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Research Article

Apparel Analysis for Layout Planning in Sewing Section

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Abstract

In Apparel manufacturing process sewing is one of the most important operation .Most of such industrial sewing is done by industrial sewing machines. The cut pieces of a garment are generally tacked, or temporarily stitched at the initial stage. The complex parts of the machine then pierces thread through the layers of the cloth and interlocks the thread. Layout planning of sewing section generally means the line sequence of m/c is required in a specific product & how many types of products are producing in different line. In sewing section the complete garments are made which are suitable to wear. Although it seems to be a simple process, industrial sewing is quite a complex process involving many preparations and mathematical calculations for the perfect seam quality. Good quality sewing also depends on the sound technical knowledge that goes into pattern designing and making. Flat sheets of fabric having holes and slits into it can curve and fold in three-dimensional shapes in very complex ways that require a high level of skill and experience to manipulate into a smooth, wrinkle-free design. Aligning the patterns printed or woven into the fabric also complicates the design process. Once a clothing designer, with the help of his technical knowledge, makes the initial specifications and markers, the fabric can then be cut using templates and sewn by sewing m/c. We have done this project work in our Apparel lab and visited one industry to get more valuable data and experience.

Keywords: *Apparel, Layout, Line-balancing, Textile sector, Garments Industry.*

Introduction

Sewing Line Layout is the sequential arrangement of sewing machines as per processes involved in a particular style of garments. Layout of apparel directs the flow of materials and work-in-process from start till its completion and integrates material handling and equipment. An efficient layout has the flexibility to be changed to meet requirements of the product line, delivery schedules, and anticipated volume. Safety is a major consideration in sewing line layout. The following factors should be taken into consideration while planning a layout:

- Minimization of manufacturing cost,
- Feeding the materials and parts at highest possible speed and in one direction without any backtracking or overlapping flow of products/materials,
- Minimization of work transfer among the processes from acceptance of raw materials till delivery of finished product with properly defined spaces for each process, and
- Reducing the bottlenecks to maintain a smooth flow of materials with a view to ensuring the right products in right quantity of right quality.

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The layout planning should be done based on the proper and precise garment analysis.

Research Objectives

- To know how to analyze a garment effectively and efficiently.
- To know ins and outs about layout planning.
- To make the solution in case of line unbalancing, bottlenecking in sewing line and some other critical problems commonly arise in a sewing line.
- To find out the effects of a garment/apparel analysis on sewing line layout planning.

Working Methodology

We divide our working methodology for this study into three major steps-

1. Literature review has been conducted to know about different terms & processes used in garment analysis, sewing line layout planning and the effects of garment analysis on sewing line layout planning.
2. A thorough study has been done to analyze the calculated layout plan and the actual lay-out plan for three specific style of garment. (Basic style, semi-critical style and critical style).

3. Data has been collected from a garment factory named AKH group, Bangladesh where this study has been completed.
4. And finally discussed the causes of poor efficiency in actual layout planning and its remedy to attain the profit maximization.

Apparel Analysis and Its Significance

Apparel analysis refers to reviewing the garment's ins and outs to identify all the processes involved especially the critical processes to make the garment. It's of one of the major tasks of production department. There are so many remarkable reasons behind apparel analysis. Some of the significant reasons are given below.

- Apparel analysis is carried out to Point out how many operations are involved in the particular item.
- To identify which machines and machine parts such as folder, guide, hemming feed, pressure feed and so on are required.
- To calculate the manpower required for that particular style.
- To estimate the production/day/style.
- To plan a sewing line properly and accurately.
- To Point out the critical operation where we can expect the bottle neck during production.
- Considering bottle neck, allow extra machines for that operation to keep production flow as you expect.
- Find out the input operation and out-put operation also.

Sewing Process

The basic process of sewing involves fastening of fabrics, leather, furs or similar other flexible materials with the help of needle and threads. Sewing is mainly used to manufacture clothing and home furnishings. In fact, sewing is one of the important processes in apparel making. Most of such industrial sewing is done by industrial sewing machines. The cut pieces of a garment are generally tacked, or temporarily stitched at the initial stage. The complex parts of the machine then pierces thread through the layers of the cloth and interlocks the thread.

