IMPLEMENTATION OF Lean Production Practices IN

BANGLADESHI RMG (READY MADE GARMENTS) INDUSTRIES

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DECLARATION

I hereby declare that, this project has been done by me under the supervision of Md**. Mahfuzur Rahman**, **Senior Lecturer, Department of TE,** Daffodil International University. I also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

This project is on “**Implementation of Lean production practices in Bangladeshi RMG (Ready Made Garments) industries**”.

The report emphasizes and illustrates the use of lean manufacturing tools and techniques that employed in the application of productivity improvements in Bangladeshi RMG (Ready Made Garments) industries. This is true today, as it was yesterday as it will be tomorrow. 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.

The implementation of a lean manufacturing strategy represents a robust contribution to the phase sequence that leads to operational excellence and the continuous improvement through the elimination of non-value added activities.

This paper studies the use of value stream mapping (VSM), 5S Method, Kaizen, Kanban, Visual Management, One-Piece Flow, Demand Management, Heijunka, Continuous Flow and Cell Design; Changeover Reduction etc are the tools of lean manufacturing implementation. As a consequence of just-in-time (JIT) implementation, manufacturers aim to achieve continuously improved productivity, cost, and product quality by eliminating all wastes in their production systems.

In this paper I discussed a “Case Study” by which we can get the way of implementation procedure of lean manufacturing tools and technique. The Case Study consists of different experimental discussion, experimental result & discussion. By careful training, education, planning, assisting and co-coordinating the activities of supervision and employees solid improvements can be made.

TABLE OF CONTENTS

CONTENS **PAGE**

FIGURES	PAGE NO

LIST OF TABLES

TABLES	PAGE NO

LIST OF GRAPHS

Chapter 01

INTRODUCTION

1.1 Introduction:

Lean manufacturing is a set of tools and methodologies that aims for the continuous elimination of all waste in the production process which is a system for improving productivity and product quality. Laconically more value with less work. Lean manufacturing is a manufacturing philosophy that shortens the time between the customer order and the product build or shipment by eliminating sources of waste. Another way of looking at lean is that it aims to achieve the same output with less input- less time, less space, less human effort, less machinery, less material, less costs. Japanese manufacturers' re-building after the Second World War was facing declining human, material and financial resources. The problems they faced in manufacturing were vastly different from their Western counterparts. These circumstances led to the development of new and lower cost manufacturing practices. Early Japanese leaders such as the Toyota Motor Company's Eiji Toyoda, Taiichi Ohno and Shigeo Shingo developed a disciplined, process-focused production system now known as the "Toyota Production System", or "Lean Production". The objective of this system was to minimize the consumption of resources that added no value to a product. When a U.S. equipment manufacturing company, Lantech completed the implementation of lean in 1995, they reported the following improvements compared to their batch-based system in 1991; manufacturing space per machine was reduced by 45%, defects were reduced by 90%, production cycle time was reduced from 16 weeks to 14 hours-5days and product delivery lead time was reduced from 4-20 weeks to 1-4 weeks [1].

Chapter2

LITERATURE REVIEW

2.1 Literature Review:

In recent years, huge literature has extensively documented the implementation of lean philosophy into various manufacturing sectors, but very few have addressed the garments environment. Lean manufacturing has received a sample attention in academic literature and practical performance, from how the lean production concept was formulated and disseminated until recent comprehensive literature review. This research addresses the confusion and inconsistency associated with "lean production". They attempted to clarify the semantic confusion surrounding lean production by conducting an extensive literature review using a historical evolutionary perspective in tracing its main components. They identified a key set of measurement items by charting the linkages between measurement instruments that have been used to measure its various components, and using case study by which we can get the way of implementation procedure of lean manufacturing tools and technique. The case study consists of different experimental discussion, experimental result & discussion. We affirm that it is not possible to define the context without including the product and the manufacturing process, at least from an operational and technological perspective. In this sense, some real and detailed case study provides the sufficient items to evaluate the implementation and under what conditions, allowing the benchmarking between practical of companies. The methodology is similar, using lean tools, and is adapted to the study variables, but the improvement point and the results achieved are different. Furthermore, in line with Milterburg (Miltenburg, 2001) (Bamber and Dale, 2000), how an implementation can be done is a subject that benefits from research. In addition, "a line of interesting researches is one that follows real one-piece flow production systems over time to learn what problems are most difficult at different points in time, how these problems are solved" (Bamber and Dale, 2000). An assembly line comprises a sequence of workstations through which a predefined set of tasks are performed repeatedly on product units while they are moving along the line. It was originally developed to support mass production of single homogeneous standardized com- modify to gain a competitive unit cost. As a consequence of just-in-time (JIT) implementation, manufacturers aim to achieve continuously improved productivity, cost, and product quality by eliminating all wastes in their production systems. However, the straight line cannot fully support the adoption of JIT principles to manufacturing especially in the utilization of multi-skilled operators. Hence, such companies replaced their traditional straight lines with U-shaped production lines, called U-lines hereafter. It was suggested a hierarchical structure in their research to model the design process of a lean production system, which consisted of design parameters and process variables (Houshmand and Jamshidnezhad, 2006). VSM means working on the big picture not on the individual processes and improving the whole flow but not just optimizing the process, which facilities more thoughtful decisions to value stream mapping. VSM is prescribed as part of the lean toolkit and has been applied in a variety of industries. I have also introduced 5S. 5S is needed to stabilize the process and reduce the much non value activities. Lean goals are not achievable without reliable machinery and processes, on the other hand, TPM is more effective in Lean driven enterprises [13].

