Faculty of Engineering
Department of Textile Engineering

REPORT ON

''Comparative study on application of industrial engineering in three different factories''

Course Title: Project (Thesis)
Course Code: TE 417

Submitted By

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

Advance in Apparel Manufacturing Technology
December, 2014

DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Mr. Md. Abdullah Al Mamun,** Assistant Professor, Dept. of TE, and Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

Acknowledgement

First we express our heartiest thanks and gratefulness to almighty Allah for his divine blessing makes us possible to complete this project successfully.

We fell grateful to and wish our profound indebtedness to **Md. Abdullah Al Mamun, assistant professor**, department of TE, daffodil international university, Dhaka. Deep knowledge & keen interest of our supervisor in the field of 'industrial engineering' influenced me to carry out this project. His endless patience ,scholarly guidance ,continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior drafts and correcting them at all stage have made it possible to complete this project.

We would also like to express our sincere gratuity to **Abu Naser Chowdhury , manager of industrial engineering of "Montex Fabric ltd**. Located at nayapara, kashimpur,gazipur" and **Md. Shamsul huda, manager of industrial engineering of "Hams Garments LTD"** south vangnahati,sreepur, gazipur" and **Milon Mahmud, manager of industrial engineering of "Fatullah group"** post office road,fatullah, Narayanganj for allowing us to complete our two months industrial training in these factories and also for their useful guidance throughout the course.

We would like to thank our entire course mate in daffodil international university, who took part in this discuss while completing the course work.

At last but not the least, we would like to acknowledge my parents for their approval, support & love to complete the report.

ABSTRACT

We discussed the paper comparing the productivity and efficiency of Mondol Group, Hams Garments Ltd. and Fatullah Group after applying the industrial engineering. 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. We have recorded the time 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) SMV, process wise capacity has been calculated, in addition to that we have calculated the target, capacity, manpower, line graph, labor productivity and line efficiency. Line has been balanced considering the bottleneck and balancing process where the balancing process has shared the excess time after the production in the bottleneck process.

In this paper we discussed some procedure about time, capacity, and production study. Also discussed about operation breakdown and others tools and techniques which consist of different experimental discussion, experimental result & discussion

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1.0. Introduction:

Present techno economic scenario is marked by increasing competition in almost every sector of economy. The expectation of the customers are on the rise and manufacturers have to design, and produce well in as many variety as possible (concept of economics of scale is no more talked off) to cater to the demands of the customers. Thus there is a challenge before the industries to manufacture goods of right quality and quantity and at right time and at minimum cost for their survival and growth. This demands the increase in productive efficiency of the organization. Industrial Engineering is going to play a pivotal role in increasing productivity. Various industrial engineering techniques are used to analyze and improve the work method, to eliminate waste and proper allocation and utilization of resources.

Industrial engineering is a profession in which a knowledge of mathematical and natural sciences gained by study, experience and practice is applied with judgment to develop the ways to utilize economically the materials and other natural resources and focus of nature for the benefit of mankind.

American Institute of Industrial Engineers (AIIE) defines Industrial Engineering as follows:

Industrial Engineering is concerned with the design, improvement and installation of integrated system of men, materials and equipment. It draws upon specialized knowledge and skills in the mathematical, physical sciences together with the principles and methods of engineering analysis and design to specify, predict and evaluate the results to be obtained from such systems.

The main aim of our project is to differentiate the production of a basic T-shirt among three factories.

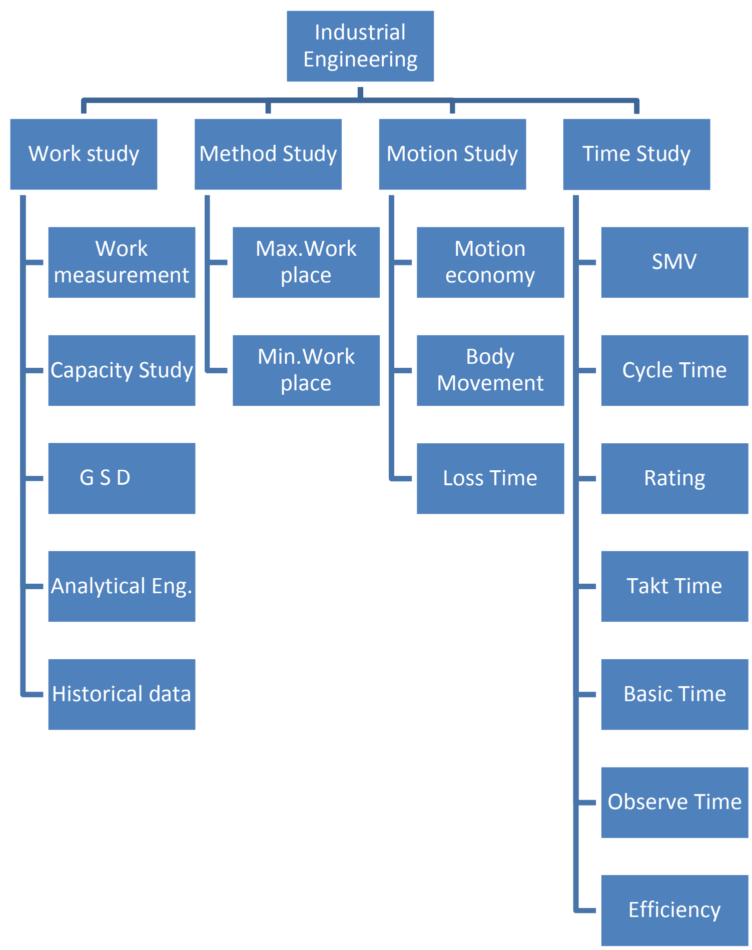
So, we studied hard and used many formulas, calculated to find out the difference on productivity that’s why we can easily find out which factory is much better and we just show you the path how to improve the other two.

2. Literature Survey

2.1 What is industrial engineering?

Industrial engineers (IE) are responsible for designing integrated systems of people, machines, material, energy, and information. Industrial engineers figure out how to do things better. They engineer processes and systems that improve quality and productivity. They work to eliminate waste of time, money, materials, energy, and resources. This is why more and more companies are hiring industrial engineers and then promoting them into management positions.

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



2.2. Activities of Industrial Engineering:

- Selection of processes and assembling methods.
- Selection and design of tools and equipment.
- Design of facilities including plant location, layout of building, machine and equipment.
- Design and improvement of planning and control system for production, inventory, quality and plant maintenance and distribution systems.
- Development of time standards, costing and performance standards.
- Installation of wage incentive schemes.
- Design and installation of value engineering and analysis system.
- Operation research including mathematical and statistical analysis.
- Performance evaluation.
- Supplier selection and evaluation.

2.3. Objectives of Industrial Engineering:

- To establish methods for improving the operations and controlling the production costs.
- To develop programmers for reducing costs.

2.4. Functions of an Industrial Engineer :

- Developing the simplest work methods and establishing one best way ofdoing the work.

- Establishing the performance standards as per the standard methods (Standard Time).

- To develop a sound wage and incentive schemes.

- To aiding the development and designing of a sound inventory control, determination of economic lot size and work in process for each stage of production.

- Development of cost reduction and cost control programmers and to establish standard costing system.

- Sound selection of site and developing a systematic layout for the smooth flow of work without any interruptions

2.5. Techniques of Industrial Engineering:

- **Method study:** To establish a standard method of performing a job or an operation after thorough analysis of the jobs and to establish the layout of production facilities to have a uniform flow of material without back tracking.

- **Time study (work measurement):**This is a technique used to establish a standard time for a job or for an operation.

- **Motion Economy:** This is used to analyses the motions employed by the operators do the work. The principles of motion economy and motion analysis are very useful in mass production or for short cycle repetitive jobs.

- **Value Analysis:** It ensures that no unnecessary costs are built into the product and it tries to provide the required functions at the minimum cost. Hence, helps to enhance the worth of the product.

- **Financial and non-financial Incentives:** These helps to evolve at a rational compensation for the efforts of the workers.

- **Production, Planning and Control:** This includes the planning for the resources (like men, materials and machine) proper scheduling and controlling production activities to ensure the right quantity, quality of product at predetermined time and pre-established cost.

- **Inventory Control:** To find the economic lot size and the reorder levels for the items so that the item should be made available to the production at the right time and quantity to avoid stock out situation and with minimum capital lock-up.

- **Job Evaluation:** This is a technique which is used to determine the relative worth of jobs of the organization to aid in matching jobs and personnel and to arrive at sound wage policy.

- **Material Handling Analysis:** To scientifically analysis the movement of materials through various departments to eliminate unnecessary movement to enhance the efficiency of material handling.

- **Ergonomics (Human Engineering):**It is concerned with study of relationship between man and his working conditions to minimize mental and physical stress. It is concerned with man-machine system.

