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SMV Distribution of Double Layer Men's Shorts on the basis of Time Study: An Authentic Mode of Operation Breakdown for Industrial Bulk Production

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Abstract- The production system of apparel manufacturing industry depends on different factors. Among these operation break down and SMV (standard minute value) distribution play vital role on the productivity depending on lead time to dispatch the product. To cope up with this situation shorten production cycle time in the garment industry is being an emergence. Sometimes labors are forced physically and mentally to perform their task within undefined time. In this study an approach to experimental knowledge based roadmap is presented for men's shorts sewing line production. A details description of workstations sequence, machine and man allocation based on SMV are described. Reasonable SMVs is calculated by time study for producing shorts. Hourly target is also defined with normal efficiency as well as set up a well-balanced sewing line in manufacturing process. A standard may be maintained in the apparel industry to obtain maximum productivity by using the operation break down properly. The outcome of this observation is to synchronize workstations and to minimize SMV as the sense of productivity improvement.

I. Introduction

The ready-made garment (RMG) sector is the life-blood of Bangladesh economy achieving higher export growth every year. The sector is now the largest contributor not only to overseas trade but also to the national economy. Bangladesh textiles and RMG industry comprises 1,55,557units – 1,48,000 handlooms units, 3,284 mechanized primary textile units, 5150 export-oriented readymade garments manufacturing units and 273 garments washing-dyeing units. The sector is a major foreign exchange earner for Bangladesh contributing 77 percent to the country's net exports. At the end of the fiscal year 2011, total export of Bangladesh garments was worth US$ 23 billion, a 43 exports. At the end of the fiscal year 2011, total export of Bangladesh garments was worth US$ 23 billion, a 43 percent increase over the previous year, accounting for almost 25 percent of the GDP(gross domestic product) [1]. Now a day, fashion & styles are changing rapidly. The rapid rate at which the whole process takes place, the interaction between workers, and the different transition times between workers make it increasingly more difficult for a human being to make correct decisions regarding how fast each operator should work in order to continue the process, while at the same time keeping productivity high and throughput at an acceptable level [2]. Different type bottom, top and underwear are manufactured in Bangladesh. Shorts are a garment worn by both men and women over their pelvic area, circling the waist and splitting to cover the upper part of the legs, sometimes extending down to the knees but not covering the entire length of the leg. Shorts are typically worn in warm weather or in an environment where comfort and air flow are more important than the protection of the legs [3]. Shorts owe much of their contemporary origins to the military. Possibly the earliest example (1880's) of modern-day shorts, is the uniform of the heavily respected Gurkha soldiers of the Nepalese army. During World War I, British Rear Admiral Mason Berridge, who stayed North American Headquarters in Bermuda and adopted a style for his fellow officers and named them "Bermuda Shorts". From then on this style is adopted as school uniform in Britain.In 1932, when Britain's top ranked tennis player, Bunny Austin appeared in the U.S. National Championships in Forrest Hills, Long Island, he wore flannel shorts instead of the standard white trousers. By the 1950's, in suburban America, Bermuda shorts were seen as essential. Today Hollywood and athletics greatly influences style, Michigan basketball's 1991's "best recruiting class ever" that created a cultural shift, from short shorts to a new, longer, baggy short, that asserted ego, personality and a new style of player [4]. In modern fashion trend, shorts belong as unisex formal and informal outwear all over the globe. Although, they are a shortened version of trousers, many derivatives and designed shorts are available in Market.

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Baggies, Bermuda shorts, Boardshorts, Boxer shorts, Cargo shorts, Jorts, Cut-offs short etc. are used by men. Women use Boyshorts, Bun huggers, Culottes, Daisy Dukes, Dolphin shorts, Hotpants, Short shorts, Skorts etc. most [5].

To make shorts industrially about 44 operations are needed. Some of these are performed by helper manually and rest of operations is completed by the operator with help of machine.

Assembly Lines are used in high production situations where the work to be performed can be divided into small tasks and tasks assigned to the workstations on the line. Key advantage of using manual assembly line is specialization of labor. By giving each worker a limited set of tasks to do repeatedly [6].

A standard method is needed to get the maximum productivity by using the assigned time properly. The job is broken down into parts and the parts are timed. The parts are known as Element. Contents of each element should be homogeneous as possible. If the element is shorter, two or more should be combined into one [7]. 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. Sharing a job of work between several people is called division of labor. Division of labor should be balanced equally by ensuring the time spent at each station approximately the same. Each individual step in the assembly of product has to be analyzed carefully, and allocated to stations in a balanced way over the available workstations. Each operator then carries out operations properly and the work flow is synchronized. 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 [8].

