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IN THE NAME OF ALLAH THE MOST BENEFICENT, THE MOST MERCIFUL

UNIVERSITY OF MANAGEMENT AND TECHNOLOGY

Implementation of lean manufacturing Tools to Reduce Production time

University of Management and Technology

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Dedication

This project is dedicated to all our parents whose efforts made us to stand where we are today. Surely where we are today is the fruit of their effort which they planted to give us for our successful career. Not only the parents but the teachers and the elders also whose prayers take us to this point in this life. The load they bear in their life to helped us a lot to achieve what we achieved till now and we are hopeful that the prayers of these people will also help us to move further ahead towards our career.

This Project is also dedicated to all those who believe in team work and want to have a successful career with their efforts.

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We hope and wishes best for the progress of STD, the teachers and for students.

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Letter of Thanks

Very humble thanks to Kahsif Zulfiqar G.M Master Textile for giving opportunity to students like us. We are also thankful to the administration and team of Master Textile. The confidence Kashif Zulfiqar sb. And administration of MsTM showed on us motivated us so much to work for this project. All results are due to the risk and time company invested on us. The visit throughout our project helped us a lot to learn many aspects. We learned a lot and this learning made our interest to learn ways to work in industry. The atmosphere was great and we face no difficulty in penetrating and adjusting in the environment of the industry. We also hope best for them as their believe on industrially in-experience people like us also motivate to work dedicatedly.

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ABSTRACT

Traditionally operated garment industries are facing problems like low productivity, longer production lead time, high rework and rejection, poor line balancing, low flexibility of style changeover etc. These problems were addressed in this study by the implementation of lean tools like cellular manufacturing, single piece flow, work standardization, just in time production etc.

After implementation of lean tools, results observed were highly encouraging. Some of the key benefits entail production cycle time decreased by 8%, number of operators required to produce equal amount of garment is decreased by 14%, rework level reduced by 80%, production lead time comes down to one hour from two days, work in progress inventory stays at a maximum of 100 pieces from around 500 to 1500 pieces. Apart from these tangible benefits operator multi-skilling as well as the flexibility of style changeover has been improved.

This study is conducted in the stitching section of a shirt manufacturing company. Study includes time studies, the conversion of traditional batch production into single piece flow and long assembly line into small work cells.

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ABBREVIATIONS

CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
CI	Continuous Improvement
FSVSM	Future State Value Stream Mapping
ISVSM	Ideal State Value Stream Mapping
JIT	Just in Time
MTM	Methods Time Measurement
PDCA	Plan Do Check Act
PFD	Personal Fatigue and Delay
PMTS	Predetermined Motion Time Systems
PSVSM	Present State Value Stream Mapping
SAM	Standard Allowed Minutes
SMED	Single Minute Exchange of Dies
TMU	Time Measurement Unit
TPM	Total Productive Maintenance
TPS	Toyota Production System
VSM	Value Stream Mapping
WIP	Work in Progress

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1: Introduction

1.1 Background:

Due to different factors which mainly include labor wages garments industry is shifting to underdeveloped countries. (1) The other factors include availability of material, the specific market nature of the industries for example: the short production trend, high volatility, low predictability, high level of impulse purchase, the quick market response; garment industries are facing the greatest challenges these days (2)

Developing countries has mainly edge in labor side, except Bangladesh all have their own in house material for denim industry. Cheap labor also result in low productivity in developing countries. For example, labor is very cheap in Bangladesh but the productivity is poor among other developing countries. (3) To avoid fabric utilization (which have main cost in production) has improved so much in past year by induction of CAD/CAM. Now the main things to focus is Labor productivity for fashion industry (making short orders in minimum time) because now a days there contribution is getting more in industry. Even today, industries are getting the same or more volumes (orders), but the number of styles they have to handle has increased drastically. Earlier if industry had orders of same style no matter how much time but now if industry have order of even two or more weeks they(orders) include different styles which also have more fashion then basic. The garment industry now has to produce multiple styles even within a day; this needs higher flexibility in volume and style change over (4)

In developing countries it has been observed that garment industry is just like a home business which lacks skilled personnel and courage to change this trend. the business is running from years as long as profits are coming but now as the competition is rising it is need to improved productivity by inducing skills to remain in markets. (5)

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The volatility in styles can only be address by flexibility in manufacturing styles. and to cope up with this best method is introducing lean manufacturing. this will reduce time, increased profits, reduce our inventory, and by training of operator will reduce re-work.