Chapter 03

BRIEF OVERVIEW ABOUT LEAN

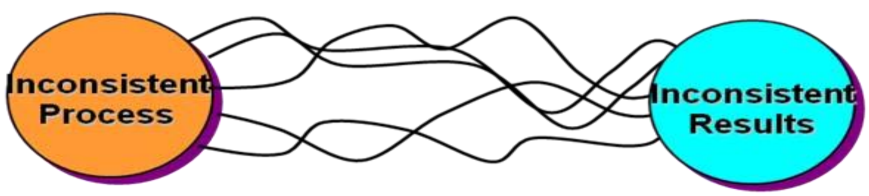
3.1 Definition of Lean:

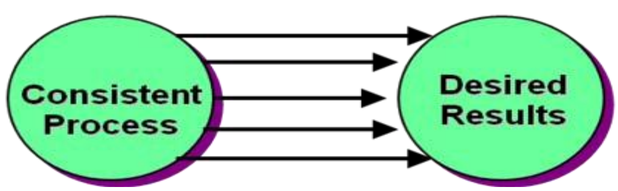
Lean Manufacturing is a business initiative to reduce waste in manufactured products. The basic idea is to reduce the cost systematically, throughout the product and production process, by means of a series of engineering reviews.

"A systematic approach to identify and eliminating waste (Non value added activities) through continuous improvement by flowing the products at the pull of the customers in pursuit of perfection ''

The main benefits of lean manufacturing are lower production costs; increased output and shorter production lead times, higher flexibility [1].

Traditional = People doing whatever they can to get results.





Lean = People using standard process to get results.

Source: Productivity Improvement Cell, BKMEA

3.2 Waste:

Anything that doesn't add value but adds only cost to the product.

Waste is known as "Muda".

Two types of actions for WASTE

Waste = can be 100% eliminated Waste = can

be reduced or simplified

Waste in Operations:
Walking
Searching
Standby
Rework
Change over

Waste in Layout:
Distances traveled
Backtracking
Crowded Conditions
Redundant handling

Waste in Flow of Goods:

Overproduction

W.I.P.
Failure to Meet Standard Output/ Hour/ Person

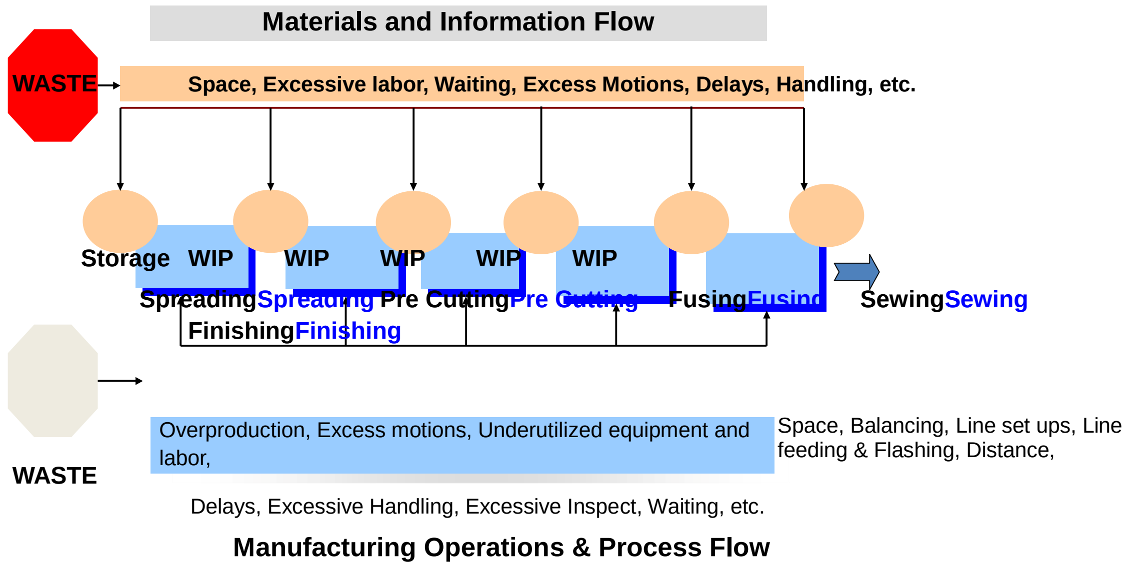
• Waste in Equipment

Line stops
Broken Down / Antiquated, Poor Production Yields

• Other Waste

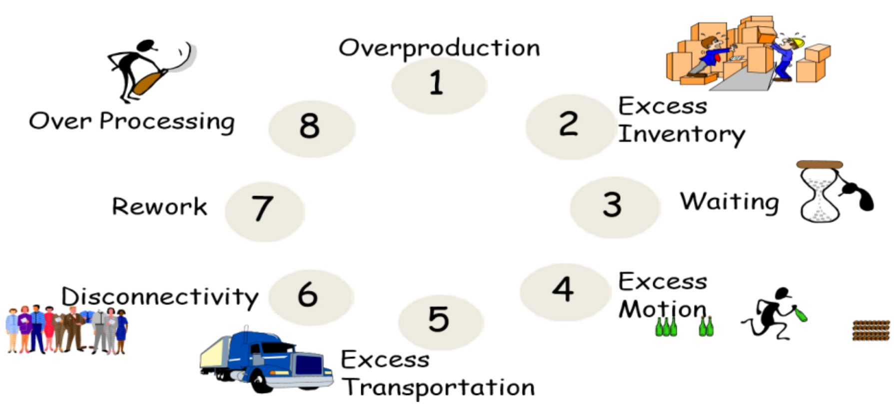
Poor Housekeeping Practices
Damaged Materials
Improper Tools
Not Having the Right Information
N.B. Lead time reduction is achieved by identifying and eliminating waste. [1]

WASTE ILLUSTRATION



Source: Productivity Improvement Cell, BKMEA

Type of Wastes



Source: Productivity Improvement Cell, BKMEA

Overproduction: Produce more than demanded or produce it before it is needed.

