



**Faculty of Engineering
Department of Textile Engineering**

REPORT ON

**“Study on Industrial Engineering in Woven
garments production”**

**Course Title: Project (Thesis)
Course Code: TE 4214**

Submitted By

Md. Ashikur Rahman	ID: 153-23-4472
Md. Imran Shekh	ID: 153-23-4501
Md. Muaz Hossain	ID: 153-23-4509

Supervised By

**Md. Abdullah Al Mamun
Assistant Professor**

This Report Presented in Partial Fulfillment of the Requirements for the Degree
of Bachelor of Science in Textile Engineering.

Advance in Apparel Manufacturing Technology

August, 2018

Declaration

We attest that this report is totally our own work, except where we have given fully documented references to the work of others and that the materials contained in this report have not previously been submitted for assessment in any formal course of study. If we do anything, which is going to breach the first declaration, the examiner/supervisor has the right to cancel my report at any point of time.

.....

Name: Md. Ashikur Rahman

ID: 153-23-4472

.....

Name: Md. Imran Shekh

ID: 153-23-4501

.....

Name: Md. Muaz Hossain

ID: 153-23-4509



Faculty of Engineering

Department of Textile Engineering

Approval Sheet

This research entitled “Study on Industrial Engineering in Woven garments production’ at **Daffodil International University, August, 2018**” prepared and submitted by **Md. Ashikur Rahman (ID#: 153-23-4472)**, **Md. Imran Shekh (ID#: 153-23-4501)** & **Md. Muaz Hossain (ID#: 153-23-4509)** in partial fulfillment of the requirement for the degree of BACHELOR OF SCIENCE IN TEXTILE ENGINEERING has been examined and hereby recommended for approval and acceptance.

Md. Abdullah Al Mamun
Assistant Professor
Supervisor

Acknowledgement

At first we would like to express our deep appreciation to Allah for providing the opportunity to complete our Thesis “Study on Industrial Engineering in Woven garments production.”

Then, our special thanks go to **Md. Abdullah Al Mamun**, Assistant Professor, and Department of textile Engineering, Daffodil International University for his encouragement and valuable suggestions.

We would like to thank the management of the “**STANDARD GROUP**”, for giving us the opportunity to perform the Thesis successfully.

We are indebted to **Mr. Alomgir Hossain Assistant Manager of IE Department of STANDARD GROUP** for his valuable teaching, advising, supervising and training during our industrial attachment. We hope his valuable information regarding to production process will help us a lot for our future carrier.

Dedication

We dedicate this report to our **Parents** who give us chance to study in Textile Engineering and support us all time.

Specially dedicate this report to our teachers and all the people who have helped us to complete this report.

Abstract

This project is on “Study on Industrial Engineering in Woven garments production”. Traditionally operated garment industries are confronting issues like low productivity, low efficiency, longer production lead time, high remake, modify, and rejection, poor line balancing, low flexibility of style change over etc. These problems were addressed in this study by the using of Industrial Engineering. This paper introduces the various concepts utilizing method, time, limit and production study, it is conceivable to enhance productivity while reducing wastage. Work study took to record the actual individual capacity of each operator. We have recorded the actual cycle time to each operation for each and every operator and helper to discover the ideal number of worker, type of machines, and individual capacity. To find out the standard minute value (SMV) = 22.70, in additional to that we have calculated the target = 723 pcs, pitch time = .50, upper control limit = .62, lower control limit=. 38, efficiency = 72%, manpower = 45, capacity = 651, labor productivity. In this paper we discussed about 5 pocket denim pant’s measurement sheet, layout plan, and the operation breakdown, SMV calculation for each operation , Target calculation for each operation, pitch time, upper control limit, lower control limit, efficiency, process wise capacity has been calculated, and others tools and techniques which consist of different experimental details, experimental result and discussion.

Table of Contents

1. Introduction:	1
1.1. Industrial engineering:.....	1
1.2. Background of Industrial Engineering:	1
2. Literature Review.....	2
2.1. Industrial engineering:.....	3
2.2. Objectives of industrial engineering:	3
2.3. IE Department working procedure:.....	3
2.3.1. For pre-production of development step:	3
2.3.2. For pre-production of conform step:	4
2.3.3. For production step:.....	4
2.4. Working Field of IE	5
2.4. Applications of Industrial Engineering:	6
2.4.1. Merchandising	6
2.4.2. Production Planning:	7
2.4.3. Maintenance:	8
2.4.4. Production:.....	8
2.4.5. Quality:	8
2.4.6. Human Resource:	8
2.4.7. Production Follow up:	9
2.4.8. Obligations of an executive:	9
2.5. Lean Manufacturing:	10
2.6. Some important definition:.....	11
2.6.1. Time study:.....	11
2.6.2. SMV:	11
2.6.3. Cycle Time:	11
2.6.4. Tack Time:.....	11
2.6.5. Pitch Time:	11
2.7. Work study:	11

2.7.1. Advantages of work study:	12
2.7.2. Techniques of Work-Study:	12
2.7.3. Some Terms of Work Study:	12
2.8. Method study:.....	13
2.8.1. Purpose of Method Study:	14
2.9. Motion Study:.....	14
2.9.1. Principles of Motion Study:.....	15
2.10. Capacity Study:	15
2.10.1. Procedure:.....	15
2.10.2 Allowances:	16
2.11. Breakdown/Dividing/Operation Bulletin:	16
2.12. Layout:	16
2.13. Line Balancing:	17
2.13.1. Importance of Line Balancing:	17
2.14. Bottleneck Process:	17
2.14.1. Bottleneck in line:.....	18
2.14.2. Way of reducing bottle neck:.....	18
2.15. Standard Minute Value (SMV):	18
2.15.1. Calculation of SMV:.....	19
2.16. Lean:.....	19
2.17. Objectives of 5s:.....	19
2.17.1. 5s can be applied:	20
2.18. Useful Formulas for Industrial Engineers:	20
2.19. Why Industrial Engineering is Need in Apparel Industry?	21
2.20. Working area of Industrial Engineering:.....	21
3. Methodology	22
3.1. Data collection:	23
3.2. Product information:	23
3.2.1. Product Sketch:.....	23
3.3. Measurement sheet:.....	25
3.4. Operation Break down:	28
3.4.1. Operation Breakdown Procedure:	28
3.4.2. Operation Breakdown Chart:.....	28

3.5. Layout Plan:	30
3.6. SMV Calculation:.....	34
3.6.1. Actual SMV in line:.....	35
3.7. Target Calculation:	38
3.8. Basic pitch time calculation:	39
3.8.1. Pitch Chart:	40
3.9. Line Balancing:	41
3.10. Efficiency Calculation:.....	42
3.11. Capacity Calculation:	43
4 . Result and discussion.....	45
4.1. Operation breakdown	46
4.1.1. Result:.....	46
4.1.2. Discussion:	46
4.2. Manpower:	46
4.2.1. Result:.....	46
4.2.2. Discussion:	46
4.3. Required Machine:	46
4.3.1. Result:.....	46
4.3.2. Machine type:	46
4.4. Time Study:.....	47
4.4.1. Result:.....	47
4.4.2. Discussion:	47
4.5. Line target:	48
4.5.1. Result:.....	48
4.5.2. Discussion:	48
4.6. Production capacity:.....	48
4.6.1. Result:.....	48
5: CONCLUSION.....	49
5.0. CONCLUSION.....	50

List of Table

3.1 Measurement Sheet	28
3.2 Operation Breakdown	30
3.3 Actual SMV in line	38
3.4 Capacity Calculation	45

List of Graph

3.1 Pitch time	41
3.2 Line Balancing	42
4. 1 Pitch time	48

List of Figure

2.1 Working Field of IE	5
3.1 Product Sketch	24
3.2 Product Sketch	24
3.3 Layout of 5 pkt pant.....	31
3.4 Layout of 5 pkt pant.....	32
3.5 Layout of 5 pkt pant.....	33
3.6 Layout of 5 pkt pant.....	34

1. Introduction:

Engineering makes things helpful to man. Industrial engineering is the engineering in which is applied to all factors, including the human factor, engaged with the product and allocation of goods and supplies. IE is going to play a significant role in developing productivity. Different work study techniques are utilized to analyze and enhance the working method to take out waste and appropriate distribution and using of resources.

1.1. Industrial engineering:

IE is a branch of engineering which is utilized to reduce waste of time, product cost, materials, machine time, working-hours, and different resources that are adding value. As like many other manufacturing industry, IE is now broadly used in textile and RMG sector. Textile and RMG sector have to face heavy Challenges because of different different factors, including their global competition, product price increase, low productivity, labor corrosion and many more. For surviving in those difficulties work study sense and formulas are utilized in RMG sector. In this article I have given some important and essential definition and formulas of industrial engineering.

1.2. Background of Industrial Engineering:

It is linked with industrial revolution and passed through many phases to reach present advanced stage. Frederick Taylor is named as father of scientific management and industrial engineering. But before Frederick Taylor, Adam Smith gave concept of Division of Labor through his book The Wealth of Nations. Also James Watt, Bolting Mathew and Robinson obtained a place in the history of Industrial Engineering because of their work related with improvements in the performance of machines and industries.

2. Literature Review

2.1. Industrial engineering:

A branch of engineering dealing with the design, development, and implement of integrate system of humans, machines, and information resources to provide products and services. Industrial engineering encompasses specialized knowledge and skills in the physical, social, engineering, and management sciences, computer system, and information technologies, manufacturing processes, operation researches, production and automation. The major activities of Industrial engineering stem from manufacturing industries and include work methods analysis and improvement.