1.2 History of lean manufacturing process:

During II world war, the economic condition of Japan was heavily destroyed. Due to this there was shortage of fund resulting in limiting access to corporate finance. In this situation, neither Toyota was able to set up a mass production system like their American counterparts, nor it was possible to layoff the employees to reduce their cost due to legislation. so They decided to produce a small batch of products which would reduce inventories. But it is often practical to replace equipment and production lines is hindered by difficulty. To tackle this problem in these multipurpose machines and tooling systems began to reduce transfer time employees trained in methods. At the same time, Toyota invested in the larger size is more important than investing in machinery and staff training is ongoing throughout the organization realized. It encourages all employees and process improvement company, input start and everyone is more open. In this way, short production runs started by Toyota became a benefit rather than a burden, as it was able to respond much more rapidly to changes in demand by quickly switching production from one model to another (6). Over time, all these elements were consolidated into a new approach to operations that formed the basis of lean or Toyota Production System.

1.2 Research problem:

The major problems and delays comes mainly with stitching. As cutting have now automated makers in most of places. Thus we have to give more attention to stitching than to cutting and finishing of garments.

The first and foremost problem of industry is high WIP due to bottlenecks on some places specially in assembly portion or in all sections of fashion article. there often come a single operation which leads to delay. This also use energies to cover up and when covered waste time on re-work.

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Secondly in traditional batch production flexibility cannot be achieved. this obstruct by the small quantity of sizes and increasing styles. The layout should be so that minimum WIP can be attain and sustain.

Thirdly the operator are not multi-skilled and are not able to work efficiently in style change. though they have unmeet able efficiently for a specific operation. This is need of future to have operators which have multi-skill.

Workload fluctuation among operators is another problem in batch processing, because one operator is given one operation at a time. So the operator who is performing easier and low time consuming jobs can pile up a huge amount of WIP whereas in the critical operations (operations which need more time and skill) there is lagging causing unbalanced WIP in-between machines and the work load is not proper among operators. This research tries to address all these problems of garment industry by

- Method Study
- Time study
- Workplace or environment improvement
- Line balancing and line flow system
- By Implementation of Lean Manufacturing Tools
- Production systems and selection for appropriate method
- Improving planning
- Improving supply chain

1.3 Lean Manufacturing:

Customers' demand for product flow by identifying and eliminating waste through continuous improvement, a systematic approach. Lean is about doing more with less time, inventory, space, people, and money. to provide low cost high quality clothing apparel manufacturers pressed.

Lean manufacturing is a process to achieve shortest cycle with low waste. The term lean manufacturing to develop a new product in half the time half the human effort in the

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company, half the manufacturing space, half the investment in Tools and have coined to represent half the engineering hours.

Thus the objective of this research is to find out how we can use lean manufacturing to achieve the following:

- To meet customer demand on time by eliminating non value added work from the process
- To minimize the work in process inventory
- To create flexibility of style changeover
- To reduce rework percentage
- To create a pool of multi-skilled operators who can respond quickly for changing style

1.3.2 Lean Principles

The major five principles of Lean are as follows (7)

- Principle 1: Accurately specify value from customer perspective for both products and services.
- Principle 2: Identify the value stream for products and services and remove non-value-adding waste along the value stream.
- Principle 3: Make the product and services flow without interruption across the value stream.
- Principle 4: Authorize production of products and services based on the pull by the customer.
- Principle 5: Strive for perfection by constantly removing layers of waste.

1.4 Industrial Engineering:

Industrial Engineering or IE approaches and integrate people into design and develop system, thus requiring and understanding of physiological, psychological and other

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characteristic, the purpose of study is to govern and affect the performance of individual or group in a working environment.

Simply we can say that IE is a logical way to find out

- Best way to do something
- Completing it in given time
- And way to measure results.

In our concern related to apparel manufacturing it is the best we can use IE because the main focus of every textile engineer related to garment field is" to do best in limited time in efficient way". With the help of improvement of IE setup a firm can increase production and decrease production cost.