Cause for overproduction waste includes:

►Wrong Takt time

►Long process setup

►Unbalance work load

Over Processing Waste: All unnecessary processing steps should be eliminated.

Cause for processing waste includes:

►Product change without process changes

►Lack of communication

Making defective products (Rework): It is a pure defect. Prevent the occurrence of defects instead of finding and repairing defects.

Cause of rework includes:

►Weak process control

► Poor quality

Waiting: Cause of waiting waste includes:

►Unbalanced work activities

►Long process set-up times

Inventory or Work in process (WIP): Cause of excess inventory includes:

►Product complexity

►Uneven scheduling

Excess Motion: Instead of automating wasted motion, the operation itself should be improved.
Cause of motion waste includes:

►Inconsistent work methods

►Unfavorable facility or cell layout

3.3 The Five Simple Principles for Lean Manufacturing:

i. Identify and understand what creates value for the customer: By accepting that only a fraction of the total time and effort expended in the organization actually adds value for the customer; understanding what the customer wants is the first step towards identifying all the non-value added activities or waste within the organization.

ii. Identify, understand and map all the process steps required to fulfill the customer: By documenting the entire set of activities across all parts of the organization involved in delivering products or services to the customer allows for an understanding how value is delivered to the customer in the current state makes it possible to identify the wasteful activities that can then be targeted for elimination.

iii. Make the value-added actions within processes flow: Flow is about creating value for the customer with the minimum number of process steps with the minimum number of delays between those process steps and the minimum number diversions along the way. The value stream is used to identify wasteful activities to be eliminated; flow concerns the rethinking or reorganization of the remaining activities to further eliminate waste. iv. Only make what the customer wants *or* Pull: If one objective for creating flow within processes is to minimize their through put time. A clear second is to ensure that processes are only initiated when customer demand requires it. Essentially, this may mean only making products or delivering services at the point the customer demands; just-in-time. As such as many process steps in the value stream should be triggered when there is a firm customer requirement.

v. Pursue Perfection through Continuous Improvement: Creating flow and pull begins with often radical changes to individual process steps, but the gains delivered by Lean principles really become significant as they are applied with increasing scrutiny. As this happens more and more layers of waste become visible and the cycle continues towards a theoretical end point of perfection; where every asset and every action adds value for the customer. Through continuous improvement the organization should strive for incremental improvements in the value stream every single day [4].

3.4 Benefits of Lean [2]:

Lean essentially aims to compress time required to deliver value to the customer.

- Halving of lead-times; doubling of stock turnover
- 30% to 50% reduction in floor space requirements
- 20% to 40% increase in Overall Equipment Effectiveness (OEE)
- 20% to 25% labor productivity gains
- Reduction in administration and co-ordination roles

3.5 Lean Manufacturing Beliefs:

- People: A core belief in lean is that people are organizations most important asset. When engaged and leveraged properly, our people are our competitive advantage. More specifically, the way in which we value those people are our competitive advantage. Keeping them safe and providing excellent working conditions help show this value.
- Quality: Producing defect free product is critical to eliminate waste. A core belief in Lean is that a product should never be sent to the next step in the process if there is a defect. This means you will need robust systems in place to ensure this.
- Delivery: Get the right products to the right place at the right time in the correct quantities. That sums up delivery in a organization. One key difference in Lean is idea that inventory is waste. The days of hoarding inventory to make up for production shortfalls are over. Just in time delivery is a core component.
- Cost: Waste increases cost. At the heart of lean production is the elimination of waste, in turn the elimination of cost. Make no mistake; eliminating or reducing costs is important in any organization [2].

3.6 Lean goals and strategy:

The espoused goals of Lean manufacturing systems differ between various authors. While some maintain an internal focus, e.g. to increase profit for the organization, others claim that improvements should be done for the sake of the customer.

Some commonly mentioned goals are [3]:

- Improve quality: To stay competitive in today's marketplace, a company must understand its customers' wants and needs and design processes to meet their expectations and requirements.

- Eliminate waste: Waste is any activity that consumes time, resources, or space but does not add any value to the product or service.

- Reduce time: Reducing the time it takes to finish an activity from start to finish is one of the most effective ways to eliminate waste and lower costs.

- Reduce total costs: To minimize cost, a company must produce only to customer demand. Overproduction increases a company’s inventory costs because of storage needs.

3.7 The 4 rules to become lean [1]:

I. Simplify ,structure & standardized every process
II. Analyze ,simplify & connect every process
III. Connect visually workers too customers & corporate objective
IV. Improve continuously through work practice and experimentation with worker participation.