Sewing Defects

There are so many defects found in sewing process. But some of the remarkable and most commonly occurred defects are as below.

- Needle damage,
- Skip stitches,
- Thread Breakages,
- Broken Stitches
- Seam Grin
- Seam Puckering
- Pleated Seam
- Wrong stitch density
- Uneven stitch density
- Staggered stitch
- Improperly formed stitches

Line Planning

Line planning is scheduling and allocating of orders to production lines according to product setting (product is being made in the line) and due dates of production completion. A line plan defines when a style is going to be loaded to the line, how many pieces to be expected (target) from the line and when order to be completed.

Benefit of Line planning

It helps production manager as well as line supervisor with information such as what is the daily production target for line. They set their line (machines and manpower) accordingly. Line plan also provides information such as how many days style would run, what is the next style going to be loaded?

Line Balancing

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.

The Objectives of Line Balancing

Line balancing is a main part of a mass production. These kinds of systems, regardless of being different in details, are workstations in a sequence. Raw material is included in the line at the beginning or in the middle. Parts included in the system transfers from one workstation through the other and at the end leaves the system as a completed product. Transfer lines uses manpower very little when compared to assembly lines [4]. The certain properties of Transfer lines are transfer and process of a product automatically through a line.
Objectives of line balancing that should be gained in a sewing line are as follows.

- Regular material flow;
- Maximum usage of man power and machine capacity;
- Minimum process times;
- Minimizing slack times;
- Minimizing workstations;
- Maximum outputs at the desired timed;
- Agreed quality maintenance of the garments;
- Reduce production costs.

Importance of Line Balancing

The importance of line balancing could be summarized as follows.

- Good line balancing increases the rate of production;

- This is the pre-condition for smooth production;
- Line balancing helps to compare the required machinery with the existing one and make a balance;
- It also helps in the determination of labor requirement;
- Good balancing reduces production time;
- Profit of a factory can be ensured by proper line balancing;
- Proper line balancing ensures optimum production at the agreed quality;
- It reduces faults in the finished products;
- Line balancing helps to know about new machines required for new styles;
- It becomes easier to distribute particular job to each operator;
- It becomes possible to deliver goods at right time at the agreed quality for least costs.

Steps in Line Balancing

Now-a-days, Standard Minute Value (SMV) is used as a tool for the line balancing, production control and the estimation of efficiency. In a similar way, the time taken to do a job for making garments like shirt/trouser/blouse/dresses could depend upon a number of factors like.

- The length of the shirt/trouser/blouse/dress;
- The number of stitches per inch;
- The presentation of item;
- The pricing of garments.

Symbol of imbalanced Line

- Low output
- Waiting for work
- Idling operator & Machine
- Crisis work distribution
- Inconsistent quality
- Overtime
- Excessive handling of transport & travel
- Managerial Supervisory stress
- Operator pressure & demoralization.

Why Line Imbalance?

- Unequal work content individual operators.
- Inability to distribute work quality among operators.
- Ineffective supervision.
- Inability to identify individual skills accurately.
- Inconsistent individual efficiency.
- Unequal skills distribution.
- Sub optimum allocation work.
- Demoralized employees.
- Quality issue.
- Poor guidance.
- Input delay.
- Machine break down.
- Disagreement on actual & proposed method.
- Erroneous estimation of work content.

Calculation of SAM/SMV

Steps for calculating Standard Allocated Minute (SAM) or Standard minute value (SMV) through Time Study:
Step 1: Select one operation for which you want to calculate SAM.
Step 2: Capture cycle time for that operation by stop watch standing by side of the operator. (Cycle time - total time taken to do all works needed to complete one operation). Do time study for consecutive five cycles. Calculate average of the 5 cycles. Time we get from time study is called cycle time.