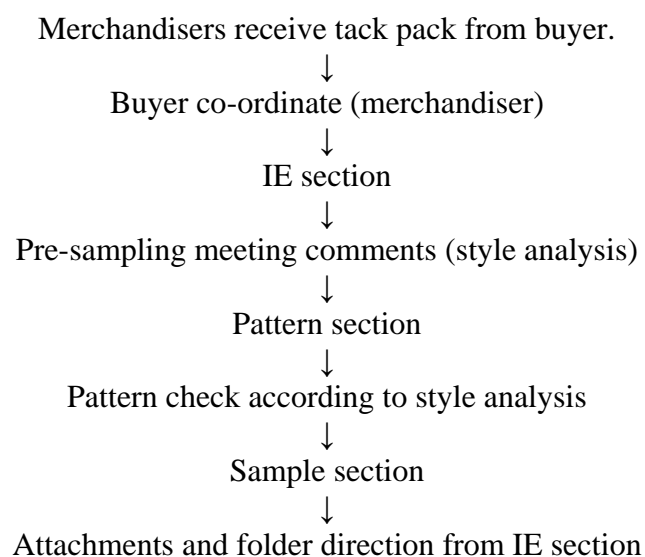
Industrial engineering (IE) = Production ↑ cost↓ proper use of all elements↑ efficiency↑ profit↑

2.2. Objectives of industrial engineering:

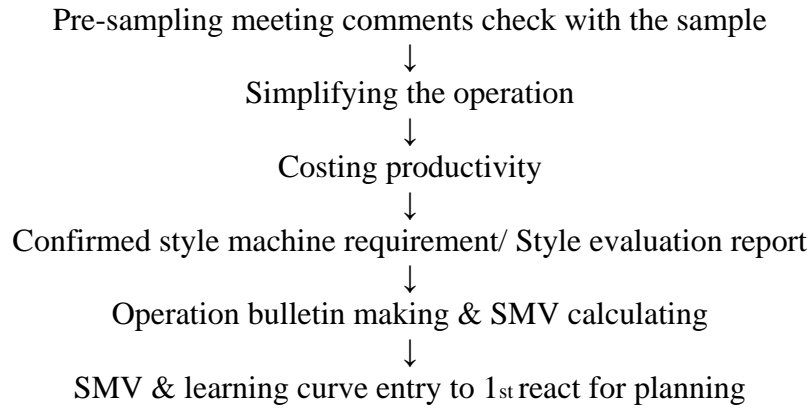
- Improving process and method of working to increase factories overall performance and standardized garment manufacturing processes.
- Monitoring production floor and having better control over the production floor.
- Contribute to the success of companies throw effective problem solving.

2.3. IE Department working procedure:

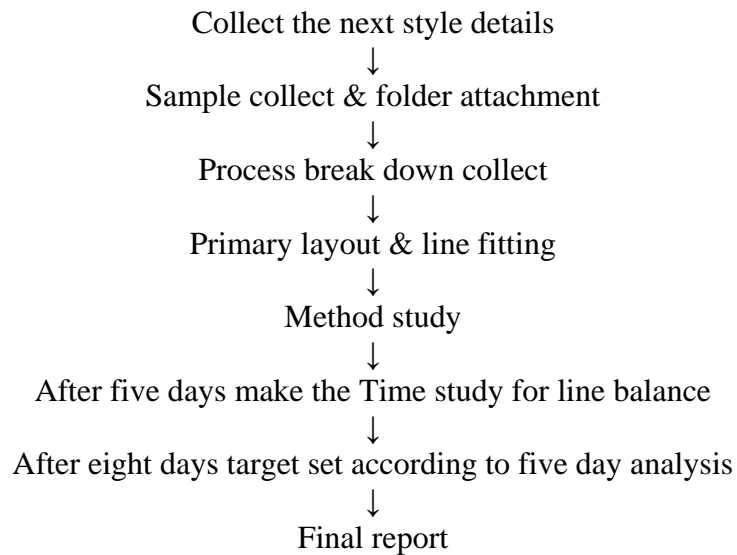
2.3.1. For pre-production of development step:



2.3.2. For pre-production of conform step:



2.3.3. For production step:



2.4. Working Field of IE



Figure 2.1 : Working Field of IE

2.4. Applications of Industrial Engineering:

The parts and duties of the Industrial Engineering office are not simply restricted to timing administrators and making task notices as it is just a piece of the activity. The I.E work can contribute essentially to change in working and efficiency of all the bureaus of clothing fabricating. Give us a chance to examine few of the exercises of different areas of clothing producing which can be related with mechanical designing.

2.4.1. Merchandising

In merchandising Department the Industrial engineer can work closely in following:

Product Analysis-

- Determine the optimum method of construction to achieve required finished product Quality.
- Install the operation sequence (Operation bulletin).
- Specify the equipment system and work aim to be used.

Activity announcement moreover contains some different parameters as takes after:

- Target
- Efficiency
- Output (per day)
- Capacity
- Total no of work places
- Total standard time

It can be extended to include

- Hourly/ period targets for each operation
- Manpower Requirements
- Equipment Requirements

The operation bulletin is a fundamental planning tool used for many functions such as

- engineering Methods
- planning Line
- planning Capacity
- measurement Performance
- Manpower planning
- Investment appraisal
- Incentive payment
- loading Factory

2.4.2. Production Planning:

Production planning is an essential prerequisite to production control. It involves management decisions on the resources that the firm will require for its manufacturing operations and selection of these resources to produce the desired goods at the appropriate time and at the least cost. Production planning is defined as, “the technique of foreseeing or picturing ahead, every step in a long series of separate operations, each step to be taken in the right place, of the right degree and at the right time, and each operation to be done at maximum efficiency. “Production planning provide a line for effective, balanced flow of product, incorporating line and individual (operation) productivity standards. The end product of production planning efforts is the formulation of production plans. The plans are formulated in light of specified future period. The plans are to be implemented in the light of the estimated cost and agreed policies.

- Plant limit can be ascertained by I.E department with the goal that arranging can book arrange according to the accessible limit.
- I.E can aid better arranging by aiding in better style designation to various units or lines.
- I.E can figure a proficiency/execution develop for a specific style in light of the work content or past execution. This can advise the arranging department that a specific line will take how long to deliver a particular amount of a style. This will help the arranging department to design the accessibility of assets and material ahead of time.

2.4.3. Maintenance:

Proper support prompts better limit use of same resource, keeping away from accordingly the interest moreover offices. So far businesses tend to disregard support work, supposing it be a not all that imperative occupation, anyway fundamental.

2.4.4. Production:

Mechanical building is a key piece of a creation procedure. One of the fundamental elements of building is to get actualities. These realities might be in type of a period think about, the designer has made or taken a toll report the architect has outlined. So we can state that the fundamental requirement for building is the requirement for management information.

2.4.5. Quality:

Quality is an advantage, which might be offered to the potential client of an item. There are two parts of value, which add to a definitive nature of the item. Nature of configuration is the primary viewpoint, which relies upon the kind of materials utilized, specs determined by the purchaser, technique for creation, information of the outline and expertise level of the individual. How much this quality is accomplished underway that is the nature of conformance is the second viewpoint.

2.4.6. Human Resource:

Manpower Planning- I.E can figure the labor required to play out a particular employment at a specific execution level. The labor can likewise be computed according to the limit of the plant utilizing standard proportions like Man to Machine proportion. The quantity of individuals for a manufacturing plant having x number of machines can be settled through this proportion.

Skill Matrix- Aptitude framework alludes to the database of accessible laborer expertise in the industrial facility. The workers' ability is dissected on various employments and in view of his/her execution on a specific occupation a review is given. This review characterizes the level of execution that administrator can accomplish on that particular occupation.

2.4.7. Production Follow up:

“Follow up” implies that somebody "checks and Stays with" something until the point that the coveted outcomes have been accomplished. Numerous beneficial plans and undertakings have fizzled in light of the fact that somebody didn't development. So for the motivations behind this preparation follow up intends to remain over something until the point that the coveted outcomes are accomplished."

Uses of operator follow up: There are a number of uses for operator follow up:

Improve Performance (Motivate)-

As a rule, operators are not delivering as much as they can. They have no specific issues, yet are simply not giving, it the push to be a 100 percent administrator. Follow-up for this situation involves inspiration. The individual doing the follow up ought not just demonstrate the administrator that she can do well, however ought to likewise influence his/her need to keep on to do well. The vast majority who are fit will perform well under development. Also, once they have performed well for a few days or seven days (or possibly more) they become acclimated to this sort of execution (and profit) and afterward tend to remain there.

Prove Job Quotas-

Perhaps the most well-known utilization of development (in any event by engineers) is to demonstrate another standard. As it were, the quantity will be demonstrated if the administrator performs well when contrasted with the new standard. Frequently administrators have a mental protection from change. It is fundamental to get the administrators to conquer this mental hindrance, and that should be possible through development and demonstrating the administrators that progressions can be made acceptably.

2.4.8. Obligations of an executive:

To manage effectively, an official/manager should distinguish and isolate his/her commitments to essential and auxiliary. He/she should first deal with essential commitments sufficiently. Sometimes this implies optional commitments should be assigned to somebody under the administrator's power.

Primary obligations

- Safety Provide
- Balance Plan and production lines
- Follow up on low output employees
- Quality Control
- Discipline
- Utilization Material
- Employees Develop

Secondary obligations:

- Bundle handling and movement
- Adjustments to machines
- Distributes supplies
- Handle parts that needs reprocessing
- Samples
- Maintenance
- House keeping
- Miscellaneous

2.5. Lean Manufacturing:

Lean Manufacturing, additionally called Lean Production, is an arrangement of apparatuses and philosophies that goes for the constant end of all loss in the creation procedure. The primary advantages of this are bring down creation costs, expanded yield and shorter generation lead times. All the more particularly, a portion of the objectives incorporate.

2.6. Some important definition:

2.6.1. Time study:

To determine the time it should take for a qualified worker to performance a specific task using a specific method by directly observing an operator. OR This is a technique used to establish a standard time for an operation.

2.6.2. SMV:

SMV is a standard minute value that it take to complete an operation including allowances using scientific technique to establish that standard time at normal pace based designed work method.

$SMV = \text{basic time} + (\text{basic time} * \text{allowance})$

2.6.3. Cycle Time:

The actual time taking by a worker at working pace to complete an operation. A measurement technique (time study) is used to measure that time.

2.6.4. Tack Time:

Tack time can be defined as the rate at which customers need products. The products should be produced at least equal to tact time to meet the customer demand.

$Tack\ time = \text{Working time} / \text{Output}$.

2.6.5. Pitch Time:

In industrial Engineering, pitch time is a ratio of total SAM of garment and number of operators to be set for the style. OR

Pitch time: $\text{Garment SAM} / \text{No. of operators}$.