Chapter 04

LEAN TOOLS & IMPLEMENTSTION FORMULA

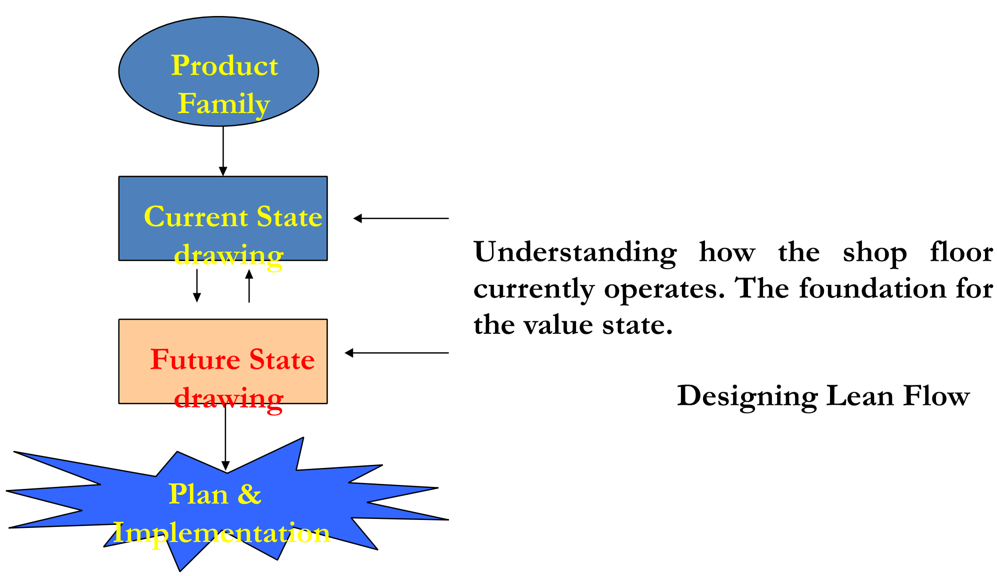
4.1: Lean tools:

❑ Value Stream Mapping:

– Value: Creating or making something of value that a customer is willing to pay for.
– Stream: Sequential flow of activities needed to create work unit and deliver to customer.

Value Stream Mapping is a method of visually mapping a product's production path (materials and information) from "door to door".
VSM can serve as a starting point to help management, engineers, production associates, schedulers, suppliers, and customers recognize waste and identify its causes.

THE STEPS - VALUE STREAMS MAPPING



Source: Productivity Improvement Cell, BKMEA

Analysis of the three phases of Lean application:

Three Phases of Lean applications has 5 Loops of focus

1. Order Customer demand
   - Loop1: Create Pull through Internal Shared Resources
   - Loop 2: Connect workers to the Corporate Objectives
   - Loop 3: Create Pull Through the Supply Chain
2. Continuous Flow
   - Loop 4: Create flow "one point flow" at pacemaker level and others streams to the hands of the buyers
3. Leveling
   - Loop 5: Scheduling and Finished goods strategy

Simulation of the Five Loops.

Tools related to the five Loops:

Loop1: Create Pull through Internal Shared Resources

- ❑ In Process Supermarkets
- ❑ Kanban
- ❑ FIFO
- ❑ Mixed Model Values
- ❑ 5S

Loop 2: Connect workers to the Corporate Objectives

- ❑ Visual Controls
- ❑ Takt time calculation
- ❑ Problem Solving Methodology

Loop 3: Create Pull Through the Supply Chain

Loop 4: Create flow

- ❑ 5S
- ❑ One Point Flow
- ❑ Cellular Manufacturing
- ❑ Cell designs

Loop 5: Leveling

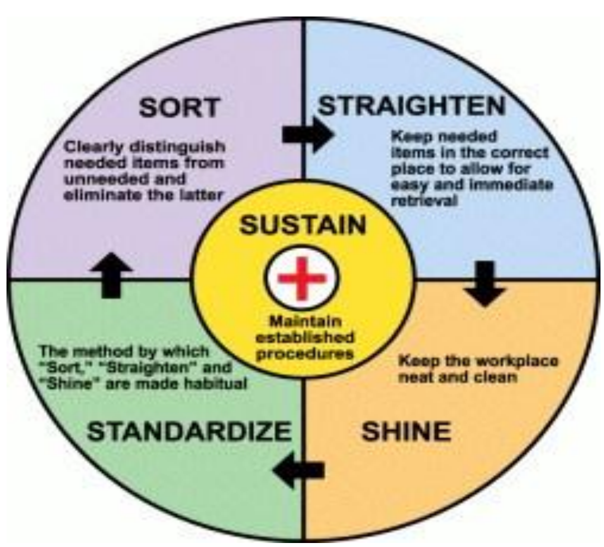
- ❑ Scheduling and Finished goods strategy
- ❑ Visible Pitch board
- ❑ Load leveling (Heijunka) box

Improvements Events on the Future State:

1. Determine when and how buffer, supermarkets etc. are needed
2. Determine where 5S should be implemented. (Even though you may constantly change things, so do not wait for everything to be completed to begin 5S. You can do at least the first three 5S activities).
3. Determine where problems solving activities should be implemented to meet customer demand such as: Cellular manufacturing, line balance, workers balance chart, Kanban, Supermarkets, FIFO, Quick changeover, Work practices standardization, connecting processes, etc. [5].

❑ The 5S Method:

Creation of standardized work is a primary reason for using the 5S method. It offers a basic housekeeping discipline for the shop floor and the office. It includes the following five steps: Sort, Straighten, Shine, Standardize, and Sustain.



❖ Sort: Clearly distinguish what is needed or not needed among the tools, supplies, and other materials.

