EFFECTIVE WAY TO ESTIMATE THE STANDARD MINUTE VALUE (SMV) OF A T-SHIRT BY WORK STUDY

Habibur Rahman
Lecturer, Department of Textile Engineering, Bangladesh University of Business and Technology, Dhaka, Bangladesh
Prashanta Kumar Roy
Rezaul Karim
Lecturer, Department of Textile Engineering, European University of Bangladesh, Dhaka, Bangladesh
Prodip Kumar Biswas
Executive, Research and Development Department, Impress-Newtex Composite Textile Limited, Mirzapur, Tangail, Bangladesh

Abstract

This study is based on calculation of standard minute value (SMV) of a T-shirt by determining the manpower and machine allocation for particular target. An experimental investigation for the distribution of SMV for each and every operation requires for making a T-shirt and provides a clear and detail concepts for determining line balancing, machine requirements, man power allocation, operational sequence of the manufacturing process for setting a definite target within a reasonable efficiency. This study is a detailed discussion and distribution of SMV of a T-shirt by work study which will assist to minimize the SMV for having a better synchronization with man, machine, materials and methods to achieve higher efficiency. A general overview over efficient productive method to make a T-shirt is given in this paper.

Keyword: SMV, T-shirt, Work study, Line balancing, Operation break down

Introduction

A T-shirt (or T shirt, tee-shirt, or tee) is a style of shirt. A T-shirt's defining characteristic is the T shape made with the body and sleeves. It is normally associated with short sleeves, a round neck line known as a "crew neck" and no collar. There are different kinds of T-shirt available in market and sewn in the readymade garments manufacturing companies such as, V neck T-shirt, Round neck, T-shirt with neck and without neck, short sleeve and long sleeve T-shirt, T-shirt with slit band and without slit band. Typically made of cotton fibers knitted in a jersey stitch, they have a distinctive soft texture compared to woven shirts. The manufacture of T-shirts has become highly automated and may include fabric cutting by laser or water jet. Today's business climate for clothing manufacturers requires low inventory and quick response systems that turn out a wide variety of products to meet customers demand. It is especially in the apparel industry that managers are trying to develop their current systems or looking for new production techniques in order to keep pace with the rapid changes in the fashion industry. To develop a new system, good observation is needed. However to observe real manufacturing systems is very expensive and sometimes cumbersome. Therefore garment production needs properly rationalized manufacturing technology, management and planning (Glock, 1995). In garment production, until garment components are gathered into a finished garment, they are assembled through a sub-assembly process. The production process includes a set of workstations at each of which a specific task is carried out in a restricted sequence, with hundreds of employees and thousands of bundles of sub-assemblies producing different styles simultaneously (Chuter, 1988). The joining together of components, known as the sewing process which is the most labor intensive part of garment manufacturing, makes the structure complex as the some works has a priority before being assembled (Cooklin, 1991). Furthermore since sewing process is labor intensive apart from material costs, the cost structure of the sewing process is also important. Therefore this process is of critical importance and needs to be planned more carefully (Tyler, 1991). As a consequence good line balancing with small stocks in the sewing line has to be drawn up to increase the efficiency and quality of production. In assembly line balancing, allocation of jobs to machines is based on the objective of minimizing the workflow among the operators reducing the throughput time as well as the work in progress and thus increasing the productivity. 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 (Eberle, 2004). 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 (Kursun, 2009).

Methodology

To make a T-shirt Single jersey knitted fabric for body, Rib for neck, Sewing thread, Pattern paper, Measuring Tape, Scissor, Pencil, Eraser, Curve

Ruler etc are required. The various component of a T-shirt are neck, front part, back part, sleeve and hem.

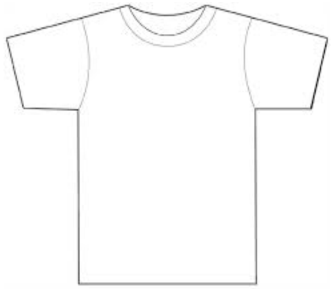


Figure: T-shirt outline.

Making Process of T-shirt

Prepare the fabric booking
↓
Prepare the accessories booking
↓
Quality check of fabric
↓
Fabric cutting
↓
Size set & PP sample
↓
Sewing
↓
Inspection
↓
Finishing

Machine sequence of T-shirt manufacturing process

Number matching front to back part
↓
Shoulder joining (by over lock machine)
↓
Neck joint (by plain machine)
↓
Neck over locking (by over lock machine)
↓
Neck piping round the neck (by flat lock machine)
↓
Round neck edge tack (by plain machine)
↓
Back tap top stitch (by plain machine)
↓
Main label attaching (by plain machine)
↓
Sleeve hem (by flat lock machine)
↓
Sleeve Joint (by over lock machine)
↓
Side Seam (by over lock machine)
↓
Care label joining (by plain machine)
↓
Side top stitch (by flat lock machine)
↓
Neck top stitch (by flat machine)
↓
Bottom hem (by flat lock machine)
↓
Inspection

Process layout and line balancing of T-shirt

There are various types of operations, machines and stitches used for making a T-shirt which are enlisted to the given table consecutively with proper man power. This information will provide a complete idea to calculate the SMV for making a T-shirt.