Standard minute value is the standard time, to complete any given task by using best possible methods at standard level of performance. To estimate SMV we have to analyze the garment carefully and check different factors that affect the SMV. SMV of a product varies according to the work content or simply according to number of operations, length of seams, fabric types, stitching accuracy needed, sewing technology to be used etc.

Standard minutes (SMV) of few basic products have been listed down with its SMV range according to work content variation [9].

Breakdown is a listing of the content of a job by elements. A garment consists of some parts& some group of operations. Breakdown means to writing down all parts & all process/operation after one another lying with the complete garment according to process sequence. It is a must to write down the estimated SMV & type of machine beside each &every process [10].

Work study is a generic term for method study and work measurement which are used in the Examination of human work in all its contexts and which lead systematically to the Investigation of all the factors which affect the efficiency and economy of the situation being reviewed, in order to effect improvement [11].

Therefore, garment production needs properly rationalized manufacturing technology, management and planning [12].

Performance rating is the process during which the time study engineer compares the performance of the operator under observation with his own concept of normal performance. The concept of normal performance must be such that the time standards set from it and must be within the capacity of the majority of workers in the enterprise [13].

Line balancing is the allocation of sewing machine according to style and design of garment. It depends of that what type of garment we have to produce [14].

An experimental investigation for the distribution of SMV for each and every operation require for making a men's and provides a clear and details concepts for determining line balancing, machine requirements, man power allocation for setting a definite target within a reasonable efficiency.

II. Objectives of the Study

The main objective of this study is to form a sequential list of all the elements (operation breakdown) in sewing line involving with producing double layer shorts as well as distributing Standard minute value for every element (tasks) of this job. Besides, following issues are concerned: To draw a clear job flow chart of making shorts, to determine the manpower and machine allocation, to define a way to minimize SMV and maximize productivity and to set up a balanced sewing line practically.

III. Methodology

A study was carried out in the garments Industry named Ehsan Garments Ltd. Located at Tongi, Gazipur, Dhaka, Bangladesh and Moonlight Garments Ltd. Located at Tongi, Gazipur, Dhaka, Bangladesh. We attempted this study for proper utilization of man and machine.

a) Analysis of particular Garment (designed double layer shorts)

Generally, two different types of fabric are used for double layer shorts. For our study we took 100% polyester single jersey fabric (width-58-60", weight-120gsm, technique-knitted) as lining fabric and ricehole mesh fabric (width58-60", 140gsm, warp knitted) as shell (outer) portion. As such type of shorts is used as nightwear, ready for the gym, walking fit wear, athletic fit and loose fitting appearance; Elastic waistband (2"

synthetic) with hidden drawstring (0.5" synthetic flat draw cord) and two side pockets are existed.

The investigation occurred for M size garments consisting with 32-34" waist and 8" inseam.

Figure.1: Basic figure of men's shorts

b) *Making process of shorts*

Preparatory section

Care label attach to back
↓
Side pocket bag close
↓
Pocket bag join to body
↓
Pocket opening 1/4 top
↓
Side Pocket fixed tack
↓
Pocket w/belt positions tack

Lining part section

Back rise join lining part
↓
Front rise join lining
↓
Side seam join lining

Shell part section

Front rise join Shell part
↓
Back rise join shell part
↓
Side seam join shell part
↓
Side seam join position over

Assembly section

Lining part joins to shell part w/belt
↓
Elastic mouth tack & mark
↓
Elastic join to w/belt
↓
Elastic join position over lock
↓
Size label attaching
↓
W/belt hole making
↓
W/belt false tack
↓
W/belt rolling
↓
Inseam joins shell part
↓
Inseam joins Lining part
↓
Bar tack at pocket corner & inseam
↓
Bottom hem over lock
↓
Bottom hemming

c) *Operation breakdown*

- After analyzing the provided shorts construction in section by section (i.e. preparatory, lining section, shale section, assembly), had to list down operations. Once we had listed all operations cross-check with sample shorts again and visualize that if all operations are done as per our list we would get exactly complete shorts as per sample.
- Based on seam type used we selected one machine and enter into the sheet against each operation with name and description of attachments or folder or guides if needed for an operations.
- At this stage we had to find SMVs by conducting Time study (time study sheet) .SMV is shown at 100% efficiency and also converted SMVs into Target efficiency (i.e. 65%). Refer to the formula. SMV at Target Efficiency = SMV @ 100% efficiency / Target efficiency%
- By using following formulas we fixed up Production per hour at target efficiency% and Number of machines.
  Calculated Production/Hour @ target efficiency = 60/Operation SMV @ target Efficiency
  Calculated Machine number = (SMV @ target efficiency * Hourly production target/60)
- Last of all a table form summary of required number of machine was drawn to achieve hourly production target.

d) Time study

In order to balance the sewing line as well as to increase the efficiency of the line, at first a detailed work and time study was carried out to find the task durations.