- Tag items if not used within a month, or that are unnecessary to perform a task, or that are broken or not usable, or insufficient for an intended purpose.

- Manufacturing: List all red-tagged items on a sheet of paper. Remove the red-tagged items and place them in an identified red-tag storage area. All items must be reviewed by the supervisor and initialed – if approved for removal.

❖ Straighten: A marked space exists for all items in the work area, allowing for easy, immediate removal.

- Organize remaining items in the work area by usage. Label daily usage items on a shadow board. Place weekly usage items in labeled drawers, placing monthly usage items under the work station or in a cabinet labeled with pictures and text.

❖ Shine: Work area is cleaned and kept in an orderly condition during working hours.

- Determine what needs to be done to create a visually attractive workplace. Keep the workstation clean and plan a weekly 10-minute cleaning maintenance for each area.

- Manufacturing illustration: Clean tools and paint machines as needed. Sweep floor. Tighten any loose fittings. Create specific cleaning instructions for the work environment, including which cleaning supplies to use and where. Add maintenance items to monthly schedule.

❖ Standardize: Work method, tools, and identification markings must be standard and recognizable throughout the factory. 5S methods are to be applied consistently in a uniform and disciplined manner.

- Identify source for waste disposal. Workers must look at their jobs and machines while performing tasks to see where debris is created. Create discipline to prevent individuals from becoming the source of waste.

- Manufacturing: Check machine(s) for oil leaks, standardize maintenance, and check for broken but functional switches that need repair.

❖ Sustain: 5S is a regular part of the working process with continuous actions required to maintain and improve the production environment. Established procedures are maintained with checklists. Areas must be kept clean so that everything is clearly identified as required or unnecessary.

- A maintenance list should be developed and discipline maintained.
- Create a check list that includes tagged items removed from the work station. List remaining items and locations, document steps for the cleaning process, and list action items for preventive maintenance.

Tools and technique to sustain 5s implementation:

- 5s slogans: Communicate the theme of the 5 pillars campaign at factory. They can be displayed on machines, stickers and posters

- 5s photo: Story board "picture is worth a thousand words''. Photo exhibits and story board showing the before and after of 5s implementation activities.

- Awarness: The employee need to understand what the 5 pillars are and how to important to sustain them.
- Time: The employee need enough time for work schedule to perform 5s daily.

- Structure: Employee need management support in terms of acknowledgment, leadership and resources.

- Rewards and recognition: The employee need to rewarded. [6]

5S Scan	Goal	Eliminate or Correct
▪ Seiri (*sort*)	▪ Keep only what you need	▪ Unneeded equipment, tools, furniture; unneeded items on walls, bulletins; items blocking aisles or stacked in corners; unneeded inventory, supplies, parts; safety hazards
▪ Seiton (*set in order*)	▪ A place for everything and everything in its place	▪ Items not in their correct places; correct places not obvious; aisles, workstations, & equipment locations not indicated; items not put away immediately after use
▪ Seisou (*shine*)	▪ Cleaning, and looking for ways to keep clean and organized	▪ Floors, walls, stairs, equipment, & surfaces not lines, clean; cleaning materials not easily accessible; labels, signs broken or unclean; other cleaning problems
▪ Seiketsu (*standardize*)	▪ Maintaining and monitoring the first three categories	▪ Necessary information not visible; standards not known; checklists missing; quantities and limits not easily recognizable; items can't be located within 30 seconds
▪ Shisuke (*sustain*)	▪ Sticking to the rules	▪ Number of workers without 5S training; number of daily 5S inspections not performed; number of personal items not stored; number of times job aids not available or up-to-date

❑ Kaizen

Kaizen is another pervasive tool since it is a focused methodology that uses teams for making improvements. If analysis indicates that this is the best systematic approach for an improvement project, then a Kaizen event should be undertaken. A continuous improvement process that empowers people to use their creativity, Kaizen can be used to fix specific problems, workflow issues, or a particular aspect of a business.

Based on quantitative analysis, a good starting point is to look at the way people work – identifying waste through a time and motion study of tasks with input from both workers and managers. Generic steps for conducting a Kaizen event are-

Prepare and train the team:
During event preparation, identify problem cells and select the cell that will be given focus. This work should have been done in the early stages if it is within an overall corporate/operational IEE project execution roadmap. Assemble the team and, if necessary, conduct training on waste control, standardized work, and continuous flow.

Analyze present methods:
The team uses a videotape to analyze the cell in action to determine material flow, cycle time, cell layout, process waste, and other vital measurements. During this time they can generate a standardized work and work combination table. The team needs to record the current number of operations over time, and the defect rates. Photographs should be used to document the overall Kaizen event.

Brainstorm, test, and evaluate ideas:
Divide the team into smaller groups to discuss ways to improve the cell, using the compiled work cell analysis statistics. Groups then test potential improvement tactics on the work cell, assessing their impact. Results from the tested ideas are shared with other team members. This keeps other groups from making similar mistakes and inspires new ideas. This cycle may be performed many times before desired results are achieved.

Implement and evaluate improvements:
After the team has developed its plan for achieving results, a maintenance request is generated, if necessary, where modifications are fully described so that management can authorize change(s) to the work cell and its processes. All of the working personnel are then trained in the new process by Kaizen team members.

Improvements are monitored, and progress is videotaped and standardized. Results are measured and items that require additional time are put on a future 30-day action list to be implemented by the team.