Basic Time = Cycle Time X Performance rating

*Performance rating: Performance rating means at what performance level operator doing the job, considering his movement and work speed. Suppose that operator performance rating is 80%. Suppose cycle time is 0.60 minutes. Basic time = (0.60 X 80%) = 0.48 minutes
Step 3: Standard allocated minutes (SAM) = (Basic minute + Bundle allowances + machine and personal allowances). Add bundle allowances (10%) and machine and personal allowances (20%) to basic time.
Now we get Standard Minute value (SMV) or SAM. SAM= (0.48+0.048+0.096) = 0.624 minutes.

Operator On-Standard Efficiency:

Operator on-standard efficiency (%) = Total minute produced /Total on-standard minute attended *100%
Where, Total minutes produced = Total pieces made by an operator X SAM of the operation [minutes]
Total on-standard minute attended = (Total hours worked – Loss time) x 60 [minutes]

Example:

An operator was doing an operation of SAM 0.50 minutes. In an 8 hours shift day he produces 400 pieces. Operator was idle 'waiting for work' for 30 minutes and his machine broke down for 15 minutes in hours shift. So according to the efficiency calculating formula, that operator's on-standard efficiency
= (400 x 0.50) / {480 – (30 +15)}*100%
= 200/435*100%
= 45.98%

Efficiency of a Production Line:

Line efficiency = Total minutes produced by the line/total minutes attended by all operators
a. Total minutes produced by the line: To get total produced minutes multiply total production pieces by SAM
b. Total minutes attended by the all operators in the line: Multiply number of operators by daily working hours.

Table1: List of Raw Materials per style

Style	Item name	Main fabric type	Contrast fabric type	Accessories
Basic	Boys Polo	Pique	1x1 rib	4-hole plastic button, Neck band, Seam tape, Label, Yarn, sewing thread etc.
Semi-critical	Baby Bodies (Ramper)	1x1 Rib	1x1 rib	Ring press button, Piping, Label, Yarn, sewing thread etc.
Critical	Ladies Long Shirt	Single Jersey Lycra	Single Jersey Lycra	4-hole plastic button, Herringbone tape, Drawstring, Label, Yarn, Sewing thread etc.

Table 2: List of machine for Basic Style garment

Machine Name	Quantity	Work Aid
Single Needle Lock Stitch	27	Plain feet, 1/16 guide
Over Lock- 4 thread	9	Pressure feet
Flat Lock- 2 needle	1	D-set hemming feed
Flat Lock- 1 needle	1	Folder
Button Hole	1	
Button Attaching	1	

Total = 40

Table3: List of machine for Semi-critical Style garment

Machine Name	Quantity	Work Aid
Single Needle lock Stitch	9	Plain feet
Over Lock- 4 thread	6	Pressure feet
Flat Lock- 2 needle	5	D-set hemming feed, Folder
Piping Cutter	1	Knife wheel

Total = 21

Table 4: List of machine for Critical Style garment

Machine Name	Quantity	Work Aid
Single Needle lock Stitch	22	Plain feet, 1/16 guide
Over Lock- 4 thread	11	Pressure feet
C.M	2	
Flat Lock- 2 needle	2	D-set hemming feed
Flat Lock- 1 needle	4	D-set top stitch feed, F-set folder
Button Hole	3	
Button Attaching	2	
Piping Cutter	1	Knife wheel

Total = 47

Materials used for this study:

Mainly 3 types of garment style are analyzed. They are:

1. Basic style
2. Semi-critical style
3. Critical style

Layout plan of Basic style

Table 5: Layout plan of basic garment

Opt. No.	**Operation Description**	**Machine Name**
1.	Shoulder join both side	O.L- 4T
2.	Both placket facing rolling	S.N.L.S
3.	Both placket join at front part	S.N.L.S
4.	Placket Nose Make	S.N.L.S
5.	Collar close with placket nose	S.N.L.S