2.6. IE JOB Profile:

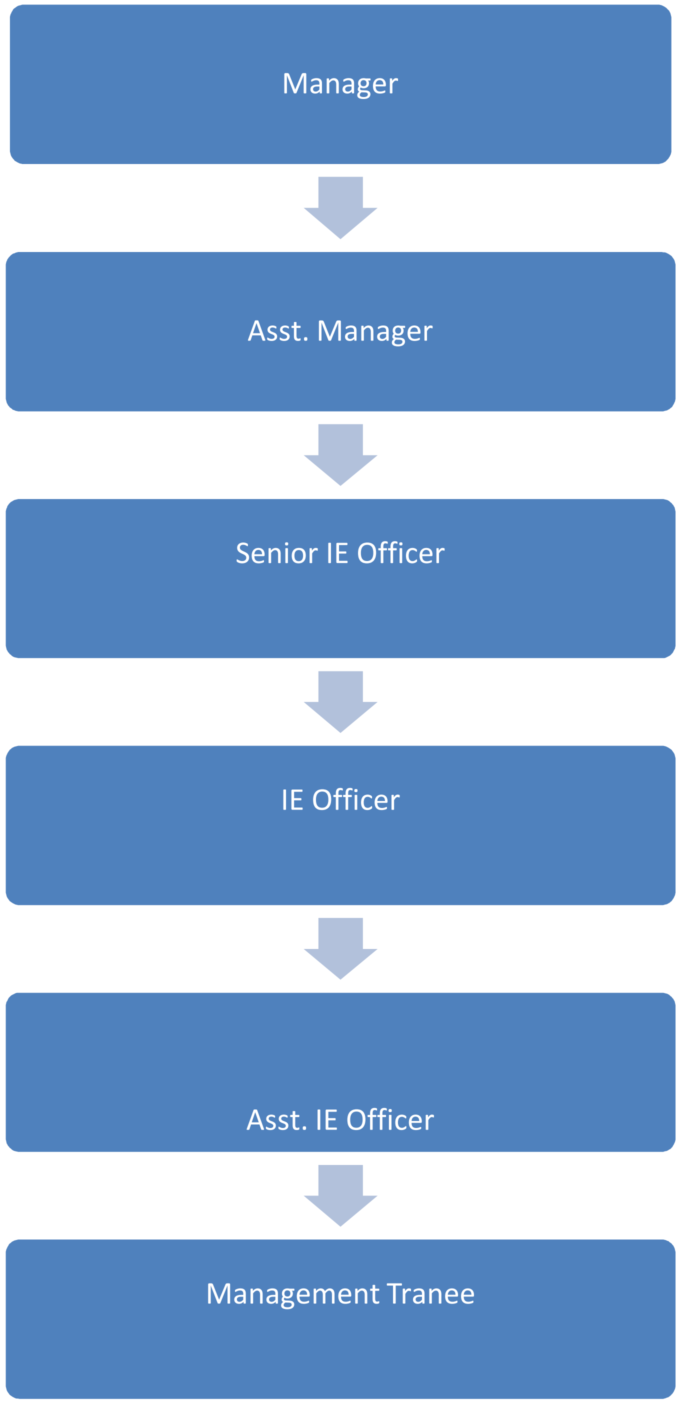
It was just a couple of years back that demand of an industrial engineer has increased many times. Reason, an Industrial engineer can do a lot to improve performance of the company. But the fresh student passed out from educational institute (Fashion institutes) acquired limited knowledge about the job profile of an Industrial engineer. Maximum works are learnt in factory by working. There is number of tools and techniques which are used in by industrial engineers to establish an effective production system in the company. Without having such tools earlier production managers and line supervisors faced difficulty in measuring work content, garment costing, and production planning correctly, even it was difficult to finalize orders. Our team has worked to find out important tasks those are important for an engineer, and needs detailed understanding of production fields, included in the following. Though job profile of an Industrial Engineer varies company to company, most of the job profile fall under following list.

- Knowledge about various sewing production systems
- Knowledge of all types of Sewing machine necessary for the company
- Time study (Cycle timing)
- Motion analysis of the operations
- Operation break down
- Preparation of OB (Operation bulletin)
- SAM Calculation
- M/C Layout and Work station layout
- Line Set up
- Production estimation of a line
- Work Sampling
- Method Study (Seeing Movements of an operation)

- WIP Control
- Line Balancing
- Capacity study
- Cost estimation of a garment
- Developing and Maintaining Skill Matrix
- Incentives schemes
- Calculating Thread Consumption
- Work aids, Guide and Attachment
- Performance Rating

An industrial engineer must have knowledge and skill on each tool and technique. Implementation of all tools at a time is not needed. Engineer has to go step by step. Almost all work study tools and methodology are adopted from others industries and implemented to the garment industry. So each work study tool has guaranteed benefit if it is used effectively.

2.7. Organogram of IE Department:



2.8. Industrial Engineering Tools:

- Lean Manufacturing
- 5S
- JIT (Just In Time).
- Kanban.
- KAIZEN.

2.8.1. Lean Manufacturing:

Lean Manufacturing, also called Lean Production, is a set of tools and methodologies that aims for the continuous elimination of all waste in the production process. The main benefits of this are lower production costs, increased output and shorter production lead times. More specifically, some of the goals include:

Defects and wastage-Reduce defects and unnecessary physical wastage, including excess use of raw material inputs, preventable defects, costs associated with reprocessing defective items, and unnecessary product characteristics which are not required by customers;

Cycle Times-Reduce manufacturing lead times and production cycle times by reducing waiting times between processing stages, as well as process preparation times and product/model conversion times;

Inventory levels-Minimize inventory levels at all stages of production, particularly works in-progress between production stages. Lower inventories also mean lower working capital requirements;

Labor productivity -Improve labor productivity, both by reducing the idle time of workers and ensuring that when workers are working, they are using their effort as productively as possible (including not doing unnecessary tasks or unnecessary motions);

Utilization of equipment and space-Use equipment and manufacturing space more efficiently by eliminating bottlenecks and maximizing the rate of production though existing equipment, while minimizing machine downtime.

flexibility -Have the ability to produce a more flexible range of products with minimum changeover costs and changeover time.

Output –Insofar as reduced cycle times, increased labor productivity and elimination of bottlenecks and machine downtime can be achieved, companies can generally significantly increased output from their existing facilities.

Most of these benefits lead to lower unit production costs –for example, more effective use of equipment and space leads to lower depreciation costs per unit produced, more effective use of labor results in lower labor costs per unit produced and lower defects lead to lower cost of goods sold.

2.8.2. 5S:

5Srepresents 5 disciplines for maintaining a visual workplace (visual controls and information systems).
These are foundational to Kaizen (continuous improvement) and a manufacturing strategy based "Lean Manufacturing" (waste removing) concepts.
5S is one of the activities that will help ensure our company's survival.
1.Sort-All unneeded tools, parts and supplies are removed from the area

2.Set in Order-A place for everything and everything is in its place

3.Shine-The area is cleaned as the work is performed

4.Standardize-Cleaning and identification methods are consistently applied

5.Sustain-5S is a habit and is continually improved

Also-Work areas are safe and free of hazardous or dangerous conditions.

5S Examples:

1.Sort-All unneeded tools, parts and supplies are removed from the area.

2.Set in Order-A place for everything and everything is in its place.

3.Shine- The area is cleaned as the work is performed (best) and\or there is a routine to keep the work area clean.

4.Standardize- Cleaning and identification methods are consistently applied.
Departments have weekly 5S tours. Every job has duties that use Sort, Set in Order and Shine. We all have common duties to do our part to keep all areas of the plant in shape - break room, restrooms, locker area, parking lot, etc.
5.Sustain- 5S is a habit and is continually improved

5S is a simple concept with powerful results. You will get additional information on 5S so that you will be well equipped. Our experience is that the more we do 5S the better the work environment becomes: cleaner, safer, more organized, the work is easier, less confusion and less stress. Use the 5S (work\home\play) -The more you use it the easier it becomes and life just gets better and better.

2.8.3. JIT (Just In Time):

- JIT philosophy means getting the right quantity of goods at the right place and the right time.
- JIT exceeds the concept of inventory reduction.
- JIT is an all-encompassing philosophy found on eliminating waste.
- Waste is anything that does not add value.

A broad JIT view is one that encompasses the entire organization.

Objective of JIT :

- Produce only the products the customer wants.
- Produce products only at the rate that the customer wants them.
- Produce with perfect quality.
- Produce with minimum lead time.
- Produce products with only those features the customer wants.
- Produce with no waste of labor, material or equipment --every movement must have a purpose so that there is zero idle inventory.
- Produce with methods that allow for the development of people .

2.8.4. KANBAN:

KANBAN, a technique for work and inventory release, is a major component of Just in Time and Lean Manufacturing philosophy. It was originally developed at Toyota in the 1950s as a way of managing material flow on the assembly line. Over the past three decades the Kanban process, a highly efficient and effective factory production system, has developed into an optimum manufacturing environment leading to global competitiveness. Kanban stands for Kan-card, Ban-signal. The essence of the Kanban concept is that a supplier, the warehouse.

manufacturing should only deliver components as and when they are needed, so that there is no excess Inventory. Within this system, workstations located along production lines only produce/deliver desired components when they receive a card and an empty container, indicating that more parts will be needed in production. In case of line interruptions, each workstation will only produce enough components to fill the container and then stop. In addition, Kanban limits the amount of inventory in the process by acting as an authorization to produce more Inventory. Since Kanban is a chain process in which orders flow from one process to another, the production or delivery of components are pulled to the production line, in contrast to the traditional forecast oriented method where parts are pushed to the line.

Advantages of Kanban Processing:

Provides a simple and understandable process. Provides quick and precise information. There are low costs associated with the transfer of information. Provides quick response to changes.

There is a strict limit of over-capacity in processes. Avoids overproduction. Minimizes waste.

Full control can be maintained. Delegate's responsibility to line workers.

2.8.5. KAIZEN :

Kaizen is a Japanese word means, simply, Continuous Improvement.

Kai = to take a part

Zen = to make good

Together these words mean to take something apart in order to make it better.

PURPOSE OF KAIZEN:

Kaizen activities focus on every operation and process in order to add value and eliminate waste.

Process: Is the sequence of operations needed to design and make a product.

Operation: is one activity performed by a single machine or person on that product.

TARGET OF KAIZEN :

Products(Quantity, Rejects etc.)

Equipment(Changeover, Utilization, Breakdown)

Human(Communication, Awareness, Stillness)

Processes(Waiting Time, Bottleneck, Line Balancing, VCS)

System(QC, Specification, Infection)

2.9. Work study:

Work study is a systematic technique of method analysis work measurement and setting of time standard that can be ensure the highest productivity by the optimum use of man power, equipment and material.

2.9.1. Father of work study:

FW (Frederic Winslow) tailor who is called the father of scientific management is the founder of work study. During Second World War USA needed many arms in short time? Then Mr. FW Tailor applied work study concept to make many arm in short time and got a tremendous result. His ideas were generated as the worked for various firms and work study is being used everywhere. Now it is circumference is getting largely day by day.

2.9.2. Distinct discipline of work study:

- **Method study**, which is concerned with the systematic way in which the tasks is carried out, and

- **Work measurement**, which is concerned with the time and effort required to carry out the task.

2.9.3. Work study procedure:

Higher productivity Work measurement To determine how long it should take to carry out. Method study To simplify the job and develop more economical methods of doing it. Work study Select Record Examine Develop Evaluate Training Install Maintain
Work study is a systematic job procedure. There are many objects to be studied systematically to carry out the most economical result. The procedure will be continued step by step for view. Let's see the below-

- **Select**: Select the task to be studied.
- **Record**: Record or collect all relevant data about the task or process.
- **Examine:** Examine the record facts critically, "the purpose of the activity, the place where it is performed, the sequence in which it is done, the person who is doing it and by which it is done".
- **Developing:** Develop the most economic method and drawing as appropriate technique on the contribution of those concerned (managers, supervisor, workers and others specialist).
- **Evaluate:** Evaluate the result attained by the new improved method comparing the cost effectiveness of the selected new method with the current method of performance.
- **Define:** Define the new method and the related time and present it to all those concerned, either verbally or in writing, using demonstrations.