Results and follow-up:
Team members document all improvement items and compile results to determine monetary savings, improved space utilization, and time reductions. Team members make a presentation to top management with a commitment to complete outstanding items. Management recognizes the team's performance and makes suggestions for the future [6].

- ❑ Kanban

A system that creates product that is then sold after it is produced is called a push system. If there is no mechanism to keep work in work-in-progress below some level that is consistent with product demand, production output can become excessive, which can lead to many problems, including product storage. In pull systems, products are created at a pace that matches customer demand. Kanbans are used to buffer variations in customer or next process step demands. A most familiar form of kanban is the American-style supermarket where each product has a short-term buffer, replenished at the rate of customer demand. The Japanese word kanban refers to the pulling of a product through a production process. The intent of kanban is to signal a preceding process that the next process needs parts or material.

A bottleneck is a system constraint. In a pull system, the bottleneck should be used to regulate the pace for the entire production line. Buffers in high-volume manufacturing serve to balance the line. It's important that such operations receive the necessary supplies in a timely basis and that poorly sequenced work does not interfere with the process completion. Pull systems address what the external and internal customers need when they want it.

Rules to consider when operating an effective kanban:
No withdrawal of parts is to occur without a kanban where subsequent processes are to Withdraw only what is needed.
Defective parts are not to be used for later processes
Preceding processes are to produce only the exact quantity of parts withdrawn by Successive processes.
Variability in the demand process should be minimized.
If production requirements drop off, the process must be stopped. An increase in production requirements is addressed through overtime and process improvement activities within the IEE discipline. Kanban can dramatically improve a process that produces few defects within workstations.

However, if there are workstations that have high defect rates (i.e., a hidden factory), the system can become “starved” for parts. This problem could be avoided by integrating kanban with an IEE measurement and improvement system. Kanban can be the relay signal between supplier and customer.

Kanban signals can be generated by lights, colored balls down a tube, or a computer network. A food market can know when to stock by keeping track of product-volume sold through a barcode system. A stock person responds to a product pull by replenishing the prescribed number using first-in, first-out product restocking. The supplier knows the volume of product to supply because of the kanban system.

Kanban “label” data can include:
Kanban number
Supplier name
Line site address: location of line where the component will be processed
Shipping area address: shipping location for finished assemblies
Part store address: factory location for temporary storage of components before assembly
line use   Part description
Quantity in kanban package
Bar code
Part number

Sample Kanban:

Types of Kanban [5]:

- Production kanban
  - authorizes production of goods
- Withdrawal kanban
  - authorizes movement of goods
- Kanban square
  - a marked area designated to hold items
- Signal kanban
  - a triangular kanban used to signal production at the previous workstation
- Material kanban
  - used to order material in advance of a process
- Supplier kanban
  - rotates between the factory and suppliers

- Visual Management:

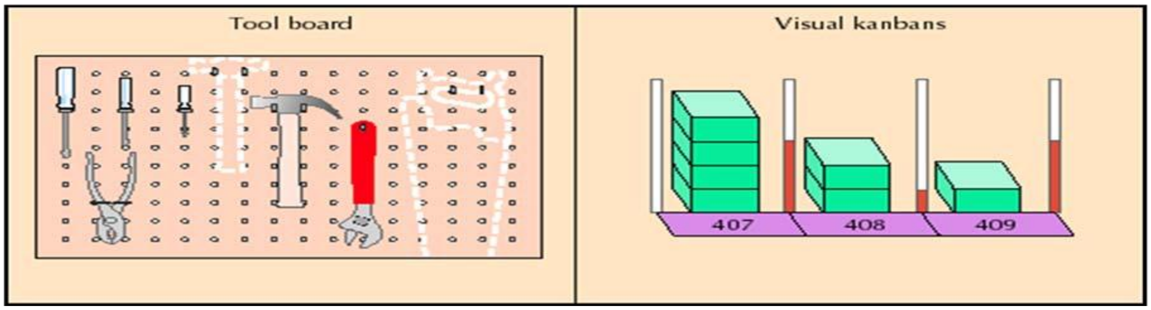
Visual management can address both visual display and control. Visual displays present information, while visual control focuses on a need to act. Information needs to address items such as schedules, standard work, and quality and maintenance requirements. Visual control can address whether a production line is running according to plan; it can highlight problems.

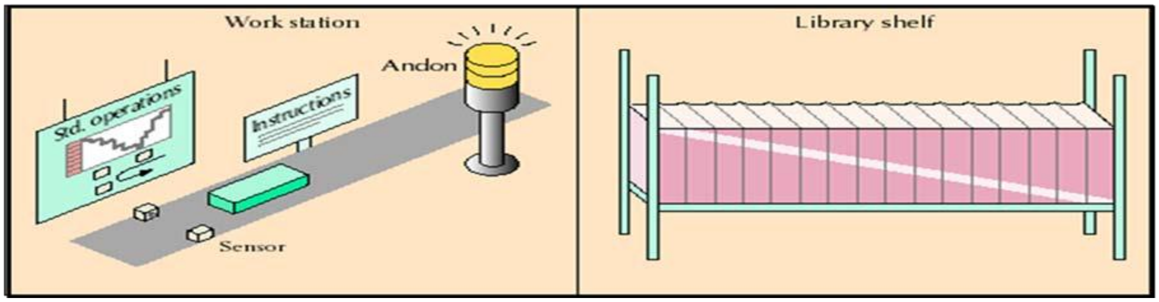
In both manufacturing and transactional processes, visual management systems can include