6.	Collar join	O.L- 4T
7.	Collar Twill Tape join	F.L- 1N
8.	Lower placket 1/16 top stitch inner side	S.N.L.S
9.	Upper placket 1/16 top stitch inner side	S.N.L.S
10.	Lower placket 1/16 top stitch outer side	S.N.L.S
11.	Upper placket 1/16 top stitch outer side	S.N.L.S
12.	Placket box inner tack	S.N.L.S
13.	Placket diamond box make	S.N.L.S
14.	Collar twill tape join top stitch	S.N.L.S
15.	Sleeve opening cuff join	O.L- 4T
16.	Sleeve join	O.L- 4T
17.	Bottom hem	F.L- 2N
18.	Care label tack	S.N.L.S
19.	Side seam insert care label & side slit O/L & excess placket cut	O.L- 4T
20.	Side slit close	S.N.L.S
21.	Side slit twill tape fold tack	S.N.L.S
22.	Side slit twill tape join	S.N.L.S
23.	Side slit twill tape join top stitch	S.N.L.S
24.	Sleeve opening close & placket inner security tack	S.N.L.S
25.	Sleeve opening chap tack	S.N.L.S
26.	Arm hole close tack	S.N.L.S
27.	Button hole at upper placket(2 point)	B/H
28.	Button attach at lower placket	B/A

Layout Plan of Semi-critical Style

Table 6: layout plan of semi-critical garment

Opt. No.	**Operation Description**	**Machine Name**
1.	Front part neck binding	F.L -2N
2.	Back part neck binding	F.L -2N
3.	Front & back part shoulder point close	S.N.L.S
4.	Front bottom edge binding	F.L- 2N
5.	Back part bottom edge binding	F.L- 2N
6.	Sleeve opening hem	F.L- 2N
7.	Sleeve join	O.L-4T
8.	Care label tack	S.N.L.S
9.	Side seam insert care label	O.L- 4T
10.	Bottom binding close & chap tack	S.N.L.S
11.	Sleeve opening close & chap tack	S.N.L.S
12.	Arm hole security tack	S.N.L.S
13.	Piping cutting	Piping cutter

Layout Plan of Critical Style:

Table 7: layout plan of critical garment

Opt. No.	**Operation Description**	**Machine Name**
1.	Sleeve hem	F.L- 2N
2.	Bottom part join with front & back	O.L- 4T
3.	Placket rolling	S.N.L.S
4.	Both placket join at front	S.N.L.S
5.	Placket & body edge over lock inside	O.L- 4T
6.	Both placket 1/16 top stitch	S.N.L.S
7.	Upper placket top stitch inner side	S.N.L.S
8.	Lower placket top stitch inner side	S.N.L.S
9.	Both placket 1/16 top stitch outer side	S.N.L.S
10.	Placket inner tack	S.N.L.S
11.	Placket box make	S.N.L.S
12.	Pleat make (3x2)	S.N.L.S

13.	Shoulder join both side	O.L- 4T
14.	Pleat neck liner servicing	O.L- 4T
15.	Main & care label tack	S.N.L.S
16.	Main label join at back neck & thread cut	S.N.L.S
17.	Neck binding	F.L- 1N
18.	Appulet O/L & thread cut	O.L- 4T
19.	Sleeve join	O.L- 4T
20.	Button hole at appulet	B/H
21.	Appulet join at sleeve	C.M
22.	Button attach on appulet join position	B/A
23.	Side seam insert care label	O.L- 4T
24.	Waist rolling	F.L- 1N
25.	Drawstring hole at front waist position	B/H
26.	Waist position top stitch	S.N.L.S
27.	Neck binding chap tack	S.N.L.S
28.	Sleeve opening close &chap tack	S.N.L.S
29.	Drawstring security tack at back waist position	S.N.L.S
30.	Drawstring end point fold tack	S.N.L.S
31.	Bottom hem	F.L- 2N
32.	Drawstring making	F.L- 1N
33.	Piping cutting	Piping cutter
34.	Button hole at upper placket	B/H
35.	Button attach at lower placket	B/A

Experimental Result and Discussion

We have observed Apparel Analysis for Layout Planning in Sewing Section in both methods: actual method & calculated method. Calculated method is done by Work Study department. We have done an experiment on three different style garments. Then we have collected data namely calculated layout and actual layout for these garments from industrial engineering dept. to make a comparison. We have found a lot of differences. They are discussed below:

a) Line Planning
b) Machine Selection
c) Processes Used
d) No of skilled operators used
e) Production Rate
f) No. of operations
g) No. of machines
h) Efficiency
i) SMV rate etc.

Table 8: Comparative study between calculated & actual Layout Plan (Basic Style-BOYS POLO)

Points to be considered	Calculated Layout plan	Actual Layout Plan
No. of m/cs required	40	43
No. of operators	39	44
Operation sequences	Assumed by work study dept.	Re-arranged according to calculated layout plan
Production capacity/hour	224	214
Productivity gap	0%	13%
Current pcs/hr	N/A	190
Total SMV	8.77	9.67
Line Balancing	Is not necessary	Must be done
Worker efficiency	80%	65%

Table 9: Comparative study between calculated & actual Layout Plan (Semi-critical Style-OC BABY BODIES)

Points to be considered	Calculated Layout plan	Actual Layout Plan
No. of m/cs required	21	24
No. of operators	21	25
Operation sequences	Assumed by work study dept.	Re-arranged according to calculated layout plan
Production capacity/hour	372	353
Productivity gap	N/A	9%
Current pcs/hr	N/A	350
Total SMV	3.05	3.59
Line Balancing	Is not necessary	Must be done
Worker efficiency	80%	73%

Table 10: Comparative study between calculated & actual Layout Plan (Critical Style-ladies long shirt)

Points to be considered	Calculated Layout plan	Actual Layout Plan
No. of m/cs required	47	45
No. of operators	44	44
Operation sequences	Assumed by work study dept.	Re-arranged according to calculated layout plan
Production capacity/hour	146	118
Productivity gap	0%	7%
Current pcs/hr	N/A	110
Total SMV	14.49	15.56
Line Balancing	Is not necessary	Must be done
Worker efficiency	80%	60%

Discussion

From the above comparative study we have seen the following results:

- In actual layout plan more m/cs are required to maintain line balancing.
- No. of operators is more in actual layout plan
- Operation sequences are not same in actual & calculated layout plan.
- There is productivity gap in actual layout plan.
- Total SMV is more in actual layout plan.
- Worker efficiency is lowest in actual layout plan.

Causes of lowest efficiency in Actual Layout Plan

1. Lack of skilled operator.
2. Lack of motivational activities.
3. Lack of high performance m/cs
4. Lack proper training & improvement programme.
5. Lack of compliance issues.
6. Operators' absenteeism.
7. More allowance time.
8. Machine break down.
9. Failure in Time study calculation.
10. Improper supervising of sewing line etc.

Steps needed to improve efficiency

1. Conducting motion study and correcting faulty motions.
2. Hourly operator capacity check.
3. Conduct R&D for the garment.
4. Use best possible line layout.
5. Scientific work station layout.
6. Reduce line setting time.
7. Improve line balancing
8. Use work aids, attachments, guides, correct pressure foots and folders.
9. Continuous feeding to the sewing line.
10. Feed fault free and precise cutting to line.
11. Training for Line supervisors.
12. Training to sewing operators.
13. Setting individual operator target.
14. Eliminate loss time and off-standard time.
15. Real time shop floor data tracking system.
16. Using auto trimmer sewing machine (UBT).
17. Installing better equipment.
18. Inline quality inspection at regular interval.
19. Operator motivation.
20. Plan for operator's Incentive scheme

Conclusion

This study on Apparel analysis for layout planning is very important and crucial task in an apparel industry. In practice we are using more machines, man-power, raw materials and other resources due to the lack of proper sewing line layout as well as the prior precise garment analysis. Sewing line should be aligned as per style of garments. Thus it would reduce the all kinds of wastes and consume least resources i.e. man, machine, materials, money, etc. In this study we have come to know about the different layout plan for different types of style and a comparative study on the actual layout and calculated layout plan. And it will definitely help us to come to the cream point of an industry i.e. profit maximization.

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