However, the time required to complete a task depends on a lot of factors such as the task, the operator, the properties of fabric and sub materials, working environment, quality level of the product, the hour of the day, psychology of the operator etc.[16]

e) Line balancing

Standard Minute Value (SMV) is used as the most usable tool for the line balancing, production control and the estimation of efficiency. After time study following steps are required to balance the line.

- Target setting
- Identification of bottleneck areas
- Eliminate bottlenecks from the line

IV. Result and Discussion

a) Operation breakdown sheet and time study sheet

The following table denotes the operations breakdown (elements) sheet and number of required machines.

Table 1: Operations breakdown (elements) sheet

NO	OPERATION	M/C	M/C OPN		MNL OPN		REQ	
		TYPE	SMV	TGT	SMV	TGT	OP	HEL
1	Back rise join lining part	4 OL	0.3	200			1.27	
2	Care label attach to back part	SNL	0.23	261			0.97	
3	Front rise join lining part	4 OL	0.27	222			1.14	
4	Back + front part matching lining part	H			0.28	214		1.18
5	Side seam join lining part	4 OL	0.5	120			2.11	
6	Side pocket bag close	5 OL	0.3	200			1.27	
7	Pocket pair matching & thread cut	H			0.28	214		1.18
8	Front rise join Shell part	4 OL	0.29	207			1.23	
9	Pocket join position mark	H			0.28	214		1.18
10	Pocket bag join to body	SNL	0.9	67			3.80	
11	Pocket join position corner cut	H			0.28	214		1.18
12	Pocket opening 1/4 top stitch	SNL	0.65	92			2.75	
13	Side Pocket fixed tack	SNL	0.5	120			2.11	
14	Pocket w/belt position tack	SNL	0.28	214			1.18	
15	Sticker remove	H			0.25	240		1.06
16	Back rise join shell part	4 OL	0.25	240			1.06	
17	Back + front part matching shell part	H			0.26	231		1.10
18	Side seam join shell part	SNL	0.75	80			3.17	
19	Side seam join position over lock	4 OL	0.55	109			2.32	
20	Side seam join position iron	IRN			0.28	214		1.18
21	Shell part mark &fitting	H			0.28	214		1.18
22	Lining part & shell part matching	H			0.22	273		0.93
23	Lining part join to shell part w/belt position	SNL	0.75	80			3.17	
24	Body turning	H			0.30	200		1.27

25	Elastic mouth tack & mark	SNL	0.3	200			1.27	
26	Elastic join to w/belt	SNL	0.5	120			2.11	
27	Elastic Join position over lock	4 OL	0.25	240			1.06	
28	Hole mark	H			0.24	250		1.01
29	Size label attach	SNL	0.25	240			1.06	
30	W/belt hole	BH	0.27	222			1.14	
31	Elastic cut, mark & wash	IRN			0.28	214		1.18
32	W/belt false tack	SNL	0.5	120			2.11	
33	Side pocket up & down check	H			0.24	250		1.01
34	W/belt rolling make	KNS	0.58	103			2.45	
35	W/belt thread cut	H			0.25	240		1.06
36	W/belt tack remove	H			0.90	67		3.80
37	Body turning	H			0.28	214		1.18
38	Inseam join shell part	4 OL	0.3	200			1.27	
39	Inseam join Lining part	4 OL	0.3	200			1.27	
40	Bartack at pocket corner & inseam point	BTK	0.4	150			1.69	
41	Inseam body arrange & turn	H			0.28	214		1.18
42	Bottom hem over lock	4 OL	0.8	75			3.38	
43	Bottom hemming	FLAT LOCK	0.85	71			3.59	
44	Final thread trimming	H			0.75	80		3.17
	TOTAL		11.82		5.93			21.89
			17.75					
	SUPPORTING MC							
	GRAND TOTAL		11.82		5.93		0.00	21.89
			17.75					
	M/C Operator	78	TARGET 100%	264pcs/hour				
	Helper	22	TARGET 65%	171pcs /hour				
	Ironman	06						