- **Install:** Install the new method, training those involved, as an agreed practice with the allotted time of operation.

- **Maintain:** Maintain the new standard practice by monitoring the results & comparing them with the original target.[5]

2.9.4. Characteristic of work study engineer:

A work study engineer need to be educated, expert, smart, confident, personal dignity and honest. Details below-

Sincerity and Honest:

The work study person must be sincere and honest only if is the case will he she gain the confidence and respect of those with whom he or she will work.

Enthusiasm:

He must be really keen on the job, believe inthe importance of what heor she is doing and be able to transmit enthusiasm to the people round about.

Tact/Diplomacy:

Tact is dealing with people comes from understanding them and not wishing to hurt their feeling by unkind or thoughtless word, even when these may be justified. Without justified no work study person is going to get very far.

Good Appearance:

The person must be neat tidy & look efficient. This will inspire confidence among the people with whom he or she has to work.

Self-Confidence:

This can only come with good training and experience of applying work study successfully. The work study practitioner must be able to stand up to top management, supervisors or workers in defense of his opinion and finding, and to do so in such a way that will respect and not give offence.

2.9.5. Function Of Work Study Engineering:

Method Study: Space environment, Equipment, Machine attachment, Element study, Effective and ineffective time segregation, Handling and movement, Contingency, Improve worker performance, Find better way of work, Reduce ineffective time and Increasing needling time, Selling better method to others.

Work Measurement: Cycle check, Observed time, Rating, BMV, and SMV, Production study, Time study, setting time standard and sampling.

General Sewing Data(GSD): Method study and develop within GSD coding time by reducing unnecessary task through method study.

Breakdown and Layout: Operation breakdown, Time setting, Process sequence, tight& loose flow, Incentive or No incentive layout, Operation & workers selection.

Consumption: All measurable trims like Thread, String, Tape, Webbing, Binding, Grosgrain, and Velcro. Elastic, Z-Band/linear, fabric & other like.

Calculation: Feeding time, Produced time, Efficiency, Target setting, productivity gap, Individual performance and capacity, Potential pieces, Required production days/hours/workers, Contingency, AQL,OQL, Accuracy & confident level, Cost breakdown point, Ratio, Load range, Sewing time, Effective time, BPT, HPT,LPT,BMV,SMV.

2.9.6. General Function:

1. **SMV and Production Plan:** SMV estimation and update production plan.

2. **Incentive Package:** Analysis and control production plan as higher performance level.

3. **Reporting:** Efficiency, Performance, Capacity, Production statement, Earning statement, Comparison, Factory/line capacity, Incentive calculation and management key information as required.

4. **Keeping History:** Standard data, Product, Earning, Efficiency, Performance, Progression, Target and target efficiency analysis.

5. **Data Centralization:** Control and centralization of all data across units.

6. **Save Material:** Protection to misuse of trims measurable like's threads. String, Binding, Tape, Velcro, Elastic, Z-band, Webbing, Grosgrain etc.and countable likes button eyelet, Stopper, Puller, Zipper etc.

7. **Multi Experience:** Basic quality procedure and acceptance level, Basic maintenance, Cutting, Marker, Pattern, Sample and packing/shipping method.

8. **Reserved Expert:** To help others section where needed as reserved expert.

9. **Motivation:** Training, Job facilities, Life standardization and techniques presentation.

2.9.7. STEPS INVOLVED:

1. Analyze each style to determine its requirement for production.

2. Style Analysis is based on:

-Firm's quality standards
-Amount of labor required
-Available equipment
-Volume to be produced
-Expected "throughput time"
3. Style requirements are determined through analysis of samples and specifications
4. Apparel Engineers are concerned with:
-equipment required
- Number, complexity and sequence of Operations
5. Operation Breakdown: Work in each style is broken down into operations

An operation B/down is sequential list of all the operations that involved in assembling a garment used to establish the workflow for each style.

6. Apparel engineers study each operation to improve its effectiveness and efficiency and to establish methods to ensure a consistent performance by operators and consistent products.

2.9.8. Standard Time and Target Setting:

Many companies do not use standard time systems; target setting is based on guesswork and experience. Establishment of Standard times and the development of the best method to manufacture is vitally important to improve productivity. Every company that wishes to compete in the future must realize this. This chart clearly illustrates the benefits to factory efficiency if standard times and well developed methods are used.

2.9.9. Method Analysis:

Most of the companies are using poor methods, operators are left to establish best way to do the job, decide on the number of bursts of stitching, folding and unfolding of parts, unnecessary matching and additional handling, all of these motions add to the time it takes to manufacture the garment and should be eliminated. Method study can be implemented in any type of production system whether it is in-house or on a contract basis. Proper method analysis can improve productivity by at least 15%.

2.9.10. Workplace Layout:

The management wants to fit as many machines in the factory as possible, reducing the scope for methods improvement. The space between machines is insufficient in many cases.

A good workplace layout will eliminate unnecessary motions and fatigue resulting in substantial increase in the efficiency of the operator.

Just look at the picture alongside and think how efficiently you will be able to work 8 hours a day sitting in that posture.

2.9.11. Operation Sequence:

Some of the production departments work without a properly planned or written operation sequence. This is a critical step in garment production and a mistake or negligence at this stage can result into huge losses later in terms of operator time, work content and quality.

2.9.12. Work Aids and Attachments:

Use of work aids and attachments is insufficient. Many new and inexpensive attachments and folders are being continuously developed, it is vital that these developments are known to ensure a program of constant improvement. Many new and inexpensive attachments and folders are being continuously developed, it is vital that these developments are known to ensure a program of constant improvement.

2.9.13. Operator Monitoring:

Most of the companies surveyed do not have the means to establish their performance against standard, so they have no idea where they stand. There are no proper measurements so their efficiency levels are at besta guess, it is impossible to understand how they will be able to continue to compete unless they have proper controls in place, and have established productivity improvement programs to move forward in the future.

2.9.14. Cycle Checks:

A simple technique aimed at establishing operator potential against their actual performance, this can be done by relatively inexperienced work study personnel and is a great aid to factory performance improvement. None of the companies perform cycle checks. The chart below shows the comparison between factories in Group A (with work study department) and Group B (without work study department) on various aspects of apparel production.

Looking at the comparison shown below it is obvious that group A factories are more productive than the group B factories. This fact is further strengthened when the overall factory survey results are compared. The factories in group A have a combined score of 61% for overall performance whereas factories in group B achieved a score of only 48%.
Work-study is the need of the hour and it is high time that the industry stalwarts understand its importance and its contribution to profitability.

2.10. Method Study for garment operations:

Method study is more of a systematic approach to job design than a set of techniques. It is defined as the systematic recording and critical examination of existing and proposed methods of doing work, as a means of developing and applying easier and more effective methods and reducing costs. The method involves systematically following six steps:

1. Selection of work to be studied: Most operations consist of many discrete jobs or activities. The first stage is to select those jobs to be studied that will give the best returns for the time spent. For example, activities with the best scopes for improvement, those causing delays or bottlenecks or those resulting in high costs.
2. Recording of all relevant facts of current method: Method study uses formal techniques to record the sequence of activities, the time relationship between different tasks, the movement of materials, and the movement of staff. There are many techniques used in method study.
3. Critical examination of those facts: This is the most important stage in method study. It is used to critically examine the current method by seeking answers to questions:
•The purpose of each element

•The place

•The sequence

•The person

•The means
4.Development of the most practical, economic and effective method: This stage is used to develop a new and better method of executing the task, by taking into account the results of critical examination. The new method is developed by a combination of entirely eliminating some activities, combining some parts, changing the sequence of some activities and by simplifying the content of others.

5. Installation of new method: This step involves project managing the changes and ensuring that everybody involved understands the changes involved. In other words they understand the new method, which is doing what, the differences compared to the old method and crucially the reason for the changes. Training is an important part of this stage particularly if the new method involves radical changes. Providing modified equipment, components and layouts may also be involved.

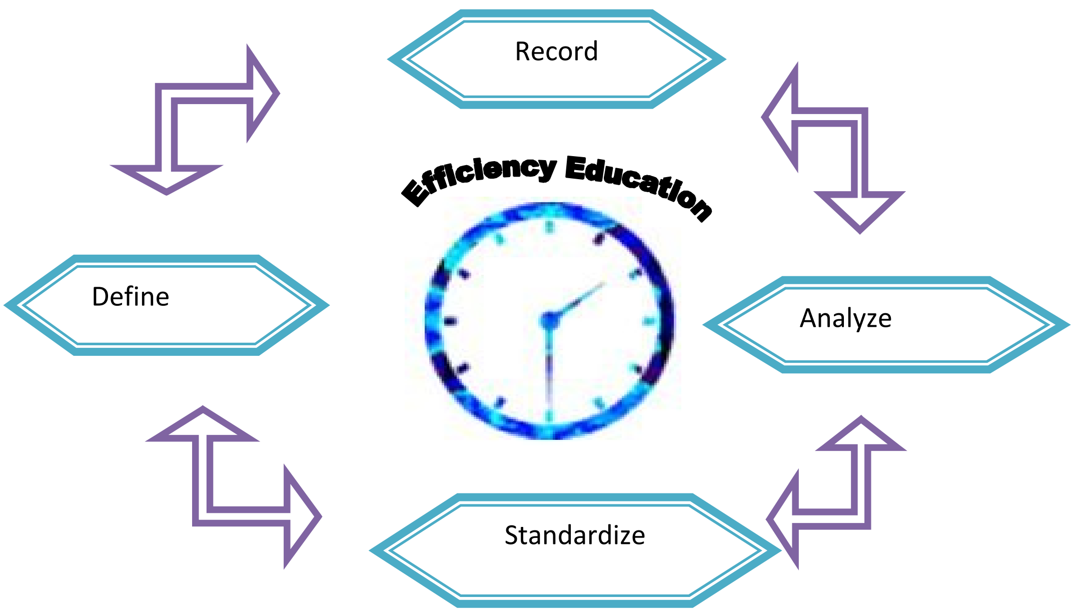
6. Maintenance of new method and periodic checking: Monitoring of how effective the new method is and how personnel have adapted is very important. One aspect that is sometimes overlooked is to check what effect the new method has on other activities. For instance, it may be that whilst the new method is successful in eliminating a bottleneck in a particular area, the bottleneck has moved elsewhere in the process. By periodic checking the new method and its effects, management can ensure that overall efficiency is improving rather than deteriorating.

