***	***11***

From table 3, the time required for the packing each piece of garments is 2.07 min.

Table 4: Efficiency considering all three sections

Sections	**SMV**	**Time in min. per pc.**	**In %**	**In terms of SMV the time in min**
Cutting	1)	0.51	0.07	0.34
Sewing	4.78	7.24	1.00	4.78
Packing	2)	2.07	0.29	1.37
Total	***4.78***	***9.82***	***3)***	***6.48***
Day required for production of 10020 pieces	$\frac{10020 \times 4.78}{26 \times 60 \times 8} = 3.84 \approx 4$	$\frac{10020 \times 9.82}{26 \times 60 \times 8} = 7.88 \approx 8$		$\frac{10020 \times 6.48}{26 \times 60 \times 8} = 5.20 \approx 6$

Now, from table 4, the total time per piece of garment required 4.78 min, 9.82 min and 6.48 min from smv, actual time and considering cutting and packing with sewing SMV considering percentage of used in cutting and packing. Then, the new SMV of the t-shirt is used to calculate the time to for completing 10020 pieces of t-shirts. Here, the number of days required to complete all the tasks in the three departments

simultaneously show 6-8 days from the SMV and actual time used. It is very interesting that the addition of time for cutting and sewing to the SMV the days required at 100% efficiency by balancing 26 man powers will need 6 days to complete the production. Hence, the production planning department may use this result if the cutting and sewing section uses same number of workers in their department.

VI. CONCLUSION

This study is completely based on only one style of the industry. Hence, if all styles can be included the overall planning and lead time as well as efficiency of the industry can be estimated. But, from this study it is observed that the time required in cutting and packing section is 7% and 29% of the time that is required in sewing section. Hence, production planning department can add this time during the estimation of lead time to ensure the delivery on time. In the same way, if it applied for the all styles running in the production floor the planning department will be more efficiently determine the lead time of their industry. As this experiment is based on only one style of T-shirt manufacturing, the result may vary on basis of the exercise and the skills of the operators of other industry. But, this will open the way for further study in this field. Hope, production department and planning department will be benefited from this type of study in the long run. Every element of the production lines should be included in the time study which is a limitation. The more close observation of those elements may increase the accuracy in this type of study. Though, SMV is generally used in the sewing section, it can be introduced in the other department as well to estimate the efficiency. To estimate the lead time completely the full time study from the start of the work order to delivery to customer should be done in the future work.

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