2.7. Work study:

Work study is the systematic examination and development of operational methods and standards to facilitate enhancement of productivity and quality of work of life.

2.7.1. Advantages of work study:

- Uniform and improved production flow
- Reduced manufacturing costs
- Higher productive efficiency.
- Fast and accurate delivery dates.
- Production capacity of mill or machine may be determined.
- Production quota can be determined for daily or hourly works.
- Fast and accurate delivery dates,
- Balanced number of machine & worker may be determined.
- Effective utilization of men, materials and machinery
- Better work place layout; neat and clean environments and working conditions

2.7.2. Techniques of Work-Study:

There are two primary techniques used by Work-Study practitioners:

Method Study: Method study is the process of subjecting work to systematic, critical scrutiny to make it more effective and/or more efficient. It is one of the keys to achieving productivity improvement.

Work Measurement: The application of techniques designed to establish the time for a Qualified worker to carry out a task to a specified method. Work Measurement Study is a general term used to describe the systematic application of industrial engineering techniques to establish the work content and time it should take to complete a task or series of tasks.

2.7.3. Some Terms of Work Study:

Observed time: In industrial engineering, the standard time is the time required by an average skilled operator, working at a normal pace, to perform a specified task using a prescribed method.

Basic time: Basic time of a job is determined by multiplying rating factor to the observed time (cycle time). Basic time is also expressed as Normal time.

Allowance time: It is the time permitted to an worker for non performing assignment, for example, going to research center, rest, evolving needle, taking guideline of boss and so on.

Relaxation allowance: It is the time permitted to the worker to take care of individual need.

Contingency allowance: It is the time permitted to the worker when unverifiable issue happen.

Standard time: It is the time required by operator to complete a job had she worked at 100% rating plus allowance time.

Bottleneck time: It is the highest time taken by an operator compared to other operator's time, generally it is the time beyond the U.C.L.

Rating: Rating is a speed of a qualified worker.

Organization efficiency: It is the efficiency of the production time.

Basic work content: It is the time contents the work without any undue loss of time.

Work count: It is the time value required by operation.

Ineffective time: It is the time means time loss due to different design fault, production fault, finishing fault etc.

Upper control limit: Upper control limit is the time limit represents efficiency.

2.8. Method study:

Method study is all the more a precise way to deal with work plan than an arrangement of strategies. It is characterized as the precise account and basic examination of existing and

proposed techniques for doing work. Strategy ponder is otherwise called techniques designing. It is one of the keys to accomplishing efficiency change in article of clothing industry. Technique contemplate is basically utilized for discovering better methods for doing work. It is additionally a strategy for cost lessening in articles of clothing fabricating.

2.8.1. Purpose of Method Study:

- The improvement of processes and procedures.
- The improvement of factory, shop and workplace layout.
- The improvement of the design of plant and equipment.
- Economy in human effort and the reduction of unnecessary fatigue.
- Improvements in the use of materials, machines and manpower.
- The development of a better physical working environment.
- Improvement of quality of the products.

2.9. Motion Study:

Motion study is a technique of analyzing the body motions employed in doing a task in order to eliminate or reduce ineffective movements and facilitates effective movements. By using motion study and the principles of motion economy the task is redesigned to be more effective and less time consuming.

2.9.1. Principles of Motion Study:

Following principles should be borne in mind in making motion study:

- Do not do jobs by hands if machines can do them.
- Materials and tools should be close to the point of works and remove them by gravity, if possible.
- Use the fewest motions possible. Move as little of the body as is necessary to do the job.
- Both hands should be used. Hands and feet should be used side by side if they can be used to do some useful movement.
- Mechanical devices should be used for heavy lifting.
- Use the body to best advantages mechanically.
- Eliminate working conditions that add to fatigue such as poor lighting, ventilation, full fame dust conditions etc.
- Allow rest on fatiguing jobs, on monotonous jobs provide occasional break.
- Assign the jobs to the workers which well suited to them. Work should be divided in smaller operations and let them specialize.

2.10. Capacity Study:

It is exactly the measure of the operator same as capability. It means the operator is capable of achieving the performance measured by the study. The major Need for capacity study is to set Quotas, to motivate operator, and to measure the productions section capacity. By measuring the individual operator capacities, supervisor can determine the overall capacity of their section. It is simply the some of individual capacity.

2.10.1. Procedure:

1. Use of stop watch
2. Measure the time study
3. Average the time cycle

2.10.2 Allowances:

Allowances are added to the 100% time determined by a time study to give a Standard Time which will provide the average operator to earn a satisfactory wage, provided there is no abnormal incidence of delays and she applies herself to her work. These are also used while estimating an operator's capacity. Three categories are recognized: -

- ✓ Machine delay.
- ✓ Personal and fatigue.
- ✓ Incentive.

2.11. Breakdown/Dividing/Operation Bulletin:

Breakdown is a listing of the content of a job by elements. A garment consists of some parts & some process 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

2.12. Layout:

Layout means to distribute/allocate elements to the individual operator in the line by considering total worker, worker experience, total machine, types of machine & mainly the estimated SMV of allocated/distributed elements in a broken down garments. A good layout is that physical arrangement, which permits the product to be produced with minimum unit cost in the shortest time.

2.13. Line Balancing:

Line Balancing is leveling the workload across all processes in a cell or value stream to remove bottlenecks and excess capacity. A constraint slows the process down and results in waiting for downstream operations and excess capacity results in waiting and absorption of fixed costs. It is the allocation of sewing machine, according to style and design of the garments. It depends on what types of garments we have to produce. It is done to increasing productivity.

2.13.1. Importance of Line Balancing:

- It becomes easier to distribute particular job to each operator.
- 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.
- Line balancing helps to know about new machine required for new style.
- It becomes possible to deliver goods at right time at the agreed quality for list cost.
- Good line balancing increase the rate of production.
- Line balancing helps to compare the required machinery with the existing one and compare balance.
- Proper line balancing ensured optimum production at the agreed quality.
- It reduces faults in the finished product.

2.14. Bottleneck Process:

A bottleneck, in a communications context, is a point in the enterprise where the flow of data is impaired or stopped entirely. Effectively, there isn't enough data handling capacity to handle the current volume of traffic. A bottleneck in a process occurs when input comes in faster than the next step can use it to create output. A garments sector is a production sector and the bottleneck used here as obstruction of normal production.

2.14.1. Bottleneck in line:

- Wrong worker selection Works flow wrong / sequence of works.
- Non balance allocation of elements.
- Negligence works by workers.
- Lack of supply.
- Workers absenteeism.
- Machine disturbances / out of order.
- Non serial supplies forward from workers.
- Color shading.
- Quality problem.
- If anybody becomes sick.

2.14.2. Way of reducing bottle neck:

- To make size set sample minimum 10 to 15 days before input.
- To arrange pre-production meeting in time.
- To prepare layout sheet before input in the line.
- To check fabrics and accessories before issuing in the line.

2.15. Standard Minute Value (SMV):

SMV is One of the tasks done by the IE department is to calculate the time taken to make a specific garment. This is usually called a SAM (Standard Allowed Minute), although some factories call this the Standard Minute Value (SMV).

Standard Allowed Minute or Standard Minute Value (SAM or SMV) is an important factor in garments manufacturing industry. Production rate can be calculated by using it.

2.15.1. Calculation of SMV:

SMV = basic time + (basic time * allowance)

Basic time = observed time * rating

Observed time = total cycle time / no of cycle

If time for sewing a side seam of a denim pant is 20, 20, 18, 22 and 20 seconds

Observed time = $(20+20+18+22+20)/5 = 20$

If workers rating is 0.80

Basic Time = Observed Time* Rating

SMV= Basic Time + (Basic Time*Allowance)

2.16. Lean:

Lean manufacturing, also referred to as lean production, is a systematic approach to achieving highly efficient factory or plant operations through eliminating waste. Lean is a Culture which ensures a beautiful and suitable environment of work. Under Lean culture, working equipment's must be well arranged, Working place must be clean, all the workers and staffs must be disciplined and production of products is carried out following a definite plan.

- Optimizing use of equipment and space
- Reducing inventory levels at every stage of production
- Improving workforce productivity
- Reducing lead and cycle times

2.17. Objectives of 5s:

- To reduce wasted effort
- To reduce wasted time
- To reduce wasted money
- To reduce accidents
- To reduce stress
- To improve customer services

2.17.1. 5s can be applied:

- In Homes
- In Schools
- In Offices
- In Factories
- In Hospitals
- In Work-sites
- In Military Establishments
- In Fact anywhere

2.18. Useful Formulas for Industrial Engineers:

Formula 1:

Daily Line Target = (Total working minutes in a day X No. of operators in a line X Line eff%)/Garment SMV.

Formula 2:

Individual operator target = (Total working minutes in a day X line efficiency %)/Operation SMV.

Formula 3:

Line Efficiency% = (Line output X garment SMV X 100)/(Number of operators X minute worked in day)

Formula 4:

Labor Productivity = Line output / No. of total manpower (operators +helpers)

Formula 5:

Machine utilization% = (Actual Machine running Time X 100) / Time available

2.19. Why Industrial Engineering is Need in Apparel Industry?

Industrial way of garment production needs a thorough preparation of production because in the same time, it is necessary to combine a few factors: people, time, machines and place of production, organization and material in a coordinated and rational system. Technological system of garment production must enable expected quality of product, necessary scope of production, delivery of ready-made garments in the expected time, maximum use of capacity with minimum expenses. An Industrial Engineer can perform several activities to fulfill their task, Processes and Procedures of manufacturing or service activities can be examined through Process Analysis. Industrial engineers can use Work Study comprehending Method Study and Time Study. The mentioned activities are also called operations Management. Furthermore can Industrial Engineering involve inventory management to make a manufacturing process more feasible and efficient. Industrial Engineers used to increase efficiencies and cost-effectiveness of operations by the products strategies like High-volume production, long-runs and minimal variations.

2.20. Working area of Industrial Engineering:

Most in Manufacturing, such as:-

- Manufacturing Engineering
- Plant Engineering
- Process engineering
- Quality Engineering
- Methods and system Improvement and many more.