2.11. Time Study for garment operations:

2.11.1. Definition of Time Study:

Time study is very important analysis for the find out of SMV condition of time study: Before making the time study officer ensure that conditions on the job are normal.

- The work flow into the operation is normal
- Amount of work in the section is normal
- The size of the work available are normal



2.11.2. **Techniques of time study:**

- Asses the performance of the worker
- Understand the flow of work
- Time study person should not disturb the operator
- Should inform to the operator that he is going to do sometimes study
- Enter every detail on study papers by a pen as it can’t delete.

Time study tools:

- ✓ A stop watch
- ✓ Time study format
- ✓ One pen or pencil

Production target:

The amount of work expected from

- An average operator
- Fully trained
- Using the correct job method
- Over a normal working day.

One important reason for having a production target is to enable each person to reduce a thereby money according to her own level of ability.

The operator with more ability will earn more money than some one with less ability.

A production target establishes a common benchmark against which to measure. Science a job target is established for an average person, those who are averages in ability will do more, and those who are below average will do less.

SAM: Standard Allocated Minute

Also known as SMV- Standard Minute Value

Time taken for one operation, fully trained average production when use correct method and reaches to an acceptable quality.

Grading the time study:

Since each operator's performance is different, the time study officer grades the performance. Grading relates actual performance to the 100% concept. He looks at two things to grade performance.

Skill:- The operators smoothness and co-ordination

Effort:- How hard the operator works during the study

2.11.3. How to conduct Time Study:

An operation cycle consists of material handling, positioning and aligning parts, sewing, trimming threads and tying and untying a bundle. So in the time study format, divide whole task into various elements according to the motion sequences of the operation.

For example, in operation 'collar run stitch', task elements may be

1. Pick up panel to sew first seam,
2. Turn collar to sew second seam,
3. Turn collar to sew third seam
4. Check work and dispose and
5. Waiting for next pieces.

Step 1: Preparation:

- ✓ Ready with stationeries like time study format, stop watch (digital one) and pencil
- ✓ Select one operation for Time study
- ✓ Tell the operator that you are going measure time he/she taking to do the job.
- ✓ Observe the operation carefully and break down operation into elements.

Step 2: Time capturing:

Now measure the time taken for completing each elements of the operation cycle by the operator. Time should be captured in seconds. Similarly, capture element timing for consecutive 5 operation cycles. During data capturing only note down reading of the stop watch and later calculate element timing. If you found any abnormal time in any elements record time during time study and later discard that reading. Or you capture time for one more cycle. Abnormal time may be occurred due to bobbin change, thread break, power cut or quality issues

Step 3: Calculation of Basic time:

From the Reading (R) calculates time taken for each element for all five cycles just by deducting previous Reading from elemental reading. Sum up times of five cycles for each element. Note, if you discard any reading than in that case no. of cycles will be four. Calculate average element times. This average time is called basic time.

Step 4: Calculation of Standard time:

To convert basic time to normal you have to multiply it with operator performance rating. Here for example, rating has been taken 100%. Now you have add allowances for machine allowances, fatigue and personal needs etc. Add machine allowance only to those elements where machine is running and fatigue and personal needs to all elements. Now we got standard time for each element in seconds. Sum up all elemental time and convert seconds into minutes. This is standard minutes or SAM .

Buyer:	SIGNET (mode fit)				Line:	B				Date:	10-09-12
Name	Process	M/C	Observed time					Total time	AVG	Industrial Capacity	Garments Capacity
			1	2	3	4	5				
Nasima	1st Shoilder joint	O/L	7	8	10	7	8	40	8	450	450
Kamola	Neck piping	F/L	9	7	8	6	6	36	7	514	514
Rabeya	2nd Shoulder joint	OL	8	12	7	10	9	46	9	400	400
Shirin	Neck rib tack	SN	9	8	10	9	8	44	9	400	400
Shamim	Sleeve gatering	SN	7	8	6	8	7	5	7	514	514
Sheuly	Level attach	SN	8	7	6	7	6	34	7	514	514
Bobita	Sleeve joint	O/L	24	26	24	25	26	25	25	144	144
Tahmina	Sleeve hem	F/L	24	22	22	23	25	116	23	157	157
Tania	Side seam	O/L	44	52	52	50	40	238	48	75	129
Shonaly	Side seam	O/L	68	65	69	68	69	339	68	53	
Foisal	Sleeve in tack	SN	12	11	9	12	8	52	10	360	360
Mizan	Sleeve top tack	SN	9	12	9	10	11	51	10	360	360
Shaied	Body hem	F/L	12	11	11	12	13	59	12	300	300

Calculation:

Avg. Time = Total time / Total number of reading (5).

Capacity/Hr = Hr (3600) / avg. Times per operation

Analysis of Time Study:

- ✓ To calculate time study, first we have to take at least five readings of each worker of all process.
- ✓ Then we have to calculate the average value of these five readings
- ✓ After then, the average value is divided by 3600 to get actual capacity per hour.

It helps for line balancing and maintains process layout of sewing operation.

2.11.4. Steps in time study:

1. Set the correct job method
2. Get an operator to use the correct job method
3. Time the operator using the correct job method
4. Grad the operator by evaluating her skill and effort.
5. Apply the standard job allowances to allow for the times when the operator would not be at the machine sewing.
6. Set the time production quota expected of the 100% (Average) operator

Work Measurement related formula:

 Standard Minutes Value (SMV) = Observe Time*Rating +15% (Allowance)

 Daily Target $= \frac{Manpower * 10(DailyworkingHours) * 60}{SMV} * WantedEfficiency\%$

 Efficiency (%) = $\frac{Output}{Input} * 100$ [Output = SMV*Pro. Quantity]

[Input = Worker*Working Hours*60]

 Individual Worker Target/Hr = $\frac{60}{SMV} * WantedEfficiency\%$

2.11.5. Layout:

Layout means to distribute/allocate elements (Sequentially) 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 arrangements which permits the product to be produced with minimum unit cost in the shortest time.

Layout Procedure:

1st Step:

Responsible person for layout making

1. APG Section Leader
2. Team Leader Technician
3. Work-Study Member

2nd Step:

1. To select line
2. To select style
3. To confirm total operator

3rd Step:

1. To breakdown the garments, elements by elements
2. To put estimated SMV beside each elements/operation
3. To calculate total SMV
4. To select machine type & number
5. To calculate average estimated SMV/Operator
6. To select right operator for right operation/elements according to performance.
7. To distribute/allocate elements (sequentially) to each operator by considering machine types, elements & estimated average (nearest) SMV.
8. To set up machine as per requirements.

Benefit of Layout:

1. The line will be quite equivalent
2. Usually a great type of bottle neck will not be found in line
3. No operator will be idle
4. Target will be achieved easily

Process Layout:

SL No.	Process	Target	SN	DN	OL	FL
1	1st Shoulder Joint				1	
2	Neck Piping					1
3	2nd Shoulder Joint				1	
4	Neck rib Tack		1			
5	Sleeve Gatering		1			
6	Level Attach		1			
7	Sleeve joint				1	
8	Sleeve hem					1
9	Side seam				2	
10	Sleeve in tack		1			
11	Sleeve top tack		1			
12	Body hem					1

2.11.6. Line balance:

Line balance means the better allocation of the necessary tasks between the operators, which reduces waiting time.

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

1) How many operators.
2) Operation.
3) SMV.
4) Performance.
5) Potential production / hour.
6) Hours to achieve target.
7) Capacity.
8) Target.

2.11.7. Capacity study:

When we make a capacity study on an operator, we are measuring the performance she should attain if she continues to work at the same pace and use the same method as observed during the study. This means that at the end of the study we can say that operator has the capacity to be a 120 % performer, or whatever performance level the study indicates.

What exactly do we mean by capacity? Well, it means the same as capability. It means that the operator is capable of achieving the performance measured by the study.

2.11.7.Capacity Study Sheet

Buyer:	Mosgen				Item:	T-shirt					Order No:	60821	
No.	Operator name	Process name	OP	M/C	Cycle Time					Average Time	SMV	Capacity	
					1	2	3	4	5				
1	Bobita	1st shoulder joint	1	O/L	8	7	7	6	6	6.80	0.10	529	
2	ayesha	Neck piping	1	F/L	7	5	6	5	6	5.80	0.08	621	
3	kamal	2nd Shoulder Joint	1	O/L	9	8	9	6	10	8.40	0.12	429	
4	Tuly	Neck rib tack	1	SN	9	8	10	11	10	9.60	0.14	375	
5	Arif	Sleeve gataring	1	SN	6	5	6	7	6	6.00	0.09	600	
6	Puspo	Level attach	1	SN	8	7	6	7	6	6.80	0.10	529	
7	Sajahan	Sleeve joint	1	O/L	24	26	24	25	26	25.00	0.36	144	
8	Jahanara	Sleeve hem	1	F/L	5	6	4	5	5	5.00	0.07	720	
9	Joshim	Side seam	1	O/L	24	23	25	26	24	24.40	0.35	148	
10	Halima	Sleeve in tack	1	SN	9	10	11	9	10	9.80	0.14	367	
11	Lipi	Sleeve top tack	1	SN	10	10	11	9	10	10.00	0.14	360	
12	Saidul	Body hem	1	F/L	9	10	11	10	9	9.80	0.14	367	

Calculation:

- Avg. Time = Total time / Total number of reading (5)
- SMV = Basic time + (basic time x 15% allowance) /60
- Basic time = avg. Cycle time x rating (here rating = 0.75)
- Capacity/Hr = Hr (3600) / avg. Times per operation

Analysis of capacity Study:

- ✓ To calculate capacity study, first we have to take at least five readings of each worker of all process.
- ✓ Then we have to calculate the average value of these five readings
- ✓ After then, the average value is divided by 3600 to get actual capacity per hour.
- ✓ Capacity study shows the worker capacity per hour.
- ✓ It helps for line balancing and maintains process layout of sewing operation.