PRODUCTION ↑↓ PRODUCTION COST

1.4.1 Function of IE:

- Quotas and piece rate
- Costing
- Man power planning
- Machine requirement
- Production planning
- Plant layout
- Production flow system
- Machine and attachment
- Pay system
- Operator performance
- Production control system
- Plant system and maintenance
- Method study
    - ✓ Motion study

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- ✓ Re-engineering process
- Work study
- Time study

(8) (9)

1.4.2 Study of Industrial engineering :

1.4.2.1.1 Manpower Requirements

To understand the manpower requirement a great deal of time study and motion study activity will need to occur. Depending on the company's policies for setting work standards one of several methods will be chosen.

1.4.2.1.2 Performing a motion study

Every job can be broken down into its' fundamental work elements. Jobs can be studied visually or through the assistance of a camera for micro-motion studies.

Whether the study is visual or micro the IE will be applying the same rules of motion economy to the person, environment and tools. The rules that are applied to the person, intend to help the person move in a more balanced and coordinated manner. The process is a continuous process. To stay good companies must continue to increase the production capacity of their facilities while reducing their cost. The IE will be expected to come up with additional improvements each year.

1.4.2.1.3 Time study

Without a standard the company will find it hard to estimate lead-time on their products. Times vary greatly when the employee does not know "what the expectation of company is"? In order to correct this problem the IE will develop a fair standard expectation for each operation. It has been estimated that 12% of a company's total cost comes from direct labor. Another 43% of cost comes from the material cost. The other 45% is spent in overhead. So the idea that the largest productivity gains can be felt on

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the floor does not hold up in this light. Standards will be set for all parts of the company not just the operations performed by the direct laborers. The IE will be involved in analyzing and standardizing office work as well.

A good time study will take into account the unavoidable delays, fatigue, and to an extent, outside interferences. Time for wasteful steps, such as searching for tools, will not be included in the final standard. The expectation is that the workplace will be designed to accommodate the work and will be free from this type of waste.

By setting a performance standard the company can look at the schedule for the next year and determine if they have the proper amount of manpower. Prior to establishing standards the company would have to go on their gut feelings about the current capacity and need for additional help.

1.4.2.1.4 Compensation

From the company's point of view they want to minimize the amount of money they have to pay to the employees. This goal often goes against the other goal of management and that is productivity. The productivity of the employee is directly linked to the monetary rewards for the employee. There are several plans that have been developed over time with the intent of balancing the cost with productivity.

An IE will help the company analyze their current situation and will often be responsible for suggesting an appropriate plan. After a plan has been decided upon the IE can be instrumental in its success. Some examples of plans are: piece rates and standard labor hour plans, gain-sharing plans, employee stock ownership plans, and profit-sharing plans.

1.4.2.1.5 Training

The operators must be properly trained. Standards are set using people that are familiar with the job and people who have mastered the skills required to perform the job. If

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other individuals are going to be expected to perform at this level then they will need to be trained.

In a good market the employees become even more valuable, but if their training is not kept up to equality then the company's most valuable asset is losing value. As new processes and methods are developed it is the responsibility of the IE to help make sure the proper level of training is administered.

1.4.2.2Machines

1.4.2.2.1Capacity

Where the mechanical engineer and manufacturing engineer will be concerned with the specific machine abilities and tooling requirements, the IE will be looking at the amount of time it will take to set-up the machine, the cycle time of the machine, the number of operators required, the foot-print size, the power requirements, as well as the ergonomic design. (8)

While the mechanical and manufacturing engineer will also be interested in the above information they will not be making their selection based on these criteria. However, the IE needs to integrate the equipment in a predefined production environment. If the machine is too large it may not fit into the area allocated for it. If the machine runs too fast then the company is buying excess capacity that may not be able to be used. If the machine runs to slow then the company is injecting a blockage into the system. The blockage will regulate the output of that part of the system. These are the types of considerations that the IE goes through during the selection of a machine. (9)

1.4.2.2.2Mobility

The size of the machine and the energy requirements are very important if the equipment is going into a cellular environment. If the machine requires a separate foundation then it becomes a monument in the plant and the flow of parts must be compensated. Unless it is unavoidable, smaller less expensive equipment should be purchased, even if minor enhancements are required. This is usually a better practice

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then buying a more expensive machine and only using 20-40% of its' functionality. This will also help the company to remain competitive by reducing the amount of invested capital. A group of specialized people can be developed in house for the purpose of machine modification. By buying less expensive machines and then modifying them the employer will have specialized equipment not available to their competitors and this will help give them an added edge.