Table-1: Process layout and line balancing of T-shirt.

Sl no.	Name of operation	Machines	Stitch type	Man power	
				Helper	Operator
01.	Number matching front to back part	-	-	1	-
02.	Shoulder joining	Over lock	Over edge Stitch	-	1
03.	Neck make	Single needle lock stitch	Lock Stitch	-	1
04.	Neck joint	Over lock	Over edge Stitch	-	1
05.	Neck piping round the neck	Flat lock	Chain / Flat bed Stitch	-	1
06.	Round neck edge tack	Single needle lock stitch	Lock Stitch	-	1
07.	Back tap top stitch	Single needle lock stitch	Lock Stitch	-	2
08.	Main label attaching	Single needle lock stitch	Lock Stitch	-	1
09.	Sleeve hem	Flat lock	Chain / Flat bed Stitch	-	1
10.	Sleeve match	Helper	–	1	-
11.	Sleeve Joining	Over lock	Over edge Stitch	-	2
12.	Side Joining	Over lock	Over edge Stitch	-	3
13.	Care label joining	Single needle lock stitch	Lock Stitch	-	1
14.	Body turning	Helper	-	1	-
15.	Side top stitch	Flat lock	Chain / Flat bed Stitch	-	2
16.	Neck top stitch	Flat lock	Chain / Flat bed Stitch	-	1
17.	Bottom hem	Flat lock	Chain / Flat bed Stitch	-	1
Total				3	19

From this table it is estimated that total number of man power is 22 needed to complete the related operation for making a T-shirt.

Formula of SMV and targeted production calculation for T-shirt

To convert cycle time to normal or basic time needs to multiply it with operator performance rating. Now allowances for machine, fatigue and personal needs etc have been added. Machine allowance only to those elements where machine is running, fatigue and personal needs to all elements is added. Finally standard time for each element in seconds is found by summing up all elemental time and then seconds is converted into minutes. This is known as Standard Minute Value (SMV).

Let,
Cycle time = 36 sec.
Performance rating = 80%
Bundle allowance, machine allowance & personal allowance = 20%
SMV or Standard Minute Value
= Normal or Basic time + Allowance%
= [(Cycle time (Second) / 60) x Performance rating %] +Allowance %
= [(36/ 60) x 80/100] + Allowance%
= 0.48 + [(20 x 0.48)/100]
= 0.48+0.096
= 0.576 minute

Targeted production = $\frac{\text{Number of worker}\times\text{Working hour}\times 60}{\text{Total SMV}}$ x Expected Efficiency%

$= \frac{22\times 1\times 60}{6.48}$ x 90%

= 183 pieces.

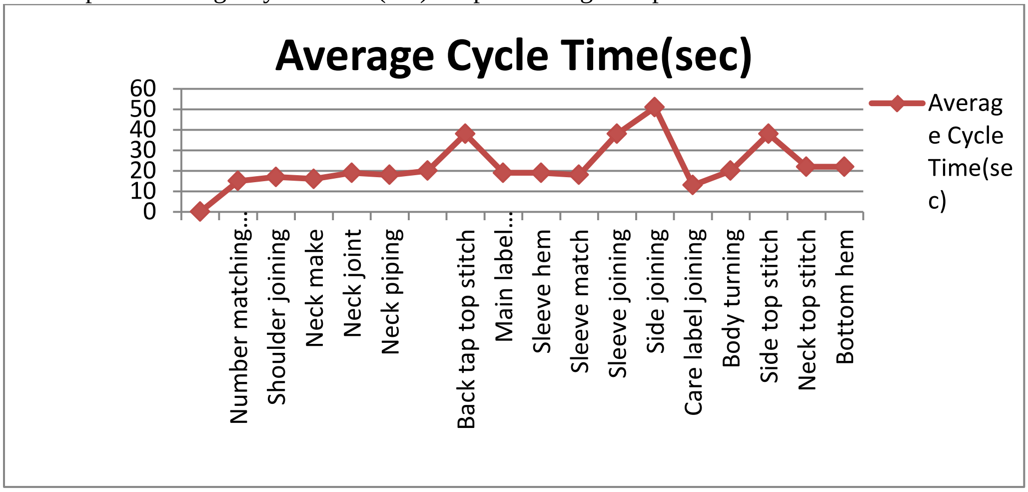
Result and discussion

The following table denotes the estimated SMV of operations to the respect of average cycle time by considering 20% job allowances.

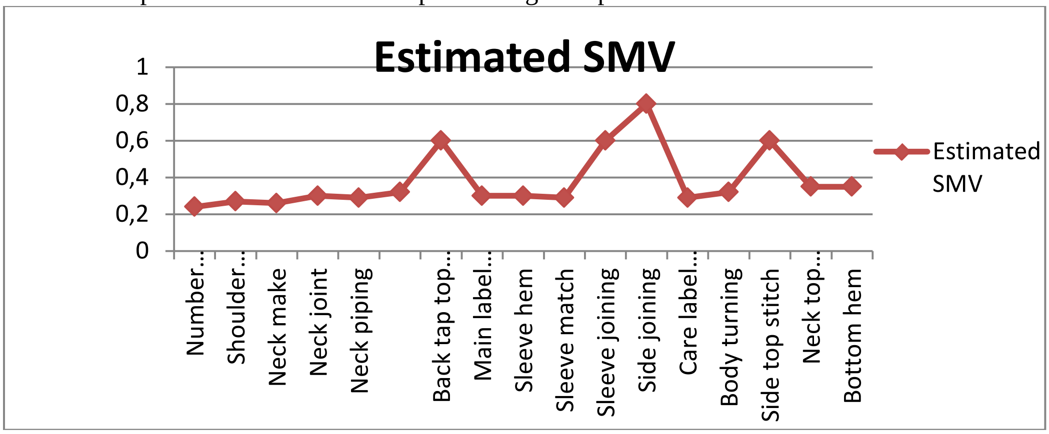
Table-2: Calculated SMV for a T-shirt.

Sl no.	Operation	Average Cycle time(sec)	Estimated SMV
01.	SMV for Number matching front to back part	15	0.24
02.	SMV for Shoulder joining	17	0.27
03.	SMV for Neck make	16	0.26
04.	SMV for Neck joint	19	0.30
05.	SMV for Neck piping	18	0.29
06.	SMV for Round neck edge tack	20	0.32
07.	SMV for Back tap top stitch	38	0.60
08.	SMV for Main label attaching	19	0.30
09.	SMV for Sleeve hem	19	0.30
10.	SMV for Sleeve match	18	0.29
11.	SMV for Sleeve joining	38	0.60
12.	SMV for Side joining	51	0.80
13.	SMV for Care label joining	13	0.29
14.	SMV for Body turning	20	0.32
15.	SMV for Side top stitch	38	0.60
16.	SMV for Neck top stitch	22	0.35
17.	SMV for Bottom hem	22	0.35
Total SMV			6.48

Graph-1: Average Cycle Time (sec) for performing the operations to make a T-shirt.



Graph-2: Estimated SMV for performing the operations to make a T-shirt.



Number of man power required to stitch a garment against a particular line target vary according to the type and style that is selected to stitch hence SMV of the T-shirt vary according to the style and number of operations carried by a T-shirt and according to the style that can be defined as basic or critical. The estimated results have been presented in the mentioned table-2. From the table-1 it is worked centering a semi critical T-shirt which contains the parts as front part, back part, neck, sleeve and hem. Again from the table-1 it is found that the number of single operations required to stitch the T-shirt is 17 (including operators and helpers) and total number of man power is 22 (19 operators and 3 helpers). In table-2, four operations contain the SMV above 0 .50 for which to achieve target around 180 pieces of T-shirt per hour that had to set double man powers whom can be used for other non value added job such as thread trimming, body turning etc. Finally it is found from the table-2 that the SMV is 6.48 for the above mentioned T-shirt.

Conclusion

This research is based on an effective layout model of T-shirt where to use balancing process using short cut method. Here it is suggested to follow pitch diagram method to identify bottleneck operations and to solve the problem by 100 percent balancing. During the research it is seen thread trimming is being done manually using helper which is non value added unnecessary operation can be removed by setting auto trimmer along with machine or by using auto machine. The study shows that this balanced layout model has brought a better synchronization among man machine and materials increasing the efficiency and productivity. Traditionally operated garment industries are facing problems like unnecessary operations, wastage, rejection, poor line balancing etc. This problem can be eradicated by getting used with 5S (Sort, Set in order, Shine, Standardization and Sustain) method and making the working environment totally visualized. Here to achieve better quality and cost effective production Standard Operation procedure (SOP) is followed. By following SOP unnecessary operations are being able to find and due to follow standard procedure wastage and rejection will gradually come down at a tolerable level to zero. Thereafter in this way expected productivity and efficiency can be obtained which is the main goal of this research.

References:

Glock, R. E. and Kunz, G. I. Apparel Manufacturing-Sewn Product Analysis. New Jersey: Prentice Hall, 1995

Chuter, A. J. Introduction to Clothing Production Management. Oxford: Blackwell Science, 1988

Cooklin, G. Introduction to Clothing Manufacturing. Oxford: Blackwell Science, 1991.

Tyler, D. J. Materials Management in Clothing Production. London: BSP Professional Books Press,1991

Eberle, H., Hermeling, H., Hornberger, M., Kilgus, R. ,Menzer, D. and Ring, W. Clothing Technology. Berlin: Beuth-Verlag GmbH, 2004

Kursun, S. and Kalaoglu, F. Simulation of Production Line Balancing in Apparel Manufacturing. Eastern Europe: FIBRES & TEXTILES, 2009