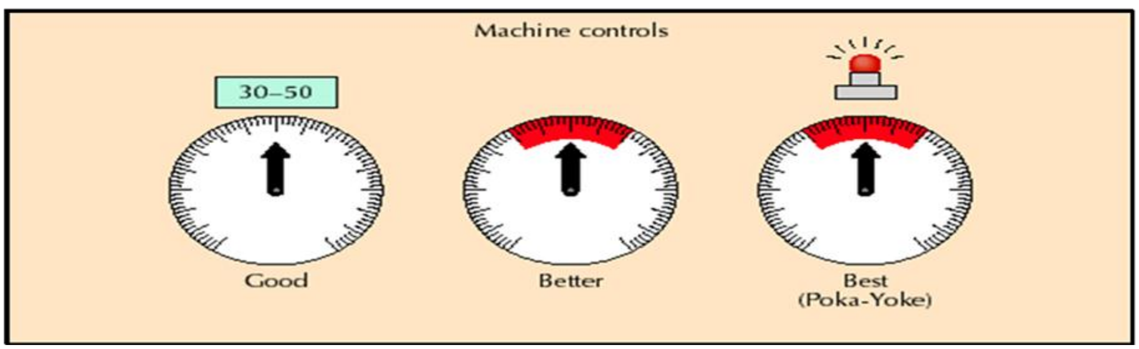
Visual management techniques:
Expose waste for elimination/prevention
Increase visibility and use of operational standards
Enhance efficiency through an organized workplace

Visual management organizations:
Improve quality through error prevention, detection, and resolution
Increase workplace efficiency
Improve workplace safety
Reduce total costs

Examples of Visual Control:







- One-Piece Flow:

One-piece flow describes the sequence of product or of transactional activities (e.g., insurance claims) through a process one unit at a time. In contrast, batch processing creates a large number of products or works on a large number of transactions at one time – sending them together as a group through each operational step. In one-piece flow, focus is on the product or on the transactional process, rather than on the waiting, transporting, and storage of either. One-piece flow methods need short changeover times and are conducive to a pull system.

One-piece flow advantages are:

Reduced customer order to shipment times

Reduction of work in progress

Early detection of defects
Increased flexibility for customer product/transactional demands
Reduced operating costs through exposure/elimination of non-value-added waste

A project process improvement could be a work flow change that reduces batch size or changes from batch processing to single-piece flow [9].

- Demand Management:

Demand Management works best when there is a uniform flow of products within the system.
While a company's policies should encourage stability, unfortunately that is not always the case.
For example, a reward system for product sales might encourage a spike in manufacturing demands at the end of each month. If these signals are ready incorrectly, it can lead to supply chain problems in the form of an inaccurate product forecast. Accounting procedures can encourage management also to produce excess inventory in order to make the number on which they are evaluated look better.
Supply chain improvements can be expected when lead times are reduced, which would improve forecasting accuracy, and when there is a sharing of supply-chain information that leads to agreement-to uniform schedules. Another improvement opportunity is to change internal policies that impact demand volume. For example, consider an end-of-the-month/quarter sales-target bonus policy that results in the sales department giving temporary price concessions so they meet their monthly/quarter sales targets.
This policy could be a candidate for change, since the sales-force reward policy may be causing a manufacturing demand peak that leads to much overtime and quality issues [8].

- Heijunka:

Heijunka is a traditional Lean scheduling methodology for environments that contain a repetitive mix of products, or a family of products. Heijunka is a kanban card post-box system that is usually at the pacemaker process. A Heijunka box provides process level scheduling/pacing, schedule visibility, and early problem highlighting.
Leveled production is customer order averaging so that small sequenced cycles produce the required volume and product mix. In a Heijunka box, customer monthly or weekly volume demands can be leveled into daily demands.

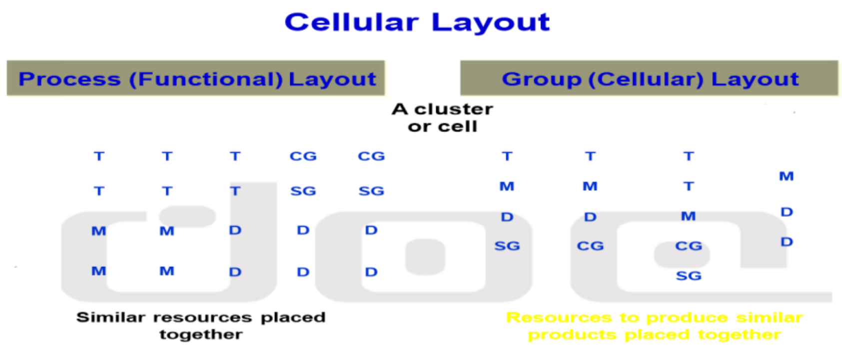
Pull systems and Heijunka work well hand-in-hand. However, system improvement may be needed for success, e.g., through quick change over. When the visual system indicates a problem, prompt identification and correction are absolutely essential [12].

- Continuous Flow and Cell Design:

The disadvantages of traditional batch production are the large amounts of work in progress, large conveyance time for parts, large lead times, and large liability for defects.

Small lot production removes the walls from batch production, and reduces work in progress, lead times, and conveyance. It can be impossible, however, to balance task durations for machine operations with this push system since one operator can spend a great deal of time waiting, and inventory can build up at a station. Within U-shaped layouts, employees are cross-functionally trained and move with changing cell layouts. This means that one person can control the work in progress. Close proximity of workers also enhances communications, makes quick defective part detection possible, and workload adjustments can be made for volume changes.