3. Methodology

3.1. Data collection:

We collect our experiment data from different section of a woven garment factory.

First we collect data from Industrial engineering section then we collect data from merchandising section and sample section. We also collect data from line where we work our experiment. And we get information from production manager.

3.2. Product information:

Product Name: Men's basic 5 pocket denim long pant

Buyer: ASDA

Item: Basic 5 pocket denim pant

Style: OPP JEAN 32

Total no of machine: 38

Total no of operation: 45

Total no of operator: 45

Total SMV: 22.70

Target: 723

Capacity: 651 pcs

3.2.1. Product Sketch:

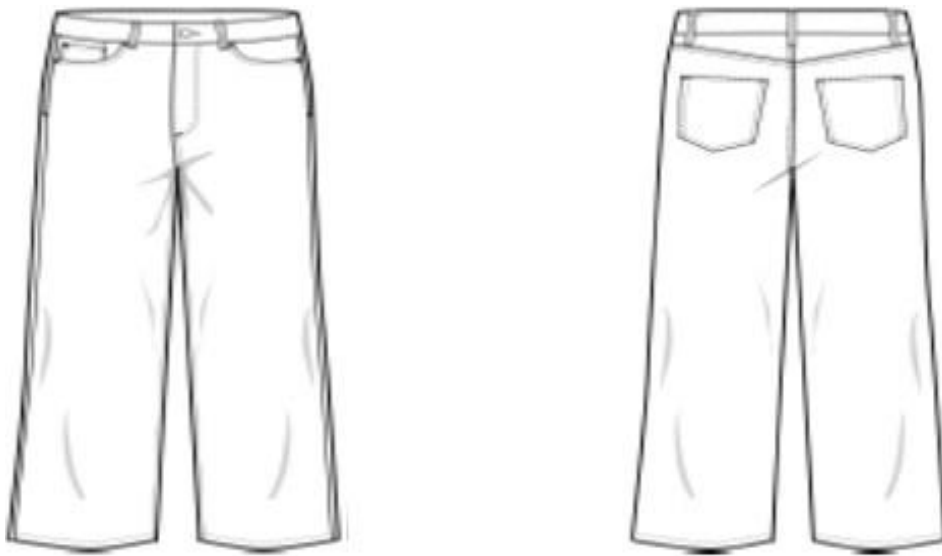


Fig 3.1: Product Sketch



Fig 3.2: Product Sketch

3.3. Measurement sheet:

OPP JEAN SUM FIT

Global Design Pack # 1205795

Wal-Mart Final Not Approved Graded Spec Sample Nbr: 4													
Style #		Product Description		Component Description									
OPP SLIM FIT		1 - OPP SLIM FIT JEAN		AW18 PH2 DENIM SLIM LEG JEAN									
Available Sizes:													
30", 32", 34", 36", 38", 40", 42", 44", 46"													
Product Area		Size Range		Component		UOM		CM					
MENS		MENS T/J/SH											
POM Ref	POM Description	Pos. Tol.	Neg. Tol.	30"	32"	34"	36"	38"	40"	42"	44"	46"	
	WAIST WIDTH	1.00	-1.00	41.00	43.00	45.00	47.50	50.00	52.50	55.00	57.50	60.00	
	HIP POSITION FROM WAIST	1.00	-1.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	
	MID HIP MEASURED IN A V	1.00	-1.00	50.00	52.50	55.00	57.50	60.00	62.50	65.00	67.50	70.00	
	THIGH AT CROTCH	1.00	-1.00	30.50	31.50	32.50	33.75	35.00	36.25	37.50	38.75	40.00	
L-15-GEN	KNEE AT HALF LEG	1.00	-1.00	18.50	19.50	20.50	21.50	22.50	23.50	24.50	25.50	26.50	
	HEM WIDTH	1.00	-1.00	17.50	18.00	18.50	19.00	19.50	20.00	20.50	21.00	21.50	
L-01-GEN	FRT RISE	0.50	-0.50	29.00	30.00	31.00	32.00	33.00	34.00	35.00	36.00	37.00	
L-05-GEN	BACK RISE	0.50	-0.50	36.50	37.50	38.50	39.50	40.50	41.50	42.50	43.50	44.50	
	INSIDE LEG (SHORT)	0.00	0.00	76.00	76.00	76.00	76.00	76.00	76.00	76.00	76.00	76.00	
	INSIDE LEG (REGULAR)	0.00	0.00	81.00	81.00	81.00	81.00	81.00	81.00	81.00	81.00	81.00	
	INSIDE LEG (LONG)	0.00	0.00	86.00	86.00	86.00	86.00	86.00	86.00	86.00	86.00	86.00	
	WAISTBAND DEPTH	0.00	0.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	
	BACK YOKE DEPTH	0.00	0.00	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	
	SIDE YOKE DEPTH	0.00	0.00	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	
	BACK POCKET POSITION FROM WAIST SEAM	0.00	0.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	
	BACK POCKET POSITION FROM SIDE SEAM	0.00	0.00	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	
	CENTRE POCKET LENGTH (BACK)	0.50	-0.50	16.50	16.50	17.50	17.50	18.50	18.50	18.50	19.50	19.50	
	POCKET WIDTH (BACK)	0.50	-0.50	16.00	16.00	17.00	17.00	18.00	18.00	18.00	19.00	19.00	
	POCKET OPENING WIDTH (FRONT)	0.50	-0.50	10.50	10.50	11.00	11.00	12.00	12.00	12.00	13.00	13.00	
	POCKET OPENING LENGTH (FRONT)	0.50	-0.50	6.50	6.50	7.00	7.00	8.00	8.00	8.00	9.00	9.00	
	FLY OPENING LENGTH	0.00	0.00	16.00	16.00	16.00	16.00	19.00	19.00	19.00	19.00	19.00	
	FLY WIDTH	0.00	0.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	
	ZIPPER LENGTH	0.00	0.00	15.00	15.00	15.00	15.00	18.00	18.00	18.00	18.00	18.00	
	BACK POCKET WIDTH AT BOTTOM EDGE	0.50	-0.50	13.00	13.00	14.00	14.00	15.00	15.00	15.00	16.00	16.00	
	TICKET POCKET WIDTH	0.50	-0.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	9.00	9.00	
	TICKET POCKET DEPTH	0.50	-0.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	10.00	10.00	

BLOCK REF: MW-DEN-01

Page 8 of 7

Fig 3.2 : Measurement sheet

Measurement Sheet: This picture is not transparent. For clear understanding we make bellow table.

Style#	OPP SLIM FIT	Production Description	1-opp slim fit jeans	component description	-AW18 PH2 DENIM SLIM LEG JEAN						
Available Size :		30", 32", 34", 36", 38", 40", 42", 44", 46"									
Product Area		MENS	Size Range	MENST/J/SH	Component	UOM	CM				

POM Description	pos. Tol	Neg Tol	30"	32"	34"	36"	38"	40"	42"	44"	46"
Waist with	1.00	-1.00	41.00	43.00	45.00	47.00	50.00	52.00	55.00	57.00	60.00
Hip position from Waist	1.00	-1.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00
Mid Hip measured in a V	1.00	-1.00	50.00	52.00	55.00	57.00	60.00	62.00	65.00	67.00	70.00
Thigh at Crotch	1.00	-1.00	30.00	31.00	32.00	33.00	35.00	36.25	37.50	38.75	40.00
Knee at half Leg	1.00	-1.00	18.50	19.50	20.50	21.50	22.50	23.50	24.50	25.50	26.50
Hem Width	1.00	-1.00	17.50	18.00	18.50	19.00	19.50	20.00	20.50	21.00	21.50
FRNT Rise	0.50	-0.50	29.00	30.00	31.00	32.00	33.00	34.00	35.00	36.00	37.00
Back Rise	0.50	-0.50	36.50	37.50	38.50	39.50	40.50	41.50	42.50	43.50	44.50
Inside Leg(Short)	0.00	0.00	76.00	76.00	76.00	76.00	76.00	76.00	76.00	76.00	76.00
Inside Leg(Regular)	0.00	0.00	81.00	81.00	81.00	81.00	81.00	81.00	81.00	81.00	81.00
Inside Leg(Long)	0.00	0.00	86.00	86.00	86.00	86.00	86.00	86.00	86.00	86.00	86.00
Waist Band Depth	0.00	0.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Back Yoke Depth	0.00	0.00	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50
Side Yoke Depth	0.00	0.00	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Back Pocket position from waist seam	0.00	0.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Back Pocket position from side seam	0.00	0.00	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00
Centre pocket Length 9Back)	0.50	-0.50	16.50	16.50	17.50	17.50	18.50	18.50	18.50	19.50	19.50

Pocket Opening Width (Front)	0.50	-0.50	10.50	10.50	11.00	11.00	12.00	12.00	12.00	13.00	13.00
Pocket Opening Length(Front)	0.50	-0.50	6.50	6.50	7.00	7.00	8.00	8.00	8.00	9.00	9.00
Fly Opening Length	0.00	0.00	16.00	16.00	16.00	16.00	19.00	19.00	19.00	19.00	19.00
Fly Width	0.00	0.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Zipper Length	0.00	0.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Back pocket Width at Bottom Edge	0.50	-0.50	13.00	13.00	14.00	14.00	15.00	15.00	15.00	16.00	16.00
Ticket Pocket Width	0.50	-0.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	9.00	9.00
Ticket Pocket Depth	0.50	-0.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	10.00	10.00

Table 3.1: Measurement sheet of a five pocket denim pants

3.4. Operation Break down:

3.4.1. Operation Breakdown Procedure:

Industrial Engineering team, Production team leader, technician and Lean project officer must sit together to make breakdown. Technician breaks the garments into parts a gathered the parts one after another by operation/process Then work study section and production section leader fix up the SMV of those operation by preceding this technique when all process completed need to summarize all process SMV and the total will be called as respective garments SMV.

3.4.2. Operation Breakdown Chart:

Operation Breakdown table consists of Operation name and machine name.