1.4.2.2.3 Set-Up Times

Set up time is the amount of time it takes to begin producing different parts on a machine. For example, this time would be calculated from the last good part, type A, to the first good part, type B. It is extremely important that this time be minimized so the economic lot size can be shrunk. If set-up times remain large the company will operate with high levels of work in progress and finished goods tying up the companies' valuable capital. Companies that fail to reduce their set-up times have a tendency to look sluggish in regards to their customers.

1.4.2.2.4Cost

An IE will generally be responsible for coming up with a cost analysis on the equipment purchase. There are a several ways of coming up with this. The IE or the upper levels of management will decide upon the specific method.

1.4.2.2.5 Life Time

The IE will also take into account how long the machine is expected to last when developing the cost analysis. A straight-line depreciation may be decided upon over the machines life. The salvage value, or the value of the machine at the end of its' useful life, is also taken into account.

1.4.2.2.6 Efficiency

The traditional way of looking at efficiency was to keep the machine running at a 100% whether the products can be used or not. The idea was that the cost of the machine could

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be spread out over the amount of time it was kept running. Therefore the higher the machines efficiency, time running / time available, the better the accounting numbers looked in regards to machine cost. This tended to increase the work in progress as well as build finished goods inventories, which is undesirable.

1.4.2.2.7 Maintenance

The amount of maintenance that the machine is going to require is a variable that must be considered by the IE before the machine is put into the system. All machines are going to require some amount of maintenance, but care should be taken when selecting machines so maintenance time is minimized.

Another issue about maintenance is whether or not the staff on hand will need to be retrained. The OEM may require that a third party perform the maintenance on the machine, if so the cost of this service should be included in the overall cost analysis.

1.4.2.3 Material

The IE is concerned with the delivery and flow of material throughout the plant. It is nice if the plant has been planned with material flow in mind, but often the plant has evolved as the company has. This can lead to a poorly outfitted facility that could be hindering higher levels of production. (8) (9)

1.4.2.3.1 Facilities Layout

Many IE are employed to evaluate the needs of a company and then design a facility that can accommodate these needs. Planning starts with the geographical selection and location. Research must be done into the local compliance codes. The planner will need to determine if there will be adequate access to suppliers and the local transportation industry.

Based on the head count in the facility the IE will need to ensure that there is enough water, adequate restrooms, and cafeteria or local food service available. If the

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employees will be driving cars to work then an appropriate parking lot will need to be set up.

Beyond that the IE will also be responsible of laying out the equipment and material storage locations for the plant. The key part of this analysis is how things will flow through the plant. You don't want the parts to travel any further then they must. Traveling is a form of waste that needs to be minimized. (8) (9)

1.4.2.3.2 Lot size

To allow the manufacturer to stay flexible the production lot sizes should be minimalized. This will only be economical after the reduction of machine set-ups has been achieved. An IE can look at the lot size of a company as an indicator of flexibility of a company. (8) (9)

1.4.2.3.3 Economic Order Quantity

This is one of the calculations that can be used to determine the quantity of material that should be ordered to minimalize the shipping and additional cost of raw material. This is a one form of a linear equation, an example of using methods development by the operations research scientist. (8) (9)

1.4.2.3.4 Inventory Levels

Since inventory is capital that cannot be converted until finished and purchased by a consumer, it should be kept to a minimal. Inventories not only tie up capital but they reduce the flexibility of the supplier. If the customer requests a change then the inventory runs the risk of becoming obsolete. The cost of this outdated inventory will, more than likely, have to be written off by the host company. (8) (9)

1.4.2.3.5Quality

The quality of the material can affect all parts of the system. Poor quality material often introduces excessive amounts of rework into each of the processes. If the company

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accepts poor material then their product will possibly end up shoddy and may or may not cause the company to lose business. A typical job for an IE would be to work with the quality department to set up a Total Quality Management system TQM. (8) (9)

1.5 SAM (Standard allowed minute) & SMV (standard minute value)

1.5.1 SAM

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

General Sewing Data (GSD) has defined set of codes for motion data for SAM calculation. There are also other methods through which one can calculate SAM of a garment without using synthetic data or GSD. In this article both methods are explained in the following.

