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Analysis on SMV to Increase Productivity in Sewing Section: A Case Study on T-Shirt Manufacturing in Bangladesh

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***ABSTRACT** : This study tries to measure the Standard Minute Value (SMV) and related production efficiency for a T-shirt in the sewing section of a Garment industry with a view to find out the way to decrease SMV as well as to increase productivity. Apparel manufacturing industries are constantly under pressure to meet lead times, thereby searching for new tools and techniques to improve efficiency in the production floor. Readymade Garments industries may use this type of time and motion study in their department to build up a proper planning by removing bottlenecks.*
***KEYWORDS**: SMV, Sewing Section, Efficiency, Productivity.*

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I. INTRODUCTION

Most intensive part of a garment industry is the joining together of different parts through sewing. Assembling apparel is a laborious and complex process which has much impact on production performance and product quality [4]. So planning is important for the proper sequential operation that results in optimum production [7]. A simple tee-shirt producing sewing line consists of 25-50 workers with 18-40 sewing machines. So capacity variation occurs here very frequently as working capacity differs from men to men. When worker changes capacity of work also changes accordingly. For this type of variation balancing the maximum and minimum capacity is a challenging step for floor managers. Again garment industries in developing countries like Bangladesh are more focused on sourcing the raw materials and changing the cost of manufacturing charge because of the availability of cheap labor. Most of the apparel industries follow progressive bundle production system. This production system has many problems and bottleneck is one of them [9].

Time study is a work measurement technique for recording the times of performing a certain specific job or its elements carried out under specified conditions, and for analyzing the data so as to obtain the time necessary for an operator to carry out at a defined rate of performance. Time study is most popular that is used for balancing the sewing line as well as solving the bottlenecks. 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 [11]. 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 [1].

Standard Minute Value is the time required to complete a specific task or operation under certain conditions and parameters maintaining standard method and efficiency. A study measured SMV of T-shirt as 6.48 min assigning performance rating 80 [10]. In sewing section, it found that garments workers spend 72.7% time in productive activities and the 23.2% time in personal allowances and unavoidable delay [5]. Another study revealed that the sewing operators engaged in 40% time in main operation, 33.25% time in associated operation and rest of 26.7 % time in allowances [12]. As a consequence, to increase the efficiency and quality of production, planning is required; SMV helps in proper planning [3]. From the literature review based on Bangladesh Garments Study, it is found that the different researchers rate the workers differently on their own views, experience and perception in a study [6]. SMV of T-shirt is measured as 14 min assigning performance rating 110.

This study tries to explore possible ways to decrease SMV to increase production per hour. For this, physical observations were carried out at the sewing section of GMS Knit Composite industry; primary data were collected for a similar order of two different dates where improvements were observed in second phase.

That information was analyzed, changes were identified and reasoning is revealed at this paper.

II. TERMS AND DEFINITIONS

Cycle time: Cycle time is defined as the time duration from starting point of a job to the starting point of the next job. It is the total time taken to do all works to complete one operation, i.e. time from pick up part of first piece to next pick up of the next piece [11, 12]. Cycle time = Machine time + Material Handling time
SMV: The amount of time required to complete a specific job or operation under existing condition, using the specified & standard method at a standard pace when there is plenty of repetitive work [9].
Basic time: Basic time of a job is determined by multiplying rating factor to the observe time (Cycle time). Basic time = (Observe time × Performance rating) / 100
Standard time = (Average observed time x Rating %) + Allowance %.
Allowance: Different types of allowances are allowed in apparel production floor. Such as personal time allowance, Delay allowances, Fatigue allowances etc.
Efficiency: Efficiency is the comparison of what is actually produced or performed with what can be achieved with the same consumption of resources [6].
Sewing line efficiency = Total Produce minute / Total available minute
Rating= the pace or speed of operation at which the operator is performing the job.
Observed time can be found by the time necessary to complete an operation. This observed time calculated by stop watch. Ratting is an evaluation of efficiency. This ratting is done by the operator who is performing the job. It can be measured by an observer who experienced in specific job which is being observed.
Cycle time:
Performance rating: Rating is a subjective comparison of any condition or activity to a bench mark best upon our experience.
Bundle allowance: Sewing operators need to open the bundle before starting sewing. So, the time needed to open the bundle is known as bundle time.
Machine allowance: Sometime garment machines are off due to mechanical or technical problems. This time is called machine allowance.
Balance: Balance is an important factor. In traditional performance measurement approach, the most important goals of evaluation is performance measurement while modern approach has focused on evaluated growth and development capacity [1].
Bottleneck: A constraint for smooth flow of operation, limits the flow of production rate, productivity, efficiency is usually termed as bottleneck. Non-productive time: Time not directly associated with manufacturing operations or performance of a job or task [9].