Op. #	Operation	M/C
1	Facing mark for pkt mouth opening tack	H/W
2	Coin and Back pkt mouth rolling	D/N
3	Coin pkt and Facing iron	H/D Iron
4	Coin pkt Attaching with Facing	D/N
5	Facing Attach with pocketing	S/N
6	S/Fly D/Fly and font rise overlock	O/L3THD
7	Pocket bag select with front	H/W
8	Pocket Bag joint with front	S/N
9	Front pocket mouth top stich with binding	D/N
10	Front pocket mouth rolling tack	S/N
11	Front pocket bag overlock	O/L3THD
12	Front pocket bag turn	H/W
13	Front pocket bag top stitch	S/N
14	S/Fly joint and edge stitch	S/N
15	Zipper attach with fly	D/N
16	J stich position mark and make	D/N
17	D/Fly attaching with Zipper	S/N
18	Zipper close stitch	S/N
19	Front rise tack	S/N
20	Front rise top stich	D/N
21	Back Yoke make by folder	FOA
22	Back rise make by folder	FOA

23	Back pocket iron	Iron
24	Back pocket make position mark	H/W
25	Back select with back	H/W
26	Back pocket attach with back	S/N
27	Back pocket and top stich make position mark	H/W
28	Back pocket 2 nd top stich make	S/N
29	Front and Back part select and side mark	H/W
30	In seam joint by folder	FOA
31	Side seam joint by overlock	O/L5THD
32	Side seam cord sticth make	S/N
33	Body waist mark and waist band mark for join	H/W
34	Waist band select with body	H/W
35	Waist band joint by K/S FOLDER	K/S
36	Waist band mouth excess cut	H/W
37	Waist band mouth close (Top)	S/N
38	Waist band mouth close (bottom)	S/N
39	Loop make by folder	Loop K/S
40	Loop size cut and select with body	H/W
41	Bottom loop attach with body	S/N
42	Top lop attach position mark	H/W
43	Top loop attach with body (5)	S/N
44	Bottom hem make	S/N
45	Loop Bartack(10)	B/T
46	Body normal Bartack (12)	B/T
47	Body Turn	H/W
48	Final Thread cut	H/W

Table 3.2 : Operation Breakdown Chart

3.5. Layout Plan:

This layout plan is based on the standard operation breakdown and it's prepared by using "Standard Group's" own ERP software.

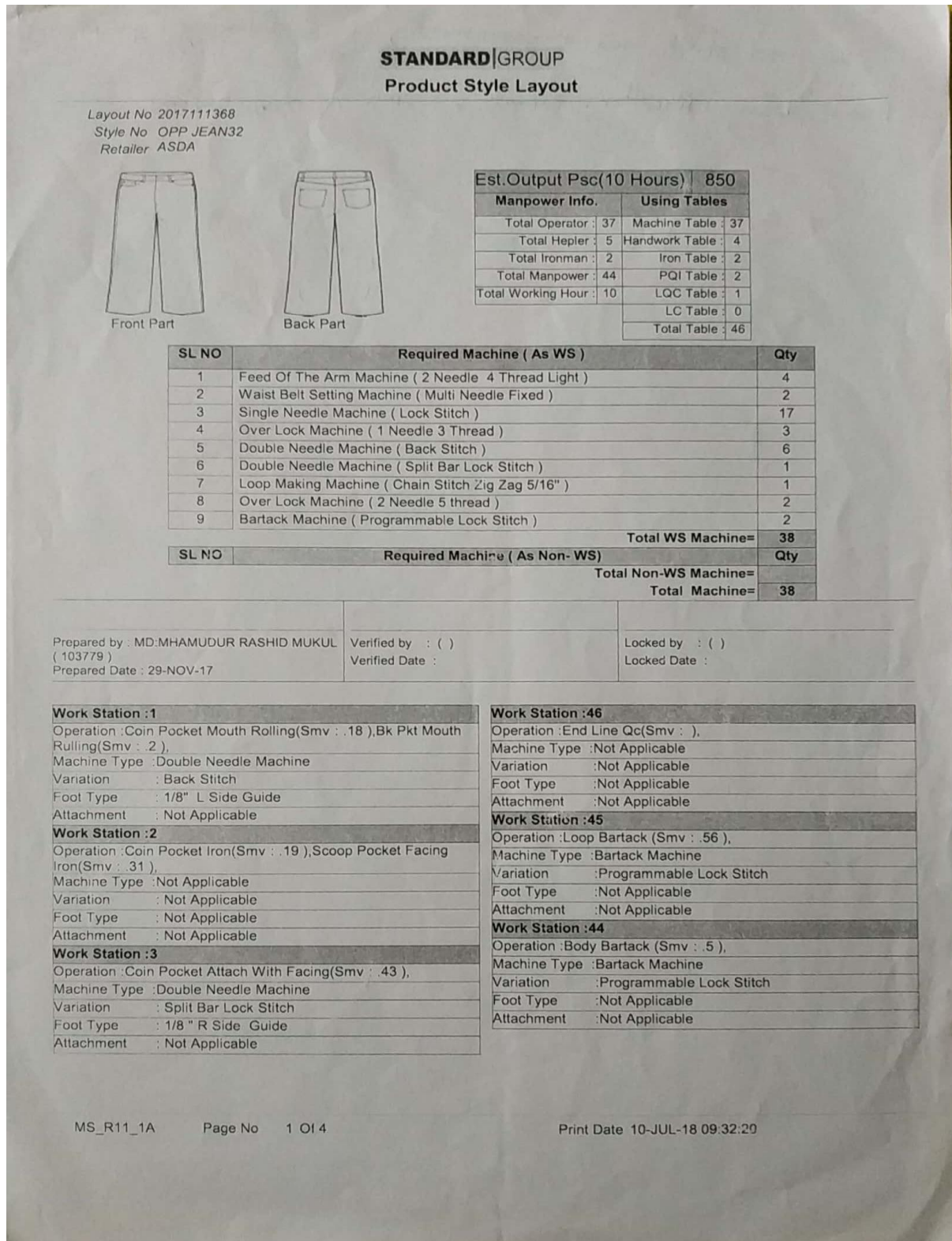


Fig 3.3 : Layout Plan

STANDARD|GROUP
Product Style Layout

Layout No 2017111368
 Style No OPP JEAN32
 Retailer ASDA

Work Station :4 Operation :Facing Attach With Pocketing(Smv : .37), Machine Type :Single Needle Machine Variation : Lock Stitch Foot Type : Plain Guide Attachment : Not Applicable	Work Station :43 Operation :Label Attach With Bk(Smv : .23), Machine Type :Single Needle Machine Variation : Lock Stitch Foot Type : Not Applicable Attachment : Not Applicable
Work Station :5 Operation :Scoop Pkt Bag O/L(Smv : .45), Machine Type :Over Lock Machine Variation : 1 Needle 3 Thread Foot Type : One Side Guide Attachment : Not Applicable	Work Station :42 Operation :Bottom Hem Make(Smv : .48), Machine Type :Single Needle Machine Variation : Lock Stitch Foot Type : Plain Guide Attachment : Not Applicable
Work Station :6 Operation :Scoop Pkt Bag Top Stc(Smv : .47), Machine Type :Single Needle Machine Variation : Lock Stitch Foot Type : 1/4 " L Side Guide Attachment : Not Applicable	Work Station :41 Operation :Bottom Hem Make(Smv : .48), Machine Type :Single Needle Machine Variation : Lock Stitch Foot Type : Plain Guide Attachment : Not Applicable
Work Station :7 Operation :D/Fly Overlock(Smv : .18),S/Fly Overlock(Smv : .17),Front Rise Overlock(Smv : .23), Machine Type :Over Lock Machine Variation : 1 Needle 3 Thread Foot Type : One Side Guide Attachment : Not Applicable	Work Station :40 Operation :Bottom Loop Attach (Smv : .54), Machine Type :Single Needle Machine Variation : Lock Stitch Foot Type : Not Applicable Attachment : Not Applicable
Work Station :8 Operation :S/Fly Edge Stc(Smv : .21), S/Fly Join With Body (Smv : .18), Machine Type :Single Needle Machine Variation : Lock Stitch Foot Type : 1/16" R Side Guide Attachment : Not Applicable	Work Station :39 Operation :Belt Loop Tack With Body Side(Smv : .24), Machine Type :Single Needle Machine Variation : Lock Stitch Foot Type : Not Applicable Attachment : Not Applicable
Work Station :9 Operation :J Stc Make(Smv : .25),J Stc Mark(Smv : .18), Machine Type :Double Needle Machine Variation : Back Stitch Foot Type : Plain Guide Attachment : Not Applicable	Work Station :38 Operation :Belt Loop Make (Smv : .24),Belt Loop Measure And Cut (Smv : .24),Belt Loop Join Psn Mark(Smv : .24), Machine Type :Loop Making Machine Variation : Chain Stitch Zig Zag 5/16" Foot Type : Not Applicable Attachment : Not Applicable
Work Station :10 Operation :Zipper Join With S/Fly(Smv : .19), Machine Type :Double Needle Machine Variation : Back Stitch Foot Type : Not Applicable Attachment : Not Applicable	Work Station :37 Operation :Waist Band Mouth Close Top(Smv : .5), Machine Type :Single Needle Machine Variation : Lock Stitch Foot Type : Not Applicable Attachment : Not Applicable
Work Station :11 Operation :Zipper Close Stitch(Smv : .41), Machine Type :Single Needle Machine Variation : Lock Stitch Foot Type : 1/8 " R Side Guide Attachment : Not Applicable	Work Station :36 Operation :Waist Band Mouth Close Btm(Smv : .59), Machine Type :Single Needle Machine Variation : Lock Stitch Foot Type : Not Applicable Attachment : Not Applicable