2.11.8. Operation breakdown:

Breakdown is a listing of the content of a job by elements. A garment consists of some parts and some group of operations. Breakdown means to writing down all parts and 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 and type of machine beside each and every process.

Breakdown Procedure:

- ✓ Floor section leader, team leader technician and work study officer must sit together to make breakdown.
- ✓ Technician breaks the garments into parts an gathered the parts one after another by operation/process
- ✓ Then work study officer and floor section leader fox up the SMV of those operation
- ✓ By proceeding this technique when all process completed need to summarize all process SMV and the total will be called as respective garments SMV

Benefit of breakdown:

- ✓ Can see the all operations of the garments at a time.
- ✓ Can anticipate the difficulties of doing critical operation
- ✓ Can make layout in a easy, simple and less time consuming way.
- ✓ Easy to select right operator for right process.
- ✓ Can know the quantity and types of machine to make the garment required.
- ✓ Can be conscious about quality for fill up the buyer standard.

Breakdown can know about additional guide, folder and attachment.

2.11.8. Operation Breakdown Sheet

SL	Operation Name	M/C	SMV	TGT	AML		Remark
					Op	Hel	
1	Single shoulder joint	O/L	0.10	600	1		
2	Neck piping	F/L	0.08	750	1		
3	Shoulder Joint	O/L	0.12	500	1		
4	Neck rib tack	SN	0.14	429	1		
5	Sleeve gataring	SN	0.09	667	1		
6	Level attach	SN	0.10	600	1		
7	Sleeve joint	O/L	0.36	167	1		
8	Sleeve hem	F/L	0.07	857	1		
9	Side seam	O/L	0.35	171	1		
10	Sleeve in tack	SN	0.14	426	1		
11	Sleeve top tack	SN	0.14	429	1		
12	Body hem	F/L	0.14	429	1		
	Total:		1.83	6028	12		

Analysis of Operation Breakdown:

- ✓ To calculate capacity study, first we have to take at least five readings of each worker of all process.
- ✓ Then we have to calculate the average value of these five readings
- ✓ After then, the SMV calculation
- ✓ Then target calculation (60/SMV)

2.11.9. Bottleneck:

The upper narrow portion of a bottle is called neck (opening side) and it is an obstruction to go to the way from large portion of a bottle through narrow portion of a neck. It is a metaphorical scene of obstruction of production sector. A garments sector is a production sector and the bottleneck used here as obstruction of normal production. In a brief the bottleneck means lost production and lost profit i.e. the lowest capacity of production.

Bottleneck in the production line

The lowest output point in the production line is called bottleneck. That is bottleneck area, where supply gathered and production goes under capacity.

Why arise bottleneck

There are so many reasons to arise a bottleneck in the production line and it is described bellow.

A) **Bottleneck before input in line.**

1) If issue is not supplied in time from M.C.D and sub store.
2) If issue comes delay.
3) Issues serial number mistake.
4) Bundling mistake.
5) Wrong issue supply.
6) Pattern problem.

B) **Bottleneck in line:**

1) Worker selection wrong.
2) Wrong works flow / sequence of works.
3) Non-balance allocation of elements.
4) Works negligence by workers.
5) Workers absenteeism.
6) Machine disturbances / out of order.
7) Lack of supply.
8) Non-serial supplies forward from workers.
9) Colour shading
10) Quality problem.
11) If anybody becomes sick.

Diagnostic character of bottleneck:

1) By checking counter machine: - After specific period (time to time) by checking counter machine it is easy to find out the bottleneck which counter is shown poor / lowest production.

2) By observing serial number of supplied issue: - After checking some operators if it is found that someone is sewing / working lowest serial number of issue and it not reasonable difference with others it is defined bottleneck.

3) By observing gathered supply: - Those areas are bottleneck areas where pile of supply is observed.

4) By performing cycle check: - By performing cycle check we can realize bottleneck from different of time. We can realize bottleneck at a glance by making graph and it is a best and scientific way to find out the real bottleneck.

Way of reducing bottle neck:

- 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.
- To submit the layout sheet to maintenance section minimum 2-3 days before for better preparation.
- To check pattern before supply in the line.
- To reduce excess works from workers.
- To select right workers for right works.
- To keep supply available in time.
- To maintain serial number.
- Reject garments should not forward.
- Supply should be forwarded after checking.
- To alert when bundling (maintain serial number)
- By improving method.
- By improving workers performance.
- By reducing sewing burst

3. Experimental Details:

3.1. Operation Breakdown:

- Body Matching
- 1st Shoulder Attach
- Body Reverse
- Folding
- Neck Piping
- Scissoring
- Neck piping make & cut
- Back neck tape attach
- Thread cut
- Neck inside tack
- 2nd shoulder attach
- Shoulder scissoring
- Neck outside tack
- Sleeve hem
- Thread cut peer make
- Sleeve attach
- Thread cut & folding
- Side seam
- Sleeve inside tack
- Sleeve outside tack
- Body hem

Operation Breakdown Sheet

Factory-1

SL	Operation Name	M/C	SMV	Target	AML	
					OP	HP
01	Body matching	HP	0.39	154		1
02	1st shoulder Att.	OL	0.30	200	1	
03	Body reverse	HP	0.30	200		1
04	Folding	HP	0.34	176		1
05	Neck piping	OL	0.30	200	1	
06	Scissoring	HP	0.30	200		1
O7	Neck piping make & cut	FL	0.34	176	1	
08	Back neck tape att.	LS	0.34	352	2	
09	Thread cut	HP	0.24	250		1
10	Neck inside tack	LS	0.31	193	1	
11	2nd shoulder att.	OL	0.30	200	1	
12	Shoulder scissoring	HP	0.30	200		1
13	Neck outside tack	LS	0.30	200	1	
14	Sleeve hem	FL	0.30	200	1	
15	Thread cut pear make	HP	0.30	200		1
16	Sleeve att.	OL	0.66	182	2	
17	Thread cut & folding	HP	0.34	176		1
18	Side seam	OL	0.88	272	4	
19	Thread cut	HP	0.30	200		1
20	Sleeve inside tack	LS	0.24	250	1	
21	Sleeve outside tack	LS	0.24	250	1	
22	Thread cut	HP	0.37	162		1
23	Body hem	FL	0.37	162	1	
24	Thread cut	HP	0.30	200		1
Total=24			8.36	4955		

Operation Breakdown Sheet

Factory-2

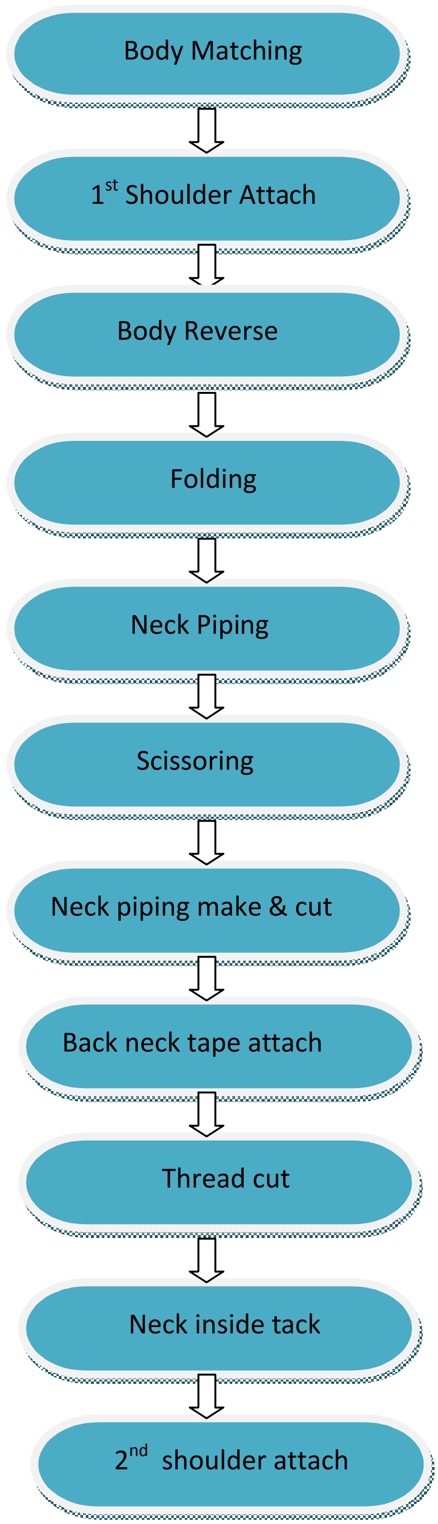
SL	Operation Name	M/C	SMV	Target	AML	
					OP	HP
01	Body matching	HP	0.32	188		1
02	1st shoulder Att.	OL	0.27	222	1	
03	Body reverse	HP	0.27	222		1
04	Folding	HP	0.27	222		1
05	Neck piping	OL	0.27	222	1	
06	Scissoring	HP	0.27	222		1
O7	Neck piping make & cut	FL	0.27	222	1	
08	Back neck tape att.	LS	0.45	266	2	
09	Thread cut	HP	0.30	200		1
10	Neck inside tack	LS	0.30	200	1	
11	2nd shoulder att.	OL	0.24	250	1	
12	Shoulder scissoring	HP	0.30	200		1
13	Neck outside tack	LS	0.27	222	1	
14	Sleeve hem	FL	0.32	188	1	
15	Thread cut pear make	HP	0.24	250		1
16	Sleeve att.	OL	0.61	196	2	
17	Thread cut & folding	HP	0.30	200		1
18	Side seam	OL	0.86	140	4	
19	Thread cut	HP	0.37	162		1
20	Sleeve inside tack	LS	0.30	200	1	
21	Sleeve outside tack	LS	0.27	222	1	
22	Thread cut	HP	0.32	188		1
23	Body hem	FL	0.30	200	1	
24	Thread cut	HP	0.27	222		1
Total=24			7.96			