	M/C Name	SNL	5 OL	4 OL	K-S	BH	BTK	FLAT LOCK	Total
	Number	27	1	14	2	1	2	3	50

Table 2: Time study sheet

Sl No	M/c	OP id no.	Process name	TIME(Second)					Avg. time	B.T. with allowance	S.M.V
				T-1	T-2	T-3	T-4	T-5			
1	OL	100	Back rise join lining part	15	16	15	14	15	15	18	0.30
2	SNL	348	Care label attach to back part	12	12	12	12	11	12	14	0.23
3	OL	321	Front rise join lining part	12	14	15	13	14	14	16	0.27
4	H	323	Back + front part matching lining part	13	14	15	13	14	14	16	0.28
5	OL	370	Side seam join lining part	26	27	25	24	25	25	30	0.50
6	OL	A-52	Side pocket bag close	15	14	15	14	16	15	18	0.30
7	H	B-81	Pocket pair matching & thread cut	12	16	14	12	13	13	16	0.28
8	OL	174	Front rise join Shell part	15	14	16	16	15	15	18	0.29
9	H	277	Pocket join position mark	14	15	12	15	13	14	16	0.28
10	SNL	24	Pocket bag join to body	46	44	48	43	47	46	54	0.90
11	H	339	Pocket join position corner cut	14	14	15	13	12	14	16	0.28
12	SNL	152	Pocket opening 1/4 top stitch	33	34	35	32	33	33	39	0.65
13	SNL	358	Side Pocket fixed tack	29	26	23	25	24	25	30	0.50
14	SNL	352	Pocket w/belt position tack	12	13	15	11	14	13	16	0.28
15	H	367	Sticker remove	12	10	13	12	14	12	15	0.25
16	OL	138	Back rise join shell part	15	11	10	12	13	12	15	0.25
17	H	361	Back + front part matching shell part	15	12	12	15	13	13	16	0.26
18	SNL	142	Side seam join shell part	39	37	35	39	40	38	45	0.75
19	OL	173	Side seam join position over lock	31	27	28	26	25	27	33	0.55
20	IRN	317	Side seam join position iron	13	10	16	12	14	13	16	0.28
21	H	373	Shell part mark & fitting	12	14	13	13	14	13	16	0.28
22	H	316	Lining part & shell part matching	13	9	12	9	11	11	13	0.22
23	SNL	327	Lining part join to shell part w/belt	41	39	37	37	38	38	45	0.75

			position								
24	H	77	Body turning	14	13	14	18	15	15	18	0.30
25	SNL	322	Elastic mouth tack & mark	15	13	16	14	16	15	18	0.30
26	SNL	37	Elastic join to w/belt	29	27	26	22	24	26	30	0.50
27	OL	226	Elastic Join position over lock	13	12	14	13	12	13	15	0.25
28	H	128	Hole mark	13	11	13	11	12	12	14	0.24
29	SNL	397	Size label attach	13	13	12	13	12	13	15	0.25
30	BH	179	W/belt hole	14	14	15	12	13	14	16	0.27
31	SNL	37	Elastic cut, mark & wash	12	15	14	13	14	14	16	0.28
32	SNL	232	W/belt false tack	31	23	23	22	26	25	30	0.50
33	H	368	Side pocket up & down check	14	10	11	11	12	12	14	0.24
34	KS	315	W/belt rolling make	28	29	31	27	32	29	35	0.58
35	H	334	W/belt thread cut	12	11	13	12	14	12	15	0.25
36	H	389	W/belt tack remove	44	46	48	45	47	46	54	0.90
37	IRN	317	Body turning	14	15	11	14	13	13	16	0.28
38	OL	172	Inseam join shell part	13	16	15	14	16	15	18	0.30
39	OL	11	Inseam join Lining part	15	14	11	16	17	15	18	0.30
40	BTK	223	Bar tack at pocket corner & inseam point	19	24	21	20	19	21	24	0.40
41	H	374	Inseam body arrange & turn	15	13	14	12	13	13	16	0.28
42	OL	233	Bottom hem over lock	40	38	43	39	41	40	48	0.80
43	FL	222	Bottom hemming	46	42	47	42	40	43	51	0.85
44	H	380	Final thread trimming	36	38	39	37	39	38	45	0.75

Calculation of SMV
Example for the first operation 'Back rise join lining part'
SAMV = Basic minute + Bundle allowances + machine and personal allowances
[Add bundle allowances (10%) and machine and personal allowances (10%) to basic time]
Now, we get Standard Minute value (SMV) = (0.25+0.05+0.05) = 0.3 minutes.