Fig 3.4: Layout Plan

STANDARD|GROUP
Product Style Layout

Layout No 2017111368
Style No OPP JEAN32
Retailer ASDA

Work Station :12	Work Station :35
Operation :Front Rise Join (Smv : .18),	Operation :Waist Band Join By Folder(Smv : .55),
Machine Type :Single Needle Machine	Machine Type :Waist Belt Setting Machine
Variation : Lock Stitch	Variation :Multi Needle Fixed
Foot Type : 1/8 " R Side Guide	Foot Type :Not Applicable
Attachment : Not Applicable	Attachment :Not Applicable
Work Station :13	Work Station :34
Operation :Front Rise Top Stc(Smv : .31),	Operation :Waistband Att: And Top Stc By Folder(Smv : .58),
Machine Type :Double Needle Machine	Machine Type :Waist Belt Setting Machine
Variation : Back Stitch	Variation :Multi Needle Fixed
Foot Type : Not Applicable	Foot Type :Not Applicable
Attachment : Not Applicable	Attachment :Not Applicable
Work Station :14	Work Station :33
Operation :Scoop Pkt Mouth Binding By Folder (Smv : .45),	Operation :Waist Band Mark(Smv : .2),
Machine Type :Double Needle Machine	Machine Type :Not Applicable
Variation : Back Stitch	Variation :Not Applicable
Foot Type : Plain Guide	Foot Type :Not Applicable
Attachment : Not Applicable	Attachment :Not Applicable
Work Station :15	Work Station :32
Operation :Scoop Pocket Mouth Binding By Folder (Smv : .5),	Operation :Process Inspection(Smv :),
Machine Type :Double Needle Machine	Machine Type :Not Applicable
Variation : Back Stitch	Variation :Not Applicable
Foot Type : 1/8" L Side Guide	Foot Type :Not Applicable
Attachment : Not Applicable	Attachment :Not Applicable
Work Station :16	Work Station :31
Operation :Scoop Pkt Side & Waist Tack(Smv : .48),	Operation :Cord Stc Make By Sn Lock Stc(Smv : .6),
Machine Type :Single Needle Machine	Machine Type :Single Needle Machine
Variation : Lock Stitch	Variation :Lock Stitch
Foot Type : Plain Guide	Foot Type :Not Applicable
Attachment : Not Applicable	Attachment :Not Applicable
Work Station :17	Work Station :30
Operation :Facing Overlock(Smv : .27),Coin Pkt Join Psn Mark(Smv : .21),Scoop Pkt Mouth Make Mark(Smv :),	Operation :Inseam Top Stc By Foa Without Folder(Smv : .45),
Machine Type :Over Lock Machine	Machine Type :Feed Of The Arm Machine
Variation : 1 Needle 3 Thread	Variation :2 Needle 4 Thread Light
Foot Type : Not Applicable	Foot Type :1/8 " R Side Guide
Attachment : Not Applicable	Attachment :Not Applicable
Work Station :18	Work Station :29
Operation :Process Inspection(Smv :),	Operation :Inseam Top Stc(Smv : .37),
Machine Type :Not Applicable	Machine Type :Feed Of The Arm Machine
Variation : Not Applicable	Variation :2 Needle 4 Thread Light
Foot Type : Not Applicable	Foot Type :One Side Guide
Attachment : Not Applicable	Attachment :Not Applicable
Work Station :19	Work Station :28
Operation :Back Rise Top Stitch By Foa Folder(Smv : .35),	Operation :Side Seam Join By 5 Thd Ol(Smv : .52),
Machine Type :Feed Of The Arm Machine	Machine Type :Over Lock Machine
Variation : 2 Needle 4 Thread Light	Variation :2 Needle 5 thread
Foot Type : 1/8 " R Side Guide	Foot Type :Not Applicable
Attachment : Two Part Straight	Attachment :Not Applicable

Fig 3.5: Layout Plan

STANDARD|GROUP
Product Style Layout

Layout No 2017111368
 Style No OPP JEAN32
 Retailer ASDA

Work Station :20	Work Station :27
Operation :Bk Yoke Top Stc By Foa Folder(Smv : .34),	Operation :Side Seam Join By 5 Thd OI(Smv : .52),
Machine Type :Feed Of The Arm Machine	Machine Type :Over Lock Machine
Variation : 2 Needle 4 Thread Light	Variation :2 Needle 5 thread
Foot Type : Not Applicable	Foot Type :Not Applicable
Attachment : Not Applicable	Attachment :Not Applicable
Work Station :21	Work Station :26
Operation :Bk Pkt Attach(Smv : .51),	Operation :Front & Back Part Select & Side Mark(Smv : .41),
Machine Type :Single Needle Machine	Machine Type :Not Applicable
Variation : Lock Stitch	Variation :Not Applicable
Foot Type : 1/16" R Side Guide	Foot Type :Not Applicable
Attachment : Not Applicable	Attachment :Not Applicable
Work Station :22	Work Station :25
Operation :Bk Pkt Attach(Smv : .51),	Operation :Back Patch Pocket Join Pns Mark(Smv : .38),
Machine Type :Single Needle Machine	Machine Type :Not Applicable
Variation : Lock Stitch	Variation :Not Applicable
Foot Type : Not Applicable	Foot Type :Not Applicable
Attachment : Not Applicable	Attachment :Not Applicable
Work Station :23	Work Station :24
Operation :Bk Pkt Decoration Stc (Smv : .49),	Operation :Back Patch Pkt Iron(3 Corner)(Smv : .29),
Machine Type :Single Needle Machine	Machine Type :Not Applicable
Variation : Lock Stitch	Variation :Not Applicable
Foot Type : Plain Guide	Foot Type :Not Applicable
Attachment : Not Applicable	Attachment :Not Applicable

Fig 3.6 : Layout Plan

3.6. SMV Calculation:

$$\begin{aligned}\text{Observe time} &= \frac{\text{Total Observe Cycle time}}{\text{No of Observe cycle time}} \\ &= \frac{3.07}{5}\end{aligned}$$

$$\text{Observe time} = 0.61$$

$$\begin{aligned}\text{Rating} &= \frac{\text{Observed Rating}}{\text{Standard Rating}} \times 100 \\ &= \frac{70}{100} \times 100\end{aligned}$$

$$\text{Rating} = 70\%$$

$$\begin{aligned}\text{Basic Time} &= \text{Observe Time} \times \text{Rating} \\ &= 0.61 \times 70\%\end{aligned}$$

$$\text{Basic Time} = 0.43$$

$$\begin{aligned}\text{SMV} &= \text{Basic Time} + (\text{Basic Time} \times \text{Allowance}) \\ &= 0.43 + (0.43 \times 10\%) \end{aligned}$$

$$\text{SMV} = 0.47$$

3.6.1. Actual SMV in line:

Op. #	Operation	M/C	Observe Cycle time					Total	AVG	Rating %	Basic time	ALL %	SMV
1	Facing S/Fly D/Fly	O/L	.55	.58	.65	.68	.61	3.07	0.61	70%	.43	10%	.47
2	Coin pocket attach	D/N	.52	.58	.48	.52	.63	2.71	.54	80%	.43	10%	.47
3	Facing mark and pocketing	H/D	.51	.63	.68	.48	.49	2.79	.55	90%	.49	10%	.53
4	Facing attach with pocketing	S/N	.45	.48	.42	.43	.45	2.23	.44	95%	.41	10%	.45
5	Pocketing join with pocket	S/N	.52	.51	.55	.59	.53	2.70	.54	85%	.46	10%	.50
6	Coin pocket iron and mouth rolling	Iron	.55	.63	.61	.59	.52	2.9	.58	75%	.43	10%	.47
7	Font pocket mouth make by folder	D/W	.49	.55	.44	.46	.49	2.43	.48	95%	.46	10%	.50
8	Front pocket mouth cut	H/W	.32	.38	.31	.25	.36	1.64	.32	95%	.30	10%	.33
9	Front pocket mouth opening tack	S/N	.55	.59	.62	.63	.53	2.92	.58	75%	.44	10%	.48
10	Front pocket turn and O/L	O/L	.65	.66	.67	.69	.67	3.34	.66	80%	.53	10%	.58
11	Front pocket turn and T/S	S/N	.59	.57	.58	.55	.59	2.86	.57	70%	.40	10%	.44
12	NEE mark	H/W	.59	.42	.48	.38	.33	2.00	.40	95%	.38	10%	.41
13	Front pocket bag turn	H/W	.39	.38	.35	.34	.32	1.74	.35	80%	.28	10%	.31
14	S/Fly joint and edge stitch	S/N	.55	.56	.50	.51	.59	2.71	.54	75%	.40	10%	.44
15	J-stitch mark, Zipper join	S/N	.62	.63	.65	.65	.69	3.22	.64	80%	.51	10%	.56
16	J stitch position mark and make	D/N	.43	.43	.45	.43	.42	2.18	.43	85%	.36	10%	.39
17	Loop Mark	L/K	.14	.15	.16	.12	.12	.69	.13	90%	.11	10%	.12
18	D/Ply join and close	S/N	.69	.75	.66	.68	.79	3.75	.71	75%	.53	10%	.58
19	Front rise tack	S/N	.55	.61	.62	.59	.53	2.5	.58	80%	.46	10%	.51
20	Front rise top stitch	D/N	.43	.46	.42	.40	.49	1.90	.41	85%	.35	10%	.38
21	Back pocket iron	Iron	.35	.38	.35	.38	.39	1.85	.37	90%	.33	10%	.36

22	Back pocket attach and mark	H/W	.60	.62	.58	.59	.65	3.04	.60	70%	.46	10%	.56
23	Pocket match and cut	H/W	.49	.53	.59	.68	.39	2.68	.53	80%	.42	10%	.46
24	Back yoke make	FO A	.35	.37	.35	.32	.33	1.72	.34	85%	.28	10%	.30
25	Back rise join	FO A	.50	.48	.49	.45	.50	2.42	.48	75%	.36	10%	.40
26	Back pocket second stitch	S/N	1,0 1	.90	.95	.90	.95	4.69	.93	80%	.74	10%	.81
27	Back pocket attach	S/N	.77	.82	.85	.87	.86	4.17	.83	85%	.70	10%	.77
28	Back pocket and coin pocket mouth rolling	S/N	.38	.38	.38	.40	.44	4.98	.39	80%	.31	10%	.34
29	Front and back part select	H/W	.69	.60	.62	.63	.62	3.16	.63	75%	.47	10%	.51
30	Side seam join	O/L	.70	.69	.62	.69	.70	3.4	.68	70%	.47	10%	.52
31	Cord stitch make	S/N	.46	.45	.46	.43	.48	2.28	.45	90%	.40	10%	.44
32	Waist band join mark and seam	S/N	.69	.70	.77	.77	.79	3.58	.71	85%	.60	10%	.66
33	Waist band attach with body	k/W	1.2 2	1.1 1	1.2	1.4 0	1.1 0	6.05	1.21	80%	.96	10%	1.05
34	Waist band mouth excess cut	K/S	.72	.58	.58	.55	.55	2.98	.59	75%	.44	10%	.48
35	Label poly and tack	S/W	.50	.57	.52	.50	.50	2.53	.50	85%	.44	10%	.48
36	Waist band close bottom	S/W	.52	.55	.53	.54	.50	2.64	.52	90%	.46	10%	.51
37	Waist band close top	S/N	.70	.62	.55	.60	.54	3.01	.60	80%	.48	10%	.53
38	Loop join mark and cut	H/W	.62	.67	.70	.71	.69	3.39	.67	75%	.50	10%	.55
39	Loop bottom tack	S/N	.63	.70	.85	.66	.70	3.34	.66	70%	.46	10%	.50
40	Loop top tack	S/N	.50	.51	.50	.52	.53	2.56	.51	75%	.38	10%	.41
41	Body normal B/T	B/T	.58	.55	.59	.60	.58	2.9	.58	80%	.46	10%	.51
42	Loop B/T	B/T	.45	.47	.50	.55	.58	2.55	.51	75%	.38	10%	.42
43	Inseam make by Folder	FO A	.80	.69	.70	.85	.82	3.66	.77	85%	.65	10%	.71
44	Inseam make by Folder	FO A	.52	.65	.62	.55	.63	2.31	.58	80%	.64	10%	.70

45	Hem make	S/N	.83	1.0 1	.83	.85	.82	4.38	.86	85%	.73	10%	.80
Total SMV												22.7	

Table 3.3: Actual SMV in line

3.7. Target Calculation:

$$\text{Target Hourly} = \frac{60}{\text{SMV}}$$

$$\text{Hourly Line Target} = \frac{60 \times \text{No of worker}}{\text{Total GMT SMV}}$$

$$\text{Line Daily Target} = \frac{60 \times \text{No of worker} \times \text{W/H}}{\text{Total GMT SMV}}$$

Bellow analysis is subjected to following assumptions:

No. Of workers (Operator and Helper	45
Absenteeism %	5
Factory Efficiency	80
No Of Working Hours	8
TOTAL GARMENTS S.M.V	22.7

$$\begin{aligned} \text{Day Line Target} &= \frac{60 \times \text{No of worker} \times \text{Working Hours}}{\text{Total GMT SMV}} \times \text{Efficiency} \\ &= \frac{60 \times 42.75 \times 8}{22.70} \times 80\% \\ &= 723 \text{ pcs} \end{aligned}$$

DAY TARGET = 723 pcs

TARGET PER HOUR = 90 pcs

3.8. Basic pitch time calculation:

Here,

No. of operation = 45

Total SMV = 22.7

So,

$$\text{Pitch Time} = \frac{\text{Total garment SMV}}{\text{No.of operation}}$$

$$= \frac{22.7}{45}$$

$$= .50$$

$$\text{Upper Control Limit} = \frac{\text{Pitch Time}}{\text{Expected Efficiency}}$$

$$= \frac{.50}{80\%}$$

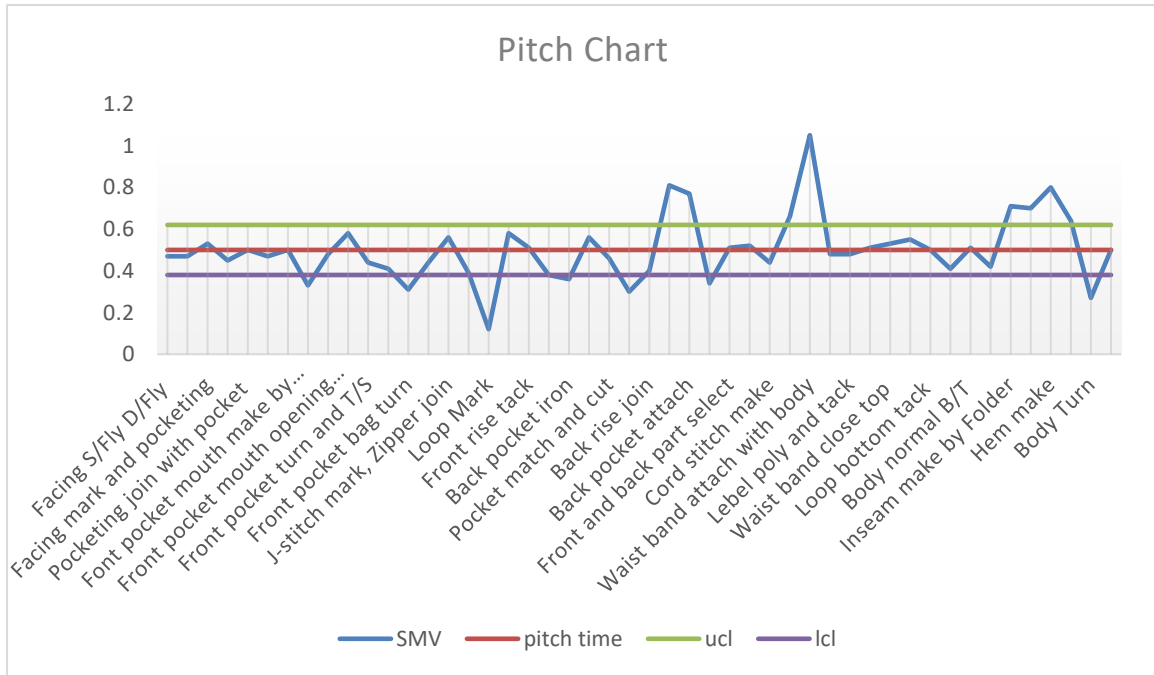
$$= .62$$

$$\text{Lower Control Limit} = (2 \times \text{Pitch Time}) - \text{UCL}$$

$$= (2 \times .50) - .62$$

$$= .38$$

3.8.1. Pitch Chart:



Graph 3.1: pitch time

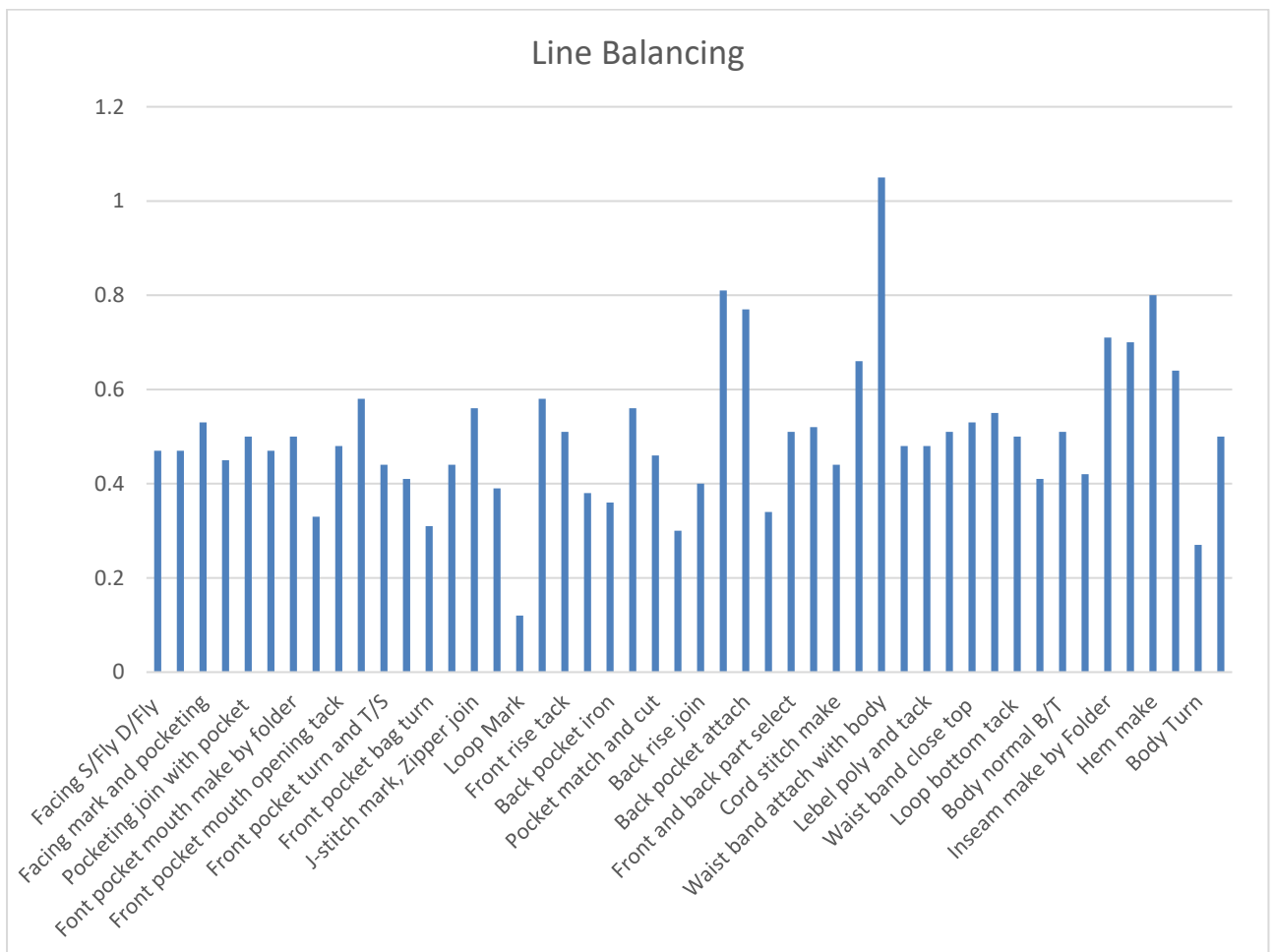
3.9. Line Balancing:

Line balance means the better parceling of the necessary tasks between the worker's, which reduces waiting time.

For line balance we have to focus some data and information those are as follows: -

- 1) Number of operators.
- 2) Operation name.
- 3) Operation SMV.

By bellow graph we can easily see where we should have to balance in this line.