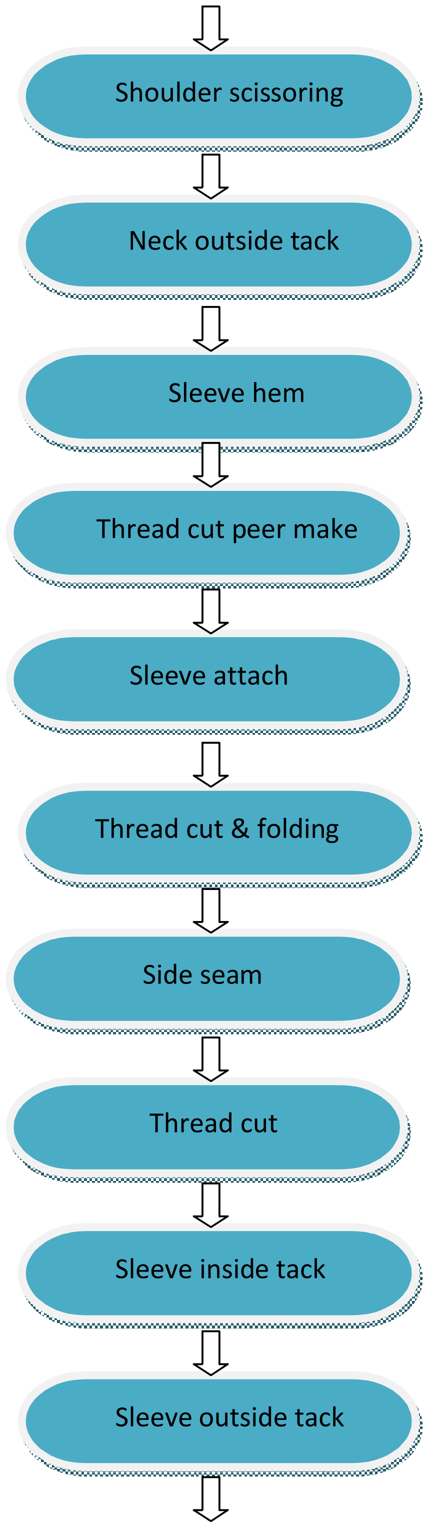
Operation Breakdown Sheet

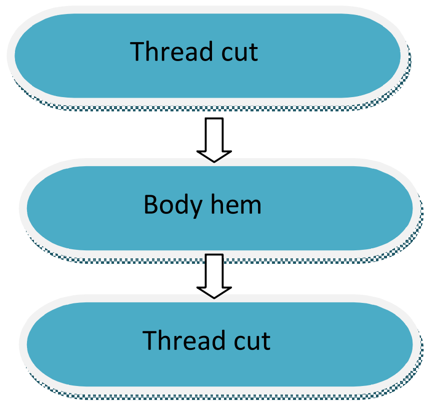
Factory-3

SL	Operation Name	M/C	SMV	Target	AML	
					OP	HP
01	Body matching	HP	0.35	172		1
02	1st shoulder Att.	OL	0.24	250	1	
03	Body reverse	HP	0.38	158		1
04	Folding	HP	0.38	158		1
05	Neck piping	OL	0.27	222	1	
06	Scissoring	HP	0.27	222		1
O7	Neck piping make & cut	FL	0.27	222	1	
08	Back neck tape att.	LS	0.31	194	2	
09	Thread cut	HP	0.24	250		1
10	Neck inside tack	LS	0.27	222	1	
11	2nd shoulder att.	OL	0.30	200	1	
12	Shoulder scissoring	HP	0.30	200		1
13	Neck outside tack	LS	0.27	222	1	
14	Sleeve hem	FL	0.25	240	1	
15	Thread cut pear make	HP	0.27	222		1
16	Sleeve att.	OL	0.37	162	2	
17	Thread cut & folding	HP	0.30	200		1
18	Side seam	OL	0.48	250	4	
19	Thread cut	HP	0.34	176		1
20	Sleeve inside tack	LS	0.24	250	1	
21	Sleeve outside tack	LS	0.27	222	1	
22	Thread cut	HP	0.32	188		1
23	Body hem	FL	0.24	250	1	
24	Thread cut	HP	0.27	222		1
Total=24			7.20			

3.2 Process Flowchart of a basic T-shirt:




Shoulder scissoring
Neck outside tack
Sleeve hem
Thread cut peer make
Sleeve attach
Thread cut & folding
Side seam
Thread cut
Sleeve inside tack
Sleeve outside tack


Thread cut
Body hem
Thread cut

3.3. Comparison of different parameters among three factories:

#Factory-1

Buyer: GOOD MAN

ITEM: Basic T-shirt

Line: 5

Operation	M/C	AML	Cycle Time					Average Time	Rating	Allowance	SMV	Process Target/Hr
			1	2	3	4	5					
Body matching	HP	1	14	17	13	12	14	14	70	20	0.39	154
1st shoulder Att.	OL	1	12	15	10	13	10	12	80	20	0.30	200
Body reverse	HP	1	15	12	13	10	10	12	80	20	0.30	200
Folding	HP	1	13	10	15	10	12	12	70	20	0.34	176
Neck piping	OL	1	12	12	13	15	10	12	80	20	0.30	200
Scissoring	HP	1	13	13	14	10	10	12	80	20	0.30	200
Neck piping make & cut	FL	1	12	13	13	10	12	12	70	20	0.34	176
Back neck tape att.	LS	2	22	19	21	25	23	14	80	20	0.34	352
Thread cut	HP	1	14	13	11	9	13	10	80	20	0.24	250
Neck inside tack	LS	1	13	13	13	14	12	11	70	20	0.31	193
2nd shoulder att.	OL	1	15	13	12	10	10	12	80	20	0.30	200
Shoulder scissoring	HP	1	14	16	15	12	13	14	70	20	0.30	200
Neck outside tack	LS	1	12	13	12	10	15	12	80	20	0.30	200
Sleeve hem	FL	1	17	16	15	18	14	12	80	20	0.30	200
Thread cut pear make	HP	1	12	14	13	10	11	12	80	20	0.30	200
Sleeve att.	OL	2	30	30	30	28	30	30	90	20	0.66	182

Thread cut & folding	HP	1	14	16	15	13	12	14	80	20	0.34	176
Side seam	OL	4	40	44	36	39	41	40	90	20	0.88	272
Thread cut	HP	1	24	18	22	20	20	14	90	20	0.30	200
Sleeve inside tack	LS	1	14	10	12	11	13	10	80	20	0.24	250
Sleeve outside tack	LS	1	13	13	11	15	13	10	80	20	0.24	250
Thread cut	HP	1	15	15	15	14	16	15	80	20	0.37	162
Body hem	FL	1	15	17	13	13	17	15	80	20	0.37	162
Thread cut	HP	1	12	15	10	10	13	12	80	20	0.30	200
Total=24		29									8.36	4955

- SMV = TOTAL BASIC TIME + (TOTAL BASIC TIME * ALLOWANCE)

  =8.36

- TARGET = $\frac{\textbf{Total manpower per line}*\textbf{Total working minute per day}}{\textbf{S}\text{MV}} * \mathbf{80}\%$

  $= \frac{\mathbf{29}*480}{\mathbf{8.36}} * \mathbf{80}\%$

  =1332

- LINE LABOR PRODUCTIVITY = $\frac{\textbf{Total number of output per day per line}}{\textbf{Number of worker worked}}$

  = 1332/29

  =46 Pcs

- Factory capacity= $\frac{\text{work hour} * \text{total workers} * \text{working day} * 60}{\text{SMV}}$*Efficiency

$$= \frac{08 * 3000 * 26 * 60}{8.36} * 80\%$$

=3582775 Pieces/ Month

- LINE EFFICIENCY = $\frac{\textbf{Total output per day per line} * \textbf{SAM}}{\textbf{Total manpower per line} * \textbf{total working minutes per Day}}$ *100%

= (1332*8.36)/(29*480)*100

= 80%

#Factory-2:

Buyer: Lotto

ITEM: Basic T-shirt

Line: 2

Operation	M/C	AML	Cycle Time					Average Time	Rating	Allowance	SMV	Process Target/Hr
			1	2	3	4	5					
Body matching	HP	1	14	12	13	14	12	13	80	20	0.32	188
1st shoulder Att.	OL	1	11	12	10	11	12	11	80	20	0.27	222
Body reverse	HP	1	11	12	11	12	10	11	80	20	0.27	222
Folding	HP	1	11	10	11	11	12	11	80	20	0.27	222
Neck piping		1	10	11	11	11	12	11	80	20	0.27	222
Scissoring	HP	1	11	11	12	11	10	11	80	20	0.27	222
Neck piping make & cut	FL	1	11	12	11	10	11	11	80	20	0.27	222
Back neck tape att.	LS	2	23	22	22	20	19	21	80	20	0.45	266
Thread cut	HP	1	11	12	11	14	11	12	80	20	0.30	200
Neck inside tack	LS	1	13	14	11	10	12	12	80	20	0.30	200
2nd shoulder att.	OL	1	9	11	10	12	9	10	80	20	0.24	250
Shoulder scissoring	HP	1	11	12	11	13	12	12	80	20	0.30	200
Neck outside tack	LS	1	13	12	11	10	10	11	80	20	0.27	222
Sleeve hem	FL	1	13	11	15	12	14	13	80	20	0.32	188
Thread cut pear make	HP	1	10	9	12	10	10	10	80	20	0.24	250
Sleeve att.	OL	2	30	27	27	28	29	28	90	20	0.61	196

Thread cut & folding	HP	1	11	14	10	11	13	12	80	20	0.30	200
Side seam	OL	2	41	38	37	39	38	39	90	20	0.86	140
Thread cut	HP	1	18	19	16	15	17	17	90	20	0.37	162
Sleeve inside tack	LS	1	14	13	10	12	11	12	80	20	0.30	200
Sleeve outside tack	LS	1	9	12	13	11	11	11	80	20	0.27	222
Thread cut	HP	1	15	12	14	11	13	13	80	20	0.32	188
Body hem	FL	1	14	11	13	12	10	12	80	20	0.30	200
Thread cut	HP	1	13	12	9	12	12	11	80	20	0.27	222
Total		27									7.96	

- SMV = TOTAL BASIC TIME + (TOTAL BASIC TIME * ALLOWANCE)

  =7.96

- TARGET = $\frac{\textbf{Total manpower per line} * \textbf{Total working minute per day}}{\textbf{SMV}} * \mathbf{80}\%$

  $= \frac{\mathbf{27} * 480}{\mathbf{7.96}} * \mathbf{80}\%$

  =1302

- LINE LABOR PRODUCTIVITY = $\frac{\textbf{Total number of output per day per line}}{\textbf{Number of worker worked}}$

  = 1302/27

  =48 Pcs

- Factory capacity= $\frac{\text{work hour}*\text{total workers}*\text{working day}*60}{\text{SMV}}$*Efficiency