A. Line balancing Chart

Line balancing is the allocation of sewing machine according to style and design of garment. Line balancing Chart is such type of tool that indicates how a sewing line balanced. It describes every workstation and required time for completing individual task in sequence with the cooperation of Basic pitch Time (BPT).

The line balanced according to our calculated SMV for the double layer men's shorts we found the following Line Balancing Chart:

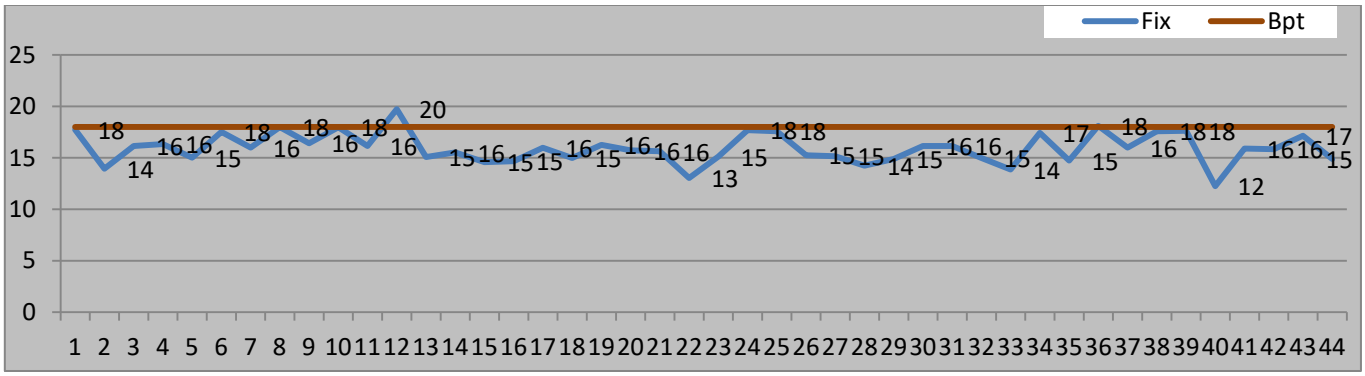

Fig.2. Line balancing Chart

The time consumption of every workstation is nearly about to BPT and that means the chances of bottleneck are reduced.

B. Discussion

During our investigation, we found few hours that failed to achieve our estimated target and bottleneck has risen up. The reason of this problem was listed out in bellow:

- Lack of skilled operator
- Improper supervising of sewing line
- Machine break down
- Lack proper training & improvement programs
- More allowance time
- Lack of high performance machines
- Lack of compliance issues
- Operators' absenteeism
- Lack of motivational activities

Following points are suggested to minimize Non-productive time (NPT).

- Ensure continuous feeding to the sewing line
- Feed fault free and precise cutting to line
- Reduce line setting time
- Use work aids, attachments, guides, correct pressure foots and folders
- Hourly operator capacity check
- Continuous training to sewing operators and line supervisors
- Setting individual operator target
- Using auto trimmer sewing machine (UBT)
- Installing better equipment
- Conduct R&D for the garment
- Filling up compliance issues
- Operator motivation
- Plan for operator's Incentive scheme

V. Conclusion

This study on operation break down and SMV distribution of men's shorts is on the basis of time study for bulk production in industry. It is very important and critical task in an apparel production industry. In practice we may use more or less machines, man power, raw materials and other resources for want of proper balance of tasks and as well as the prior precise apparel industry. Thus it would reduce the all kinds of wastes and consume least resources i.e. man, machine, materials, money, etc. It will definitely help us to come the main goal of an industry that is making maximum profit.

By this study, we have described the whole job of making double layer short broken down into elements. This study was going on with experienced and non- experienced machine operators and helpers. The environment kept in standard for Bangladesh. It is suggested that to get better productivity all the people involved with production should be experienced and standard environment of workstations should maintain properly. According to our elements (operation) bulletin we also designed a line layout concerned with the SMVs sheet that taken by direct time study. Line balancing chart indicates succeed of the established line.

To conclude, this research has demonstrated the better synchronization among man machine and

materials which full fill our main study objective to increase the efficiency and productivity.

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