Graph 3.2: Line Balancing

3.10. Efficiency Calculation:

Here,

Work hour = 8

SMV = 22.7

Manpower = 45

Absenteeism = 5%

Output = 650 pcs.

So,

$$\begin{aligned}\text{Line efficiency (\%)} &= \frac{\text{Total output per day} \times \text{SMV}}{\text{Total manpower} \times \text{work hour} \times 60} \times 100 \\ &= \frac{650 \times 22.7}{42.75 \times 8 \times 60} \times 100 \\ &= 72\%\end{aligned}$$

3.11. Capacity Calculation:

Op. #	Operation	M/C	SMV	Manning	Capacity
1	Facing S/Fly D/Fly	O/L	.47	1	128
2	Coin pocket attach	D/N	.47	1	128
3	Facing mark and pocketing	H/D	.53	1	113
4	Facing attach with pocketing	S/N	.45	1	133
5	Pocketing join with pocket	S/N	.50	1	120
6	Coin pocket iron and mouth rolling	Iron	.47	1	128
7	Font pocket mouth make by folder	D/W	.50	1	120
8	Front pocket mouth cut	H/W	.33	1	182
9	Front pocket mouth opening tack	S/N	.48	1	125
10	Front pocket turn and O/L	O/L	.58	1	103
11	Front pocket turn and T/S	S/N	.44	1	136
12	NEE mark	H/W	.41	1	146
13	Front pocket bag turn	H/W	.31	1	194
14	S/Fly joint and edge stitch	S/N	.44	1	136
15	J-stitch mark, Zipper join	S/N	.56	1	107
16	J stitch position mark and make	D/N	.39	1	154
17	Loop Mark	L/K	.12	1	500
18	D/Ply join and close	S/N	.58	1	103
19	Front rise tack	S/N	.51	1	118
20	Front rise top stitch	D/N	.38	1	158
21	Back pocket iron	Iron	.36	1	167
22	Back pocket attach and mark	H/W	.56	1	107
23	Pocket match and cut	H/W	.46	1	130
24	Back yoke make	FOA	.30	1	200
25	Back rise join	FOA	.40	1	150
26	Back pocket second stitch	S/N	.81	1	74
27	Back pocket attach	S/N	.77	1	79
28	Back pocket and coin pocket mouth rolling	S/N	.34	1	176
29	Front and back part select	H/W	.51	1	118
30	Side seam join	O/L	.52	1	115
31	Cord stitch make	S/N	.44	1	136

32	Waist band join mark and seam	S/N	.66	1	91
33	Waist band attach with body	k/W	1.05	1	57
34	Waist band mouth excess cut	K/S	.48	1	125
35	Label poly and tack	S/W	.48	1	125
36	Waist band close bottom	S/W	.51	1	118
37	Waist band close top	S/N	.53	1	113
38	Loop join mark and cut	H/W	.55	1	109
39	Loop bottom tack	S/N	.50	1	120
40	Loop top tack	S/N	.41	1	146
41	Body normal B/T	B/T	.51	1	118
42	Loop B/T	B/T	.42	1	143
43	Inseam make by Folder	FOA	.71	1	85
44	Inseam make by Folder	FOA	.70	1	86
45	Hem make	S/N	.80	1	75

Table 3.4 : Capacity Calculation

Bellow analysis is subjected to following assumptions:

No. Of workers (Operator and Helper	45
Absenteeism %	5
Factory Efficiency	80
No Of Working Hours	8
TOTAL GARMENTS S.M.V	29.12

$$\begin{aligned}
 \text{Day Capacity} &= \frac{60 \times \text{No of worker} \times \text{Working Houres}}{\text{Total GMT SMV}} \times \text{Efficiency} \\
 &= \frac{60 \times 42.75 \times 8}{22.7} \times 72\% \\
 &= \mathbf{651 \text{ pcs}}
 \end{aligned}$$

Day Capacity = 651 pcs

Capacity PER HOUR = 81 pcs

4 . Result and discussion

4.1. Operation breakdown

4.1.1. Result:

In this thesis we collect all kind of data for our experiment. In the floor our working line number was 3. And there is 48 operations.

4.1.2. Discussion:

Here the product is 5 pocket denim pant and it is a critical process that's why operation breakdown is high. In the other product like T-shirt, here operation breakdown is lower than 5 pocket denim pant.

4.2. Manpower:

4.2.1. Result:

Manpower is 45 and in this line input was 723 pieces per day (8 hours) and output was 650 pieces per day (8 hours).

4.2.2. Discussion:

There are some unskilled operator and helper, that's why line efficiency was decreases and they did not complete their target.

4.3. Required Machine:

4.3.1. Result:

Total number of machine= 38

From line balancing we have seen that they used 38 machines.

4.3.2. Machine type:

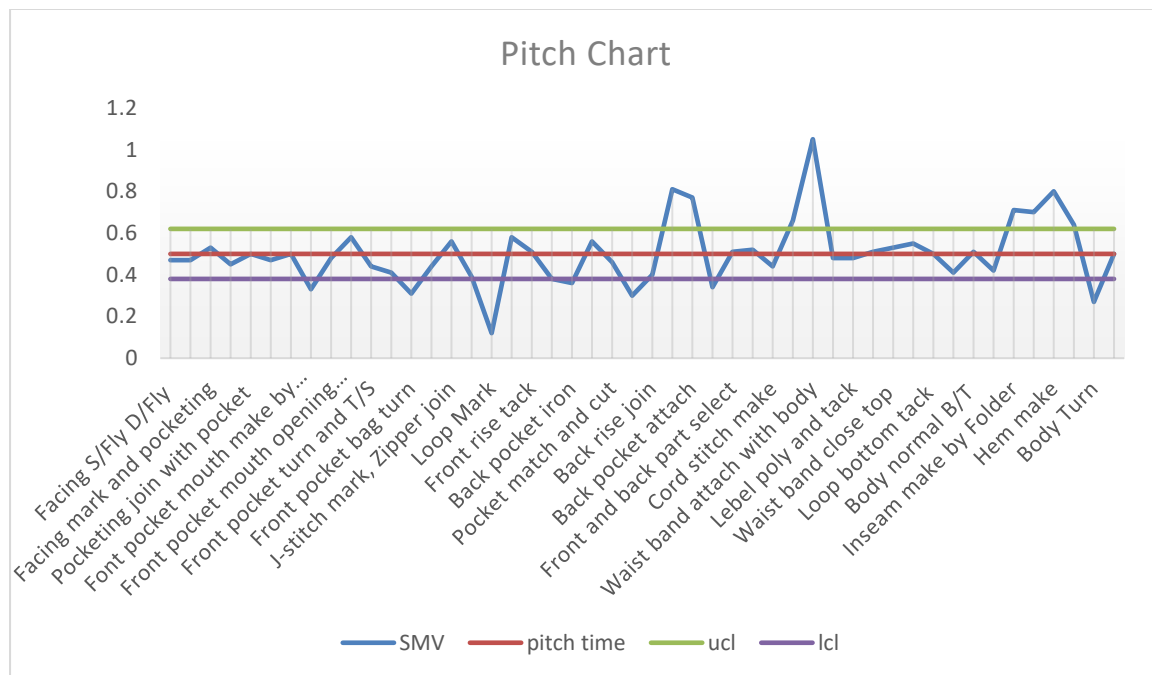
Feed of the arm machine -	4
Waist belt setting machine (multi needle fixed machine)-	2
Single needle machine -	17
Over lock machine (1 needle 3 thread) -	3
Double needle machine (Back stitch) -	6
Double needle machine (split bar lock stitch) -	1
Loop making machine (chain stitch zig zag 5/16") -	1
Over lock machine (2 needle 5 thread) -	2
Bar tack machine (programmable lock stitch) -	2

4.4. Time Study:

4.4.1. Result:

By using stopwatch we took cycle time then calculated its average then we added rating 70% to 95%. After adding rating we got basic time. Then with basic we add allowance (10%) then we got 22.7 SMV. But. Sometime we added 15%. Allowance because the worker use extra motion although their efficiency is lower.

Then we calculated Pitch time = .50, upper control limit = .62, lower control limit = .38.



Graph 4.1: pitch time

4.4.2. Discussion:

The SMV of basic 5 pocket denim pant is 22.7 that mean the lines take 22.7 minutes to complete the garment.

Pitch time .50 means the average time of operation is .50 and upper control limit is .62 means the highest time of an operation needed .62 and lower control limit is .38 means the lowest time of an operation needed .38.

So that “loop marking” operation are competed lowest time and “waist band attach with body” operation are competed highest time by seeing above graph.

In this line we see “loop marking” operation are doing by an unskilled helper and added extra 1 machine for the operation “waist band attach with body” for balancing the line.

4.5. Line target:

4.5.1. Result:

By considering 80% efficiency and $SMV = 22.7$ the line target was per hour 90 pieces per hour and per day 723 pieces per day.

4.5.2. Discussion:

From the line we collect data, here line efficiency was 72% then we calculated target in actual line efficiency and we got the target is 685 pieces per day. But we saw the production target is 723 pieces per day.

4.6. Production capacity:

4.6.1. Result:

Production capacity per day 651 pieces (8 hour duty without lunch). Here working hour is 8 but when shipment date is knocking the door and the shipment target are not completed they extend 3 hours overtime and then working hours will 10.

5: CONCLUSION

5.0. CONCLUSION

Industrial engineering is now most important and essential part of any apparel industry. By doing this experiment we learn many procedure and important thing about Industrial engineering. We found many problems in Industrial engineering, by doing this experiment we also know how to solve problems and how to arrange all the work of Industrial Engineering. Before IE there was many problems in garment industry such as production capacity, daily line target capacity, layout, delivery problem. After this experiment we find out this calculation, the standard minute value (SMV) = 22.70, in additional to that we have calculated the target = 723 pcs, pitch time = .50, upper control limit = .62, lower control limit = .38, efficiency = 72%, manpower = 45, capacity = 651, labor productivity. After IE and planning there is implementation in line balancing, daily line target, production capacity increase. Additionally gives us a chance to extend our insight into material organization, generation arranging, acquisition framework, creation process, and apparatuses and encourage us to modify with the modern life.