General formula of SMV is given below-
SMV= Basic time + Allowance Where,
Basic time= Observed time × Rating/ 100
Allowance= Relaxation allowance + Contingency allowance + Machine Delay Allowance.

III. METHODOLOGY

All relevant data used in this paper were collected from different units of GMS Composite Knitting Industries Limited, Bangladesh. The case study was conducted on a similar style of order and background information was also collected accordingly. At first, sewing lines were observed where a particular style and order of "Tee" item is sewn. Secondly, it was compared with the previous available record of that particular style and tried to find out the changes from two layout sheets from two different dates. Machine SMV, Operator and Helper SMV, Total SMV, Efficiency were calculated. Thirdly, tried to find out the reason behind higher production in second lay out sheet of recent date and impact of SMV on productivity was marked. Fourthly, changes behind the improvement in terms of production efficiency were presented accordingly. Besides, backward linkage information like fiber, yarn, knitting, dyeing, washing, and finishing specifications were also gathered from different sections and disclosed for that particular item.

IV. MATERIALS AND MACHINES

Fiber, Yarn, Fabric Specification
Fiber:
Fiber Name : Cotton Fiber
Brand Name : Nahar

Source : India
Yarn:
Yarn Type : Combed
Count : 26 Ne

Fabric:
Fabric : 100% Cotton.
Knitted type : Weft
Fabric dia & gauge : 30 inch dia and 24 gauge
Fabric GSM : 180

Process and Machine Specification:
Knitting, Dyeing, Washing, Finishing, Sewing specifications are described below:
Knitting Specifications
Machine No : 96-100
Machine Name : Mayer & Cie
Origin : Germany
Volt : 180-220v A/C
Frequency : 50-6- HZ
Max : 6A
Model : Relanit1.6R
Year : 2004
Machine Gauge : 24
Diameter : 30 inch
Needle Brand : Groz, Bakert
Sinker : Ruster
Required Oil : 100-105 Drops
Average Speed : 25 rpm
Mayer Container : 1.8 kg
Count : 26 Ne
Knitted Type : Weft
Fabric Type : Pique
GSM : 180
Yarn Type : Combed

Dyeing Specification
Machine No : 09
Machine Name : KTM
Capacity : 500 KGS
Pressure : 3.7 bar
Dyeing Method : CPB Dyeing
Dye Name : Reactive Dye (Cold Brand)
Dye Brand : Huntsman (West Singapore)

Dyeing Process Applied
Scouring (40 Mins, 100^{o} C) → Enzyme (50/60 Mins, 55^{o}C) → Wash until water clearing (20/30 Mins) → Normal leveling (5 Mins, 40^{o}C) → Salt (10/5 Mins, 40^{o}C) → Color (20/30 Mins, 40^{o}/50^{o}C, NT) → Soda (20/30 Mins, 40^{o}/50^{o}/60^{o}C) → Color Steam (60 Mins, 100^{o}C) → VD-Wash (to remove fad-effect due to soda, salt) → CNW hot (10 Mins, 80^{o}C) → Softener (15 Mins, 40^{o}C) → Shade Card Check → Unloading

Washing
Wash **:** Washable Wash (Acid Wash)

Washing Process Applied:
Hot Steam (10 Mins, 70^{o} C) → Rins 3 times → MAC chemical: (In cold 5 Mins & in hot 60^{o} C, 10 Mins) → Soda → Run (60 ^{o} /65 ^{o} C, 16 Mins) → Rins 1 time → Ashu fix w (cold, 5 Mins) → Mixing (2-5 Mins) → Hot wash (70 ^{o} C, 15 Mins) → Glauber Salt (15 Mins) → Wash → PH Check → Runs (5 Mins)

Finishing Specification

Stenter Machine : Bruckner
Origin : Germany
Type : Power Pad
Steam Pressure : Max 7 bar

Finishing Process: -
Back Burner → Blower → Cooling Zone → Output

Sewing Specification
Sewing Machine Name : Brother & Pegasus (MX Series)

Sewing Process: -
Back and front part match & size sticker attach → Shoulder join and fold → Neck piping → Piping cut & stich open → Piping inner tack → Neck close → Back tape piping & cut → Back tape close → Sleeve pair → Sleeve match with body → Sleeve join → Sticker remove & thread cut → Care label make → Side seam → Check thread cut & fold → Sleeve hem→ Check & thread cut → Body hem → Check & thread cut and inspection