- Cellular layouts attempt to combine the flexibility of a process layout with the efficiency of a product layout
- Based on the concept of group technology (GT), dissimilar machines are grouped into work centers, called *cells*, to process parts with similar shapes or processing requirements
- The layout of machines *within* each cell resembles a small assembly line
- Production flow analysis (PFA) is a group technology technique that reorders part routing matrices to identify families of parts with similar processing requirements



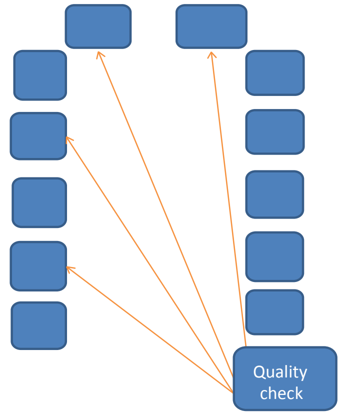
Advantages of cellular layout:

- Reduced material and Transit time
- Reduced Setup time
- Reduced work-in-process inventory
- Better use of human resources

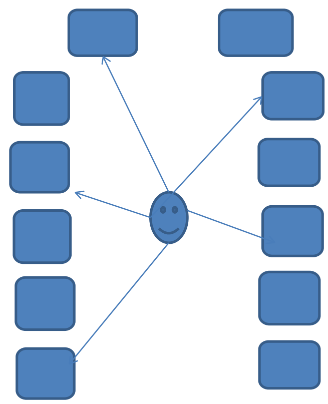
Direct impact of quality on line

- Quality is at the end of the line so alter or quality problem is directly impact on the line

. If one take place in the line it is quickly recovered.



Better control of supervision



- Better control of line
- Supervisor/Leader need not much movement to control line.

Better line balancing

- In ideal U-shaped cell workers share each other works

. Better labor utilization is ensured

The Comparison between Conventional line & Cellular line:

Conventional line			
No. of M/C Used	No. of Person Used	Production / 8 hr	Efficiency
18	28	1680	28%
Cel lular line			
No. of M/C Used	No. of Person Used	Production / 8 hr	Efficiency
9	11	840	36%

N.B: This improvement is done only by using the cellular line.

Efficiency= (Production/8 hr*2.26)/ (No. of person used*480)

Areas	Conventional line	Cellular line	Improvement Ratio
Line Balancing	80%	90%	13%
Productivity	28%	36%	27%
Alter	6%	3.52%	41%
Work In Process(WIP), (pieces)	880	220	75%

Source: Productivity Improvement Cell, BKMEA

Disadvantages of a cellular layout [11]:

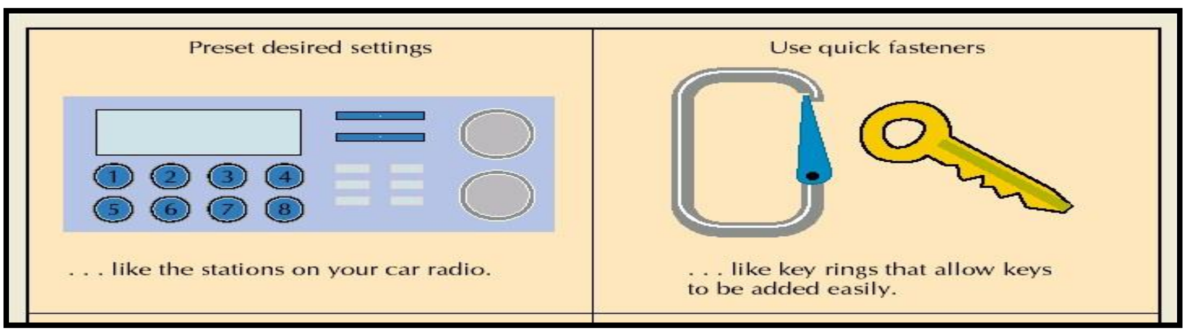
- Inadequate part families
- Poorly balanced cells
- Expanded training and scheduling of workers

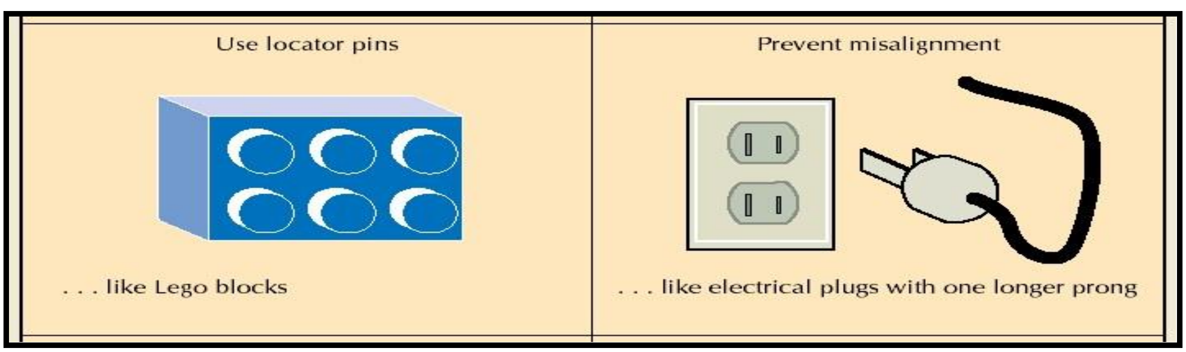
❑ Changeover Reduction:

