APPLICATION OF INDUSTRIAL ENGINEERING IN GARMENTS INDUSTRY AND PREPARATION OF OB SHEET AND LINE LAYOUT FOR INCREASING PRODUCTIVITY OF SEWING LINE

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This paper represents the application of Industrial Engineering in garments sector for reducing the cost of SMV and improving productivity by implementation of proper line balancing. Line balancing process is one of the most important stages in ready-made Clothing sector. Line balancing is an important parameter. In apparel manufacturing, skills and expertise of a sewing operator is being presented in Efficiency term. An operator with higher efficiency produces more garments than an operator with lower efficiency in the same time frame. The Line Balancing is to design a smooth production flow by allotting processes to workers so as to allow each worker to complete the allotted workload within an even time. It is a system where we meet the production expectations and we can find the same amount of work in process in every operation at any point in the day. We know that in our garments sector main problem is that the garments are conducted by the poor, inefficient and entraining people. So that a big concern is essential in this sector like low production, longer production lead time, high rework, rejection, poor line blanching, low flexibility of style change.

Keywords: *Industrial Engineering, Line Balancing, Productivity, Efficiency, skill.*

ABSTRACT

This project represents the application of Industrial Engineering in garments sector for reducing the cost of SMV and improving production by implementation of proper line balancing. Line balancing process is one of the most important stages in ready-made Clothing sector. Line balancing is an important parameter. In apparel manufacturing, skills and expertise of a sewing operator is being presented in Efficiency term. An operator with higher efficiency produces more garments than an operator with lower efficiency in the same time frame. The Line Balancing is to design a smooth production flow by allotting processes to workers so as to allow each worker to complete the allotted workload within an even time. It is a system where we meet the production expectations and we can find the same amount of work in process in every operation at any point in the day. In this project we create operation sheet and line layout. Operation bulletin (OB) sheet creates major role in industrial industry. For preparing OB sheet we have to find operation sequences, SMV, SAM, efficiency, target, production target, target efficiency, methodology, sample size, product name, station, grade, thread consumption etc., after creating ob sheet we set the line layout.

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1 .INTRODUCTION

Line and work cell balancing is an effective tool to improve the throughput of assembly lines and work cells while reducing manpower requirements and costs. Assembly Line Balancing or simply Line Balancing (LB) is the problem of assigning operations to workstations along an assembly line, in such a way that the assignment be optimal in some sense. LB has been an optimization problem of significant industrial importance: the efficiency difference between an optimal and a sub-optimal assignment can yield economies (or waste) reaching millions of dollars per year. LB is a classic Operations Research (OR) optimization problem, having been tackled by OR over several decades. Many algorithms have been proposed for the problem. Yet despite the practical importance of the problem, and the OR efforts that have been made to tackle it, little commercially available software is available to help industry in optimizing their lines. The expectation of the customer are on the rise and manufactures have to design and produce well in as many Varity as possible to cater to the demand of the costumer in productive efficiency of the organization so the SMV & line balancing is going to play pivotal role in increasing productivity. Varies SMV and line balancing techniques are used to analyze improve the time method to eliminate waste and proper allocation and utilization of recourse.SMV& line balancing is the knowledge of mathematically and natural science gain by study. Experience and particle is apply with judgment develop way to utilize economically the material and natural recourse and focus nature for the benefit of mankind.

SMV or Standard Allowed Minute is used to measure task or work content of a garment. This term is widely used by industrial engineers and production people in the garment manufacturing industry. For the estimation of cost of making a garment SMV value plays a very important role. In past scientists and apparel technicians did research on how much time to be allowed to do a job when one follows standard method during doing the job. According to the research study minute value has been defined for each movement needed to accomplish a job.

Industrial Engineering department assists production department in setting line, improving production and measuring production performance. Major activities of Industrial Engineering department are product analysis, making operation bulletin, calculating garment SAM, making line layout and workstation layout. They capture production data and prepare daily production report .In a typical garment unit, industrial engineering department handles following activities

- Estimating the SAM of the garment for a new style for costing
- Calculating thread consumption for garments
- Providing operational breakdown with SAM and target for each operation for an order (style)
- Method improvements through method study
- Time study of the operators
- Capacity Study of operators
- Line Balancing

- Calculating direct labor cost
- Documentation of all methods using manuals, computer-based system as appropriate.
- Production Control system.

1.2 OBJECTIVES

- To increase productivity
- Process improvement by motion reducing.
- Reduce work in process (WIP) and remove the bottleneck.
- Increase efficiency of operations
- Reduce man machine ratio
- Process improvement to reduce cost, waste and rejection Reduce wastage and defects
- Fill up Key Performance Indicator (KPI) target.
- Keep workplace and environment safe
- Production planning and implementation
- Manpower balancing, target setting, and monitoring achievements.

1.3 SCOPE

Industrial engineering – industrial engineering is engineering approach to the detailed analysis of the use and cost of the resource of an organization. The main resources are the men, money, materials equipment and machinery. The industrial engineer carries out such analysis in order to organization. Essentially, the industrial engineer is engaged in the design of a system and his function is primarily that management. If industrial engineer had to focus on only one concept to describe his field of interest and objective, it would have to be productivity improvement.

1.4 FUTURE SCOPE

Industrial engineering is all about designing and managing methods and procedures to increase productivity, quality and efficiency in manufacturing process. The increasing complexity of industrial operations and the expansion of automated processes in factories and offices is contributing to the demand for industrial engineers. They have to first determine what aspect of production needs to be automated and if it makes financial sense. All the manufacturing units are always in look out for people who can help them in deciding about the best machinery which can lead to reduction in manufacturing process and increased production.As industrial engineers are experts in this field their demand is constantly increasing. Due to globalization more and more companies are starting up with their manufacturing process in India there is a cut throat competition. Since industrial engineers are experts in determining the suitability of locations for factories depending on the best combination of raw materials availability, transportation and other allied cost, the manufacturing units are always in the look out for them.

2. LITERATURE REVIEW

The garment manufacturing industry faces many global challenges due to various factors including competition, increased production costs, less productivity/efficiency and labor attribution. So, there is a need to focus and concentrate on identifying the real issues, taking corrective actions suited to the specific industrial centre of the unit, empowering the technical and managerial staff by enhancing

their knowledge and ability, analyzing orders efficiently and deciding whether actions are viable for the company. The world economy has changed in significant ways during the past several decades, especially in the areas of international trade and industrial organization. Two of the most important new features of the contemporary economy are the globalization of production and trade. Therefore today's technological systems are characterized by orientation to productivity; this can be achieved through the apparel engineering. This paper introduces the various concepts and methods that have been used in Industrial Engineering as a part of Apparel Engineering in Garment industries. Generally, Industrial Engineering is defined an approach applied to all factors, including human factor involved in the production & distribution of production and services.

In (Sudarshan and Nageswara, 2014) have studied that the readymade garment (RMG) industries produce momentous quantities in shorter cycle times. Garment product is highly correlated with high level of productivity as sewing line is balanced in shorter possible time and effective way for each style of garment and required quantity. The focal constraint against the higher productivity is the difference in individual capacity leading to improper line balancing and thus abottle neck. This paper is based on an effective layout model to clear the bottleneck process through benchmark capacity leading for a balancing process using two separate concepts of manufacturing processes- modular line and Traditional system both together.

2.1 BENEFITS OF INDUSTRIAL ENGINEERING

The basic aspect of a business is to control the expense and accelerate the profit. This is the ultimate key for successful business. The sheer method to cut the cost is implementation of ideas. Industrial engineering is that arm of engineering which is concerned with the deduction of cost and enhancement of profit. The process of industrial engineering is to layout the effective operations.

- Industrial engineers identify the waste and thus it turns into optimum utilization.
- The distribution and production process can be enhanced and improved with seeking support from the industrial engineers.
- Renders effective solutions and creative ideas to boost the production level of a business.
- The industrial engineers can analyze and identify the running weakness of a firm or business and module it into positive aspects.

Responsibilities of Industrial Engineers,

Though the time study and motion study are the most common function of Industrial engineer, the some other responsibilities are,

1. Planning layouts
2. Monitoring Production flow system
3. Deicide the machines and attachments for all style
4. Pay system
5. Monitoring and improve the operator performance
6. Operator training
7. Production control system
8. Quality control

2.2 INDUSTRIAL ENGINEERING PROCEDURE

This one is really a tough question to answer. As I don't know if there is a defined IE procedure for the garment industry. So, instead of defining Industrial Engineering (IE) procedure I would to explain things for better clarification. In garment production Industrial Engineers do a number of tasks. They use number of tools and techniques, and methods for the tasks. I would say it is not exactly IE procedure but procedure of implementation of IE tools and techniques.

2.3 OB SHEET

IMAAGE		Style#:		Prepared/Revised On:		Planned Target/Shift:	600
		Line No:		Sample Size	L	Working time:	600
		Product:	Womens T-shirt	Planned Operator:	11	Total SAM	6.43
		Program:	Crew neck top	Planned Efficiency:	60%	Planed SAM:	10.72

Sl.no	Operation	SAM	Target /Hr	Planned Smv	Planned Target/Hr	Machine/ Manual Type	Attachment /Folder	Station	Grade	Seam Length	Needle	Looper
1	Sleeve hem	0.50	120	0.833	72	3T F/L		0.8	B	28	SPUN	FILAMENT
2	Shoulder attach	0.40	150	0.667	90	4T O/L		0.7	C	10	SPUN	FILAMENT
3	Bottom hem	0.60	100	1.000	60	3T F/L		1.0	B	48	SPUN	FILAMENT
4	Sleeve attach	0.75	80	1.250	48	4T O/L		1.3	A	44	SPUN	FILAMENT
5	Side seam	0.83	72	1.383	43	4T O/L		1.4	A+	40	SPUN	FILAMENT
6	Neck rib ready	0.40	150	0.667	90	4T O/L		0.7	C	3	SPUN	FILAMENT
7	Neck rib attach	0.50	120	0.833	72	4T O/L		0.8	B	32	SPUN	SPUN
8	Neck tape attach	0.51	118	0.850	71	SNLS UBT		0.9	B	9	SPUN	SPUN
9	Neck loop attach	0.49	122	0.817	73	SNLS UBT		0.8	B	1	SPUN	SPUN
10	Neck top stitch	0.45	133	0.750	80	2T F/L		0.8	B	22	SPUN	FILAMENT
11	Neck tape closing	0.50	120	0.833	72	SNLS UBT		0.8	B	10	SPUN	SPUN
12	End tack	0.50	120	0.833	72	SNLS UBT		0.8	B	3	SPUN	SPUN

PREPARED BY CHECKED BY APPROVED BY

Line layout:

LINE LAYOUT

LINE: **STYLE:**
WORK STATION: 12 **TARGET: 600**

W/S	Machine Type	Operation	Operation	Machine Type	W/S
21					22
19					20
17					18
15					16
13					14
11	SNLS UBT	Neck tape closing	End tack	SNLS UBT	12
9	SNLS UBT	Neck loop attach	Neck top stitch	2T F/L	10
7	4T O/L	Neck rib attach	Neck tape attach	SNLS UBT	8
5	4T O/L	Side seam	Neck rib ready	SNLS UBT	6
3	3T F/L HEM	Bottom hem	Sleeve attach	4T O/L	4
1	3T F/L HEM	Sleeve hem	Shoulder attach	4T O/L	2

Prepared By: Supervisor:
Checked By: Incharge:
Approved By: PM:

3 Materials and Methods

As the study is based on knit garments so the experiment was done on knit garments also. The first experiment was studied on a knitted T-shirt. After taking the sample Analysis was done through a several steps. The experiment and analysis is presented bellow correspondingly.
At first I noted some important information regarding types of fabric used to produce the specimen, fabric composition, Item types, Buyer name, Order NO, Style NO, Order quantity etc.

Fabric Types: Single Jersey (S/J)
Item Types: Long sleeve T-shirt
Fabric Composition: 80% cotton + 20% polyester
Buyer Name: ADLER
Oder NO: 38
Style NO: 0053
Oder Quantity: 7000

This is the most important task needed to do before starting production. Because this gives a clear view of the total jobs needed to complete the garments. Normally the responsible person or (IE) gives the breakdown of garments. This is also called operation bulletin.

1. Front & back part match by helper
2. 1st shoulder join over lock machine
3. Rib join
4. Neck piping
5. Neck top stitch
6. 2nd shoulder join
7. Shoulder out tuck
8. Sleeve hem
9. Thread cut
10. Body & sleeve match
11. Sleeve join
12. Side seam close & main label join
13. Thread cut
14. Body hem
15. Sleeve in tuck
16. Care label join
17. Thread cut

There are some important calculations closely related to the production. The calculation is too much essential for costing, time estimating, target setting, shipment, worker grading etc.
Different operation takes different time. So, the SMV is also different for each operation. Calculate SMV of each operation and then compared with the SMV calculation of the floor. Saw that it was same in both cases. The SMV of the garments can be obtained by adding all the individual SMV of each operation. The individual operation SMV gives worker ratting, capacity, individual process

target, worker grading and finally line target which ultimately influences the production or efficiency. The final SMV of the garments gives the time required to complete the garments, line target, Output, Efficiency and Costing etc.

3.1 Front & back part match calculation

Actual time = 0.22min
Observe time = 0.20min
Ratting = (observe time/actual time) ×100
= (0.22/0.20)×100
=90%
Basic time = observe time ×ratting
= 0.20×90%
= 0.18
SMV = basic time + allowance
= 0.18+20%
= 0.22min
Target = 60÷SMV
=60÷0.22
=272

Now the calculation bellow obtained from the data presented above.

Pitch time = smv/total operation
=5.33÷17
=.31
Efficiency

= (Output × SMV) ÷ (Manpower × Working hour×60) × 100
= (1530×5.33) ÷ (19×8×60) ×100
= 85%

Production

= (total manpower× total working hour ÷smv) × 85% = (20×8×60) × 85% =1530

SAH = (Output × SMV) ÷ 60
= (1530×5.33) ÷60
=136

3.2 METHODOLOGY

- Operation Sequence
- Sam

- ☐ Target
- ☐ Planned Smv
- ☐ Planned Target
- ☐ Machine Type
- ☐ Attachment Folder
- ☐ Station
- ☐ Grade
- ☐ Sample Pcs Image
- ☐ Style No
- ☐ Product Type
- ☐ Line Number
- ☐ Program
- ☐ Sample Size
- ☐ Planned Operator
- ☐ Planned Efficiency
- ☐ Planned Target /Shift
- ☐ Total Garment Sam
- ☐ Planned Sam

3.3. IE WORK FLOW CHART

Still if you like to know about IE procedures, it can describe with a work flow. Most common tasks of an IE are presented in an order in the following.
Style analysis --> Make operation breakdown --> Thread consumption calculation--> Making line layout on paper --> Select m/c and equipment --> arrange guides and attachment -->Planning for production target --> Setting line when new style is loaded --> Do line balancing --> Record production data --> Make production reports --> Report to higher management (P.S. This is just an example of work flow).

Industrial Engineering A new concept of Apparel Engineering. The world economy has changed in significant ways during the past several decades, especially in the areas of international trade and industrial organization. Two of the most important new features of the contemporary economy are the globalization of production and trade. Therefore today's technological systems are characterized by orientation to productivity; this can be achieved through the apparel engineering. This paper introduces the various concepts and methods that have been used in Industrial Engineering as a part of Apparel Engineering in Garment industries. Generally, Industrial Engineering is defined an approach applied to all factors, including human factor involved in the production & distribution of production and services. Further this paper discusses the various basic works of the industrial engineers and the importance of it in achieving the good productivity and improve efficiency.(5)
Application of industrial engineering in Apparel industry. The paper comparing the productivity and efficiency before and after applying the Industrial engineering technique. This is true today Millions of dollars are wasted each and every day in organization, through lack of awareness of this need to constantly improve productivity. Most of it can be stopped. By using method, time, capacity and production study, it is possible to improve productivity while reducing wastage. Two important attributes have been considered, one is possible standard method for each process and another is

considerable time. Time study took to record the actual individual capacity of each worker. The time has been recorded to make each process for each and every worker to find out the optimum number of operator and helper, type of machines, basic and standard pitch time and individual capacity. To find out the (standard minute value) S.M.V, process wise capacity has been calculate

Industrial Engineering Techniques

- Work study
- Capacity study
- Method study
- Time study
- Engineering layout
- Line balancing

4. Result and Discussion

From the experimental details on discussion I come to know that several personnel and machineries are involved in industrial engineering production which developed merchandising department, production department, finishing department, quality assurance production etc. The industrial department accepts various steps to increase production.

A standard working procedure is involved maintaining IE department. The procedure is done step by step. These steps are made day by day with experiences met by the Industrial Engineering department. I also come to know a standard operating procedure of production by the IE department.

To complete the total garment it needs 17 operations. All the operations don't take equal time to complete. The minimum time (SMV = 0.16) taken by the operation named thread cut and maximum time (SMV = 0.79) taken by the operation named thread cut. The difference is too high and numerical value is 0.63. This time is enough to complete another 2 processes as the average SMV called pitch time is 0.31. So, it is a clear indication that the bottleneck occurs in those operations having more SMV. Now the main task is to minimize the bottleneck as possible. To do this some steps should be taken. If the operation having SMV 0.79 can be divided in to 3 operators then it takes time near about 0.26 that is available in other operations. But it is a matter of more cost.

Another step can be taken that the operation can be divided within the existing operators. Some operations take low SMV than the pitch time such as thread cut 0.16, sleeve hem 0.19 and so on. They can be employed to do the part of the divided operation having more SMV. Because their output is so high and after a time they sit idle as the lengthy operations can't complete their output and bottle neck occurs. In this case the operators have to be trained to do versatile work. These measures don't take more cost usually.

5 Conclusions

We create operation bulletin sheet and line layout. So it is easily analyse thread consumption, manpower, efficiency, target, production per day, target, cost, sample size, methodology, grade for the particular style. It's also easier to show the operation bulletin sheet and line layout to the buyer.

Result would have been more effective if would have taken some large quantity order and balancing the process is highly related to the type of machines as machine utilized in bottleneck and balancing process should be similar.

Further improvements in the productivity can be achieved by considering large amount of order. The new bench mark target which can be the further chance of improvements to balance the line. Skilled workers are eligible for the production processes and proper training and supervision is essential to achieve the optimum improvements on productivity and efficiency. Researchers can do work regarding this issue.

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