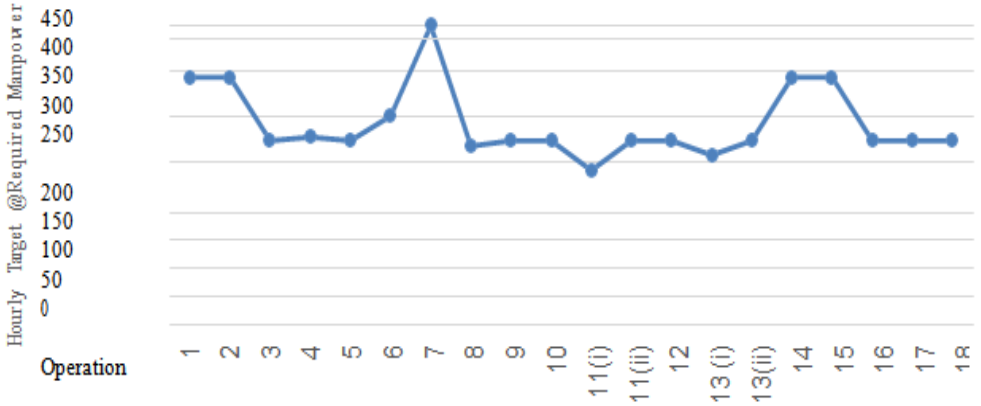
V. FINDINGS & ANALYSIS

Layout Sheet -1:
SMV Calculation, Daily Production Target on Date **5-Jul-2017**

BUYER	J & J	
STYLE	JOR BUNED TEE SS	
ITEM	TEE	
QTY	16932	
OP+HP	18	13
TOTAL MANPOWER	31	

M/C SMV	3.73
HP SMV	2.67
TOTAL SMV	6.40
EFICIENCY %	84
TARGET / hr	243
DAILY TARGET	2427

Sl No	Operation Description	M/c Type or done by helper	SMV	Hourly Potential @100%	Hourly Target @Required Manpower	Daily Potential @100%	Operator	Helper
1	Back & Front Part Match & Size Sticker Attach	HP	0.35	171	343	3429		2
2	Shoulder Join & Fold	40L	0.35	171	343	3429	2	
3	Neck Piping	40L	0.22	273	273	2727	1	
4	Piping Cut & Stich Open	HP	0.65	92	277	2769		3
5	Piping Inner Tack	SN	0.22	273	273	2727	1	
6	Neck Close	40L	0.20	300	300	3000	1	
7	Back Tape Piping &Cut	2FL	0.30	200	400	4000	2	
8	Back Tape Close	SN	0.45	133	267	2667	2	
9	Sleeve Pair	HP	0.22	273	273	2727		1
10	Sleeve Match With Body	HP	0.22	273	273	2727		1
11	Sleeve Join	40L	0.50	120	240	2400	2	
	Sticker Remove & Thread Cut	HP	0.22	273	273	2727		1
12	Care Label Make	SN	0.22	273	273	2727	1	
13	Side Seam	40L	0.70	86	257	2571	3	
	Check, Thread Cut& Fold	HP	0.22	273	273	2727		1
14	Sleeve Hem	3FL	0.35	171	343	3429	2	
15	Check & Thread Cut	HP	0.35	171	343	3429		2
16	Body Hem	3FL	0.22	273	273	2727	1	
17	Check & Thread Cut	HP	0.22	273	273	2727		1
18	Final Check & Thread Cut	HP	0.22	273	273	2727		1
							18	13



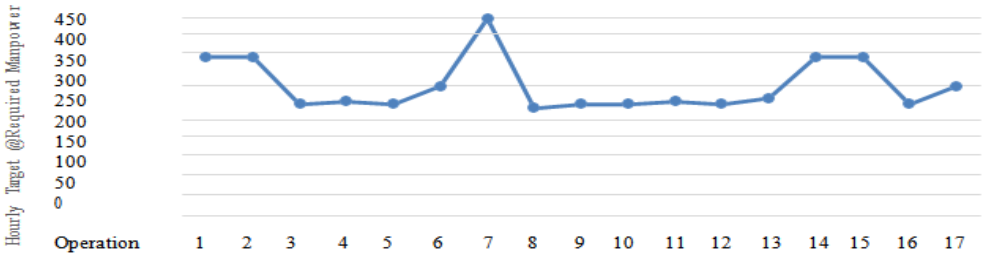
Graph-1: Operation vs hourly target for manpower