$=\frac{08*2000*26*60}{7.96}*80\%$

=2508542 Pieces/month

- LINE EFFICIENCY = $\frac{\textbf{Total output per day per line}*\textbf{SAM}}{\textbf{Total manpwer per line}*\textbf{total working minutes per Day}}$ *100%

= 1302*7.96/27*480*100

= 80%

#Factory-3:

Buyer: Rich MAN

ITEM: Basic T-shirt

Line: 5

Operation	M/C	AML	Cycle Time					Average Time	Rating	Allowance	SMV	Process Target/Hr
			1	2	3	4	5					
Body matching	HP	1	16	14	12	14	12	14	80	20	0.35	172
1st shoulder Att.	OL	1	9	11	12	10	8	10	80	20	0.24	250
Body reverse	HP	1	15	14	16	13	14	15	80	20	0.38	158
Folding	HP	1	13	14	16	15	15	15	80	20	0.38	158
Neck piping		1	11	12	11	12	10	11	80	20	0.27	222
Scissoring	HP	1	11	11	10	12	11	11	80	20	0.27	222
Neck piping make & cut	FL	1	12	11	10	12	10	11	80	20	0.27	222
Back neck tape att.	LS	1	13	15	14	14	14	14	90	20	0.31	194
Thread cut	HP	1	9	11	10	11	10	10	80	20	0.24	250
Neck inside tack	LS	1	10	11	10	11	12	11	80	20	0.27	222
2nd shoulder att.	OL	1	12	13	10	13	12	12	80	20	0.30	200
Shoulder scissoring	HP	1	12	13	11	12	12	12	80	20	0.30	200
Neck outside tack	LS	1	10	10	11	12	12	11	80	20	0.27	222
Sleeve hem	FL	1	10	9	11	11	10	10	80	20	0.25	240
Thread cut pear make	HP	1	11	11	12	11	11	11	80	20	0.27	222
Sleeve att.	OL	1	15	18	18	17	16	17	90	20	0.37	162
Thread cut & folding	HP	1	11	12	13	11	13	12	80	20	0.30	200
Side seam	OL	2	20	19	24	21	24	22	90	20	0.48	250
Thread cut	HP	1	13	13	16	13	15	14	80	20	0.34	176

Sleeve inside tack	LS	1	10	9	11	10	11	10	80	20	0.24	250
Sleeve outside tack	LS	1	11	10	12	11	12	11	80	20	0.27	222
Thread cut	HP	1	14	15	12	12	12	13	80	20	0.32	188
Body hem	FL	1	11	9	11	10	11	11	90	20	0.24	250
Thread cut	HP	1	10	11	12	12	10	11	80	20	0.27	222
Total		25									7.20	

- SMV = TOTAL BASIC TIME + (TOTAL BASIC TIME * ALLOWANCE)

  =7.20

- TARGET = $\frac{\textbf{Total manpower per line} * \textbf{Total working minute per day}}{\textbf{S}\text{MV}} * \mathbf{80}\%$

  $=\frac{\mathbf{25} * 480}{7.20} * \mathbf{80}\%$

  =1333

- LINE LABOR PRODUCTIVITY = $\frac{\textbf{Total number of output per day per line}}{\textbf{Number of worker worked}}$

  =1333/25

  =53 Pcs

- Factory capacity= $\frac{\text{work hour} * \text{total workers} * \text{working day} * 60}{\text{SMV}}$*Efficiency

$$=\frac{08*1500*26*60}{7.20}*80\%$$

=2080000 pieces/month

- LINE EFFICIENCY = $\frac{\textbf{Total output per day per line} * \textbf{SAM}}{\textbf{Total manpwer per line} * \textbf{total working minutes per Day}}$ *100%

=1400*7.20/25*480*100

=84%

4.0. Result and Discussion:

Comparison between three factories (Basic T-shirt):

1. SMV:

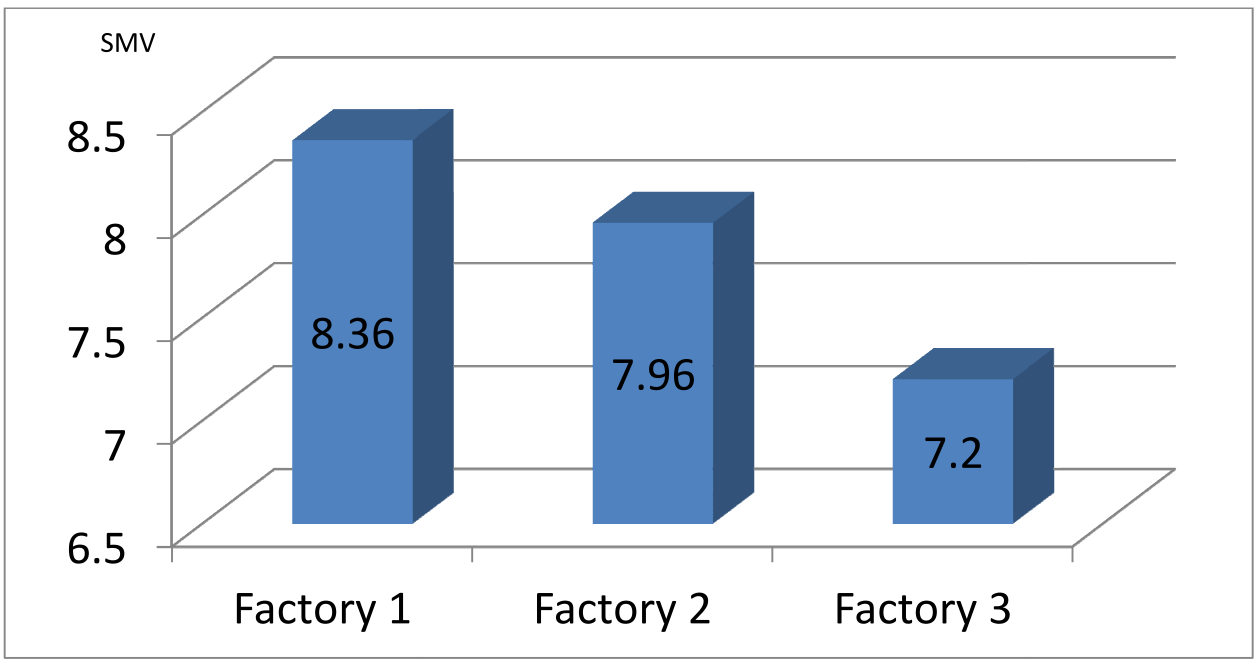
SMV of the factory-1 is 8.36

SMV of the factory-2 is 7.96

SMV of the factory-3 is 7.20

Comments: 1. Factory-3 has more skilled operator but less skill operator is on other two factory.

2. Factory-3 has less quality problem but more on other two factories.



2. Line Efficiency:

Line Efficiency of the factory-1 is 80%

Line Efficiency of the factory-2 is 80%

Line Efficiency of the factory-3 is 84%

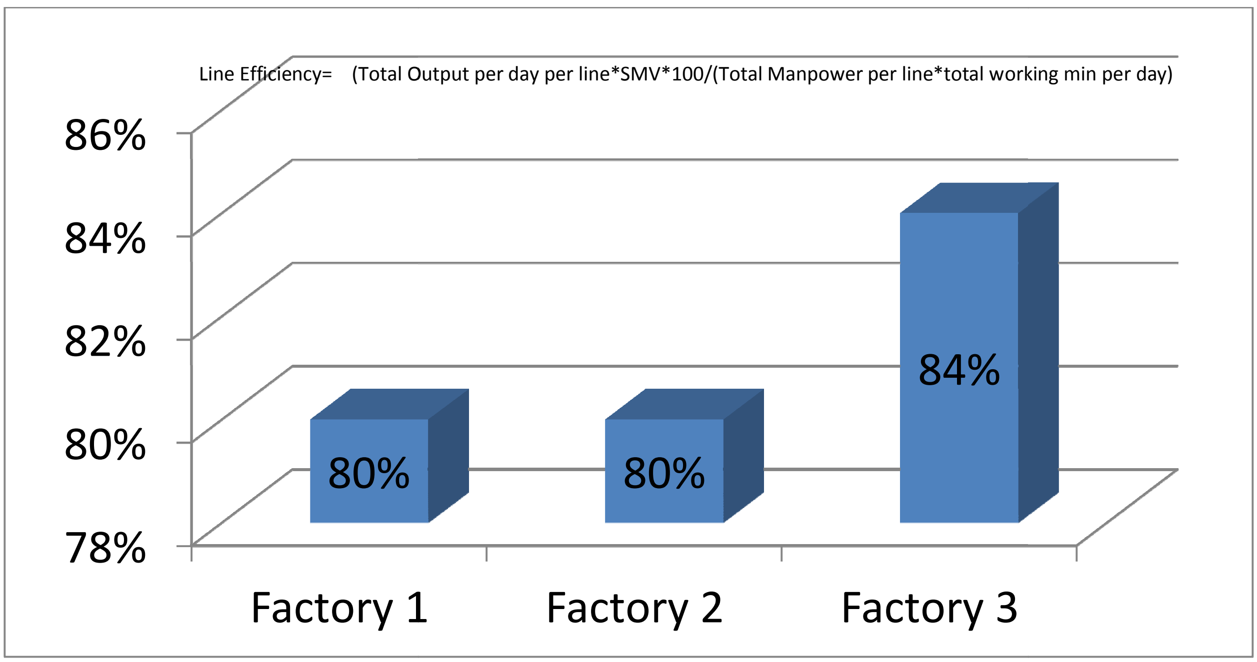
Comments: 1. Less machine breakdown at factory-3 but more machine breakdown of other two.