1.5.1.1Method #1 Calculation of SAM Using Synthetic Data

Step 1:

Select one operation for which you want to calculate SAM.
Step 2:

Study the motions of that operation. Stand by side of an operator (experienced one) and see the operator how he is doing it. Note all movement used by the operator in doing one complete cycle of work. See carefully again and recheck your note if all movement/motion are captured and correct. (for example motions are like - pick up parts one hand or two hand, align part on table or machine foot, realign plies, etc.)

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Step 3: List down all motion sequentially

Refer the synthetic data for TMU (Time measuring unit) values. For synthetic data you can refer GSD (without license use of GSD code prohibited but for personal use and study one can refer GSD code and TMU values) or Sewing Performance Data table (SPD). Now you got TMU value for one operation (for example say it is 400 TMU). Convert total TMU into minutes (1 TMU=0.0006 minute). This is called as Basic Time in minutes. In this example it is 0.24 minutes.
Step 4:

Standard allowed minutes (SAM) = (Basic minute + Bundle allowances + machine and personal allowances). Assume bundle allowances (10%) and machine and personal allowances (20%) to basic time. Now you got Standard Minute value (SMV) or SAM.

SAM= (0.24+0.024+0.048) = 0.31 minutes.

(10)

1.5.1.2 Method #2: Calculation of SAM through Time Study

Step 1:

Select one operation for which you want to calculate SAM.
Step 2:

Take one stop watch. Stand by side of the operator. Capture cycle time for that operation. (cycle time – total time taken to do all works needed to complete one operation, i.e. time from pick up part of first piece to next pick up of the next piece). Do time study for consecutive five cycles. Discard if found abnormal time in any cycle. Calculate average of the 5 cycles. Time you got from time study is called cycle time. To convert this cycle time into basic time you have to multiply cycle time with operator performance rating.

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ASCT is average single cycle time and can be calculated by following formula

$$ASCT = \frac{\text{SUM OF TIME}}{total\ number}$$

Step 3: Performance efficiency

Now you have to rate the operator at what performance level he was doing the job seeing his movement and work speed. Suppose that operator performance rating is 80%. Suppose ASCT is 0.60 minutes so target single cycle time TSCT = (0.60 X 80%) = 0.48 minutes

TSCT is target single cycle time and can be calculated by

TSCT= ASCT * rating or efficiency

Step 4: Standard allowed minutes

SAM = TSCT * (1 + MDA % + PF %) + BHT.

MDA is machine delay allowance

PF is personal fatigue

BHT is bundle handling time (standard)

Suppose bundle allowances (10%) and machine and personal allowances (20%) to TSCT. Now you got Standard Minute value (SMV) or SAM. SAM = 0.624 minutes.

There are two schools of thoughts

- One say's SAM and SMV are same
- Other say SAM and SMV are different

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(10)

1.6 Requirement (purpose of study)

Industrial engineering differs from other branches of engineering in essentially two ways. First, it applies to all types of industrial, commercial, and government activities. Second, it is the only branch of engineering that is obviously concerned with people as well as things.

Industrial engineers are prime sources of management talent. They learn to make decisions concerning the best use of people, material, equipment, and energy in achieving an organization's aims. To accomplish best use of resources, the industrial engineer systematically collects, analyzes, and arranges factual information in such a way as to fulfill management's needs.

In Pakistan we didn't give so much importance to IE especially in textile industries.IE is the only cheapest way to reduce SAM and production cost and increase productivity. From last few years trend change a little bit and big units start working on IE. They successfully increase productivity and decrease production cost. The biggest example of our study is cotton web who worked with technopak (a consulting company) with collaboration of UNDP (United Nation Development Program). The result of this venture was that cotton web becomes the fastest growing apparel section. They started their work with 17 machines in 1997 and with the work they done on their industrial engineering they are now successfully running three units and one is under development. The other industries who use industrial engineering as a tool are CBL (crescent bahuman LTD), MTM (masood textile mill), US Apparel, US denim; Nishat Apparel and Azgard9 are on growing side.