Layout Sheet -2:
SMV Calculation, Daily Production Target on Date **3-Jan-2018**

BUYER	J & J	
STYLE	JOR BUNED TEE SS	
ITEM	TEE	
QTY	16932	
OP+HP	20	10
TOTAL MANPOWER	30	

M/c SMV	4.03
HP SMV	1.99
TOTAL SMV	6.02
EFICIENCY %	84
TARGET / hr	250
DAILY TARGET	2497

Sl No	Operation Description	M/c Type or done by helper	SMV	Hourly Potential @100%	Hourly Target @Required Manpower	Daily Potential @100%	Operator	Helper
1	Back & Front Part Match & Size Sticker Attach	HP	0.35	171	343	3429		2
2	Shoulder Join & Fold	40L	0.35	171	343	3429	2	
3	Neck Piping	40L	0.22	273	273	2727	1	
4	Piping Cut & Stich Open	HP	0.65	92	277	2769		3
5	Piping Inner Tack	SN	0.22	273	273	2727	1	
6	Neck Close	40L	0.20	300	300	3000	1	
7	Back Tape Piping &Cut	2FL	0.30	200	400	4000	2	
8	Back Tape Close	SN	0.45	133	267	2667	2	
9	Sleeve Pair	HP	0.22	273	273	2727		1
10	Sleeve Match With Body	HP	0.22	273	273	2727		1
11	Sleeve Join, Sticker Remove& Thread Cut	40L	0.65	92	277	2769	3	
12	Care Label Make	SN	0.22	273	273	2727	1	
13	Side Seam & Fold	40L	0.85	71	282	2824	4	
14	Sleeve Hem	3FL	0.35	171	343	3429	2	
15	Check & Thread Cut	HP	0.35	171	343	3429		2
16	Body Hem	3FL	0.22	273	273	2727	1	
17	Check & Thread Cut	HP	0.20	300	300	3000		1
							20	10



Graph-2: Operation vs hourly target for manpower

VI. DISCUSSION

Comparison between Two Layouts

Sl No	Description	Layout - 1	Layout - 2
1	Total Helper	13	10
2	Total Operator	18	20
3	Total Manpower	31	30
4	M/C SMV	3.73	4.03
5	Helper SMV	2.67	1.99
6	Total SMV	6.40	6.02
7	Target/hour	243	250
8	Daily Target	2427	2497

In the first layout sheet of 5th July 2017, Total SMV = 6.40, Target/hour = 243 and Daily Target = 2427. In the second layout sheet of 3rd Jan 2018, Total SMV = 6.02, Target/hour = 250 and Daily Target = 2497. So SMV is decreased by 0.38, Target/hour is increased by 7 and daily target is increased by 70.

Changes behind Improvement:

Changes No	**Description**	**Layout - 1**	**Layout - 2**
1	Operation -11 (i) Sleeve Join (ii)Sticker remove & Thread Cut	Operation (i) & (ii) are done done separately, two operators & one helper are used, hourly potential is 120, hourly target is 240 and Daily potential is 2400.	Operation (i) & (ii) are done together, three operators but no helper are used, hourly potential is 92, hourly target is 277 and Daily potential is 2769.
2	Operation -13 (i) Side seam ii)Check, Thread cut & Fold	Operation (i) & (ii) are done separately, three operators & one helper are used, hourly potential is 86, hourly target is 257 and Daily potential is 2571.	Operation (i) & (ii) are done together, four operators but no helper are used, hourly potential is 71, hourly target is 282 and Daily potential is 2824.
3	Operation -17 & 18 17- Check & Thread Cut 18- Final Check &Thread Cut	Operations 17 & 18 are done separately, only two helpers are used, hourly potential is , hourly target is 273 and Daily potential is 2727.	Operations 17 & 18 are done together, only one helper is used, hourly potential is 300, hourly target is 300 and Daily potential is 3000.

VII. CONCLUSION

Based on the practical experiment conducted, it can be seen that SMV and such like others tools can be effectively applied to apparel industries for better production efficiency. Using this tool, it is possible to map the current status and subsequently analyze to achieve better target. However, the work provides some ways of improvement to increase the line efficiency by applying time study and line balancing techniques. As a consequence, good line balancing with small stocks in the sewing line has to be drawn up increase the efficiency and quality of production. This study is completely based on a case study on 'T-item'. With some small changes in the work distribution among sewing line, an increase in production volume was observed. Line balancing removing unnecessary delays and bottlenecks contributed to reduced SMV and increased target per hour which is a potential learning outcome for sewing floors in apparel industries irrespective of order or style. Therefore, organizations of similar type can use the research as a knowledge base to identify their problems and come up with suitable remedies. Findings of this study can be valuable and helpful to other similar apparel industries of Bangladesh, those who expect for better production efficiency through effective use of resources.

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