2. Factory-3 has good balance line but not so good in other two.

3. Good quality at factory-3 but less quality in other two.

4. Factory-3 has more skill operator but has less skill operator in other two.

5. Factory-3 has good plant lay out but other two plant lay out not so good.



3. Labor Productivity:

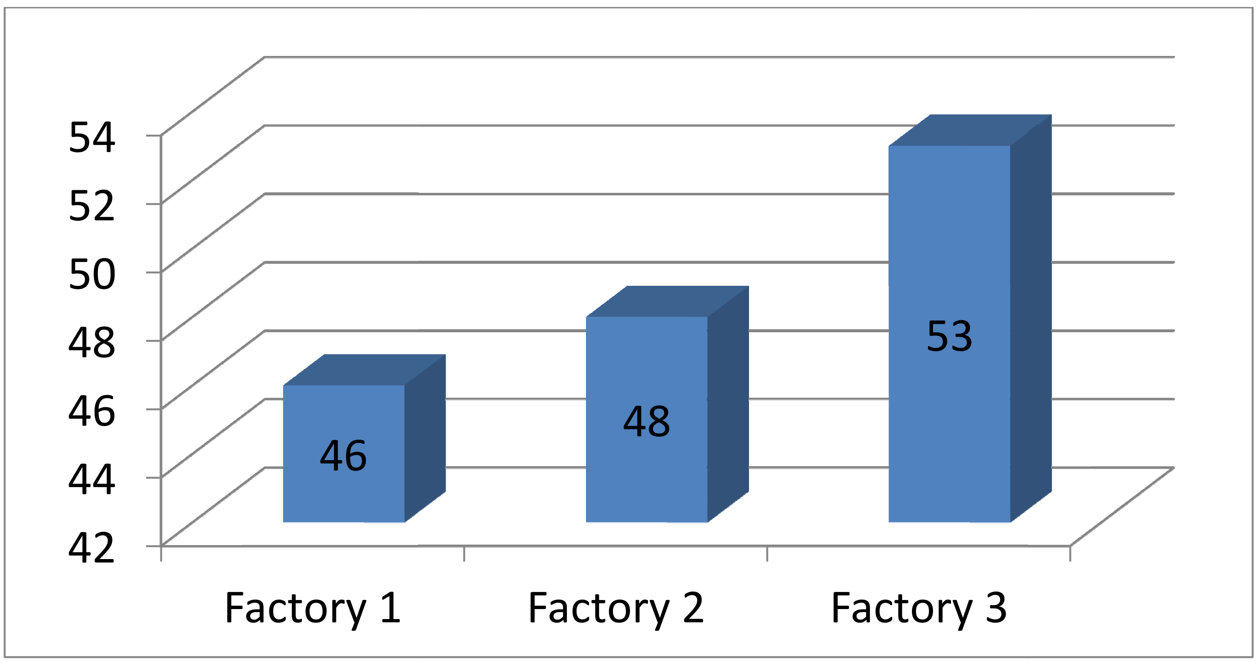
Labor Productivity of factory-1 is 46 Pcs

Labor Productivity of factory-2 is 48 Pcs

Labor Productivity of factory-3 is 53 Pcs

Comments: 1. Worker of factory-1 is more attentive on their task but less attentive in other two.

2. Less machine breakdown at factory-1 but more machine breakdown at other two.



4. Line Target:

Line target of factory-1 is 1332 pieces

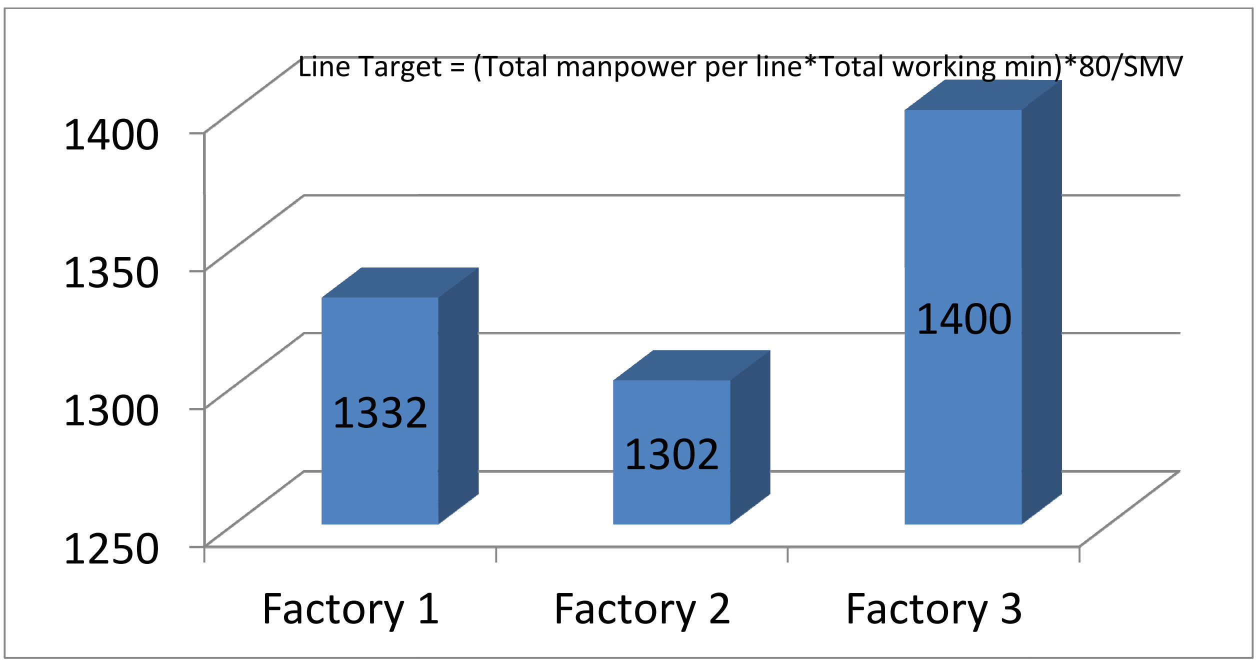
Line target of factory-2 is 1302 pieces

Line target of factory-3 is 1400 pieces

Comments: 1. Factory-1 has good plant lay out but not so good plant layout at other two.

2. Sufficient input in factory-1 but insufficient at other two.

3. Another important parameter is skill operator at factory-1.



5. Factory Capacity:

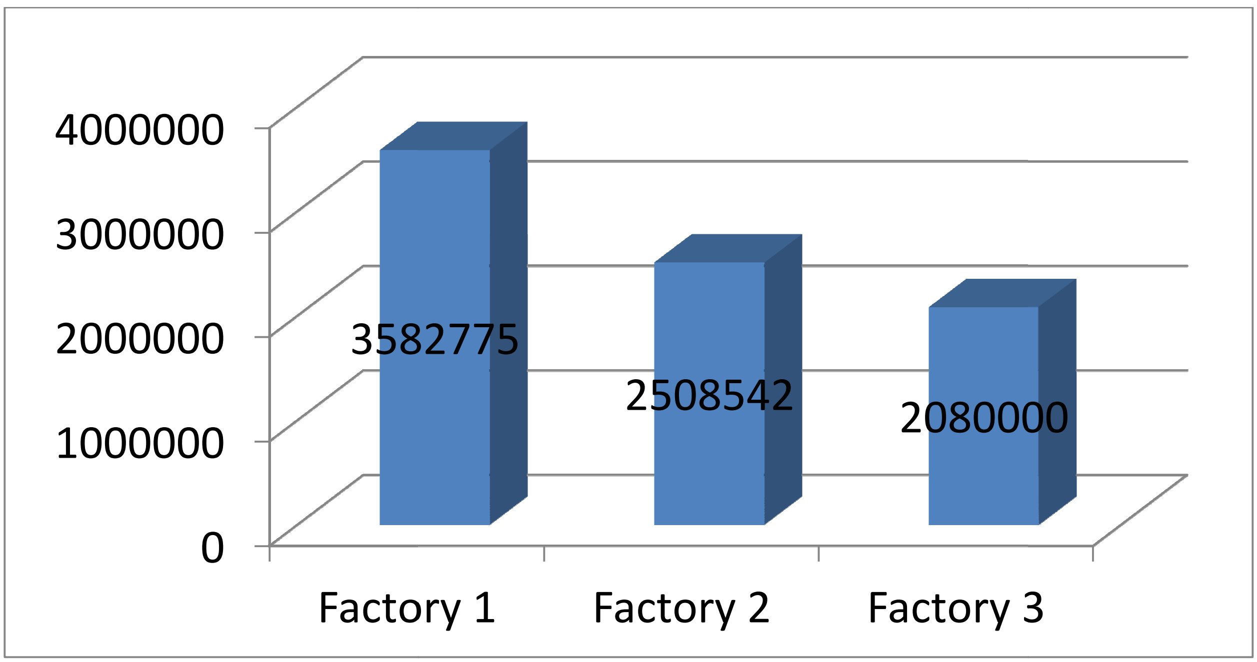
Factory-1 capacity is 3582775 pieces/ month

Factory-2 capacity is 2508542 pieces/ month

Factory-3 capacity is 2080000 pieces/ month

Comments: 1. Factory-1 has more total space than the other two.

2. More equipment at factory-1 than the other two.



Discussion:

If we want to increase high production as Factory-3 at other two factories, at first we should develop some system like Factory-3 such as,

Selection and design of tools and equipment:

- Design of facilities including plant location, layout of building, machine and equipment.
- Design and improvement of planning and control system for production, inventory, quality and plant maintenance and distribution systems.
- Development of time standards, costing and performance standards.
- Installation of wage incentive schemes.
- Design and installation of value engineering and analysis system.
- Operation research including mathematical and statistical analysis.
- Performance evaluation.
- Supplier selection and evaluation.

PERCEPTION ACHIEVED BY THE COMPARISON STUDY:

- Multi-skilled workers should be produced.
- Lean management should be developed.
- Unavailability of workers in different region.
- The parameters of evaluation of the industries vary because of different environment of different industries.

5.0. Conclusion:

Industrial engineering is an important and essential part of any apparel industry. We learn all the implementations of the processes which we have studied theoretically. It gives us an opportunity to compare the theoretical knowledge with practical facts and thus develop our knowledge and skills. This project also gives us an opportunity to enlarge our knowledge of textile administration, production planning, procurement system, production process, and machineries and teach us to adjust with the industrial life.

6. References:

Books:

- Production planning, control & Industrial management.

  (By Dr. KC. Jain)
- Industrial Engineering In Apparel Production

  (By V Ramesh Babu)
- The Apparel Industry

  (By Richard M Jones)
- Industrial Engineering And Management

  (By C.Natha Muhi Reddy)
- Industrial Engineering and Engineering Management

  (By professor john W H)

Website links:

- http://www.fibre2fashion.com/industry-article/16/1591/industrial-engineering-a-new-concept-of-apparel-engineering1.asp
- http://www.lcmibd.com/industrialengineering.htm
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- http://wiki.answers.com/Q/Industrial_engineering_work_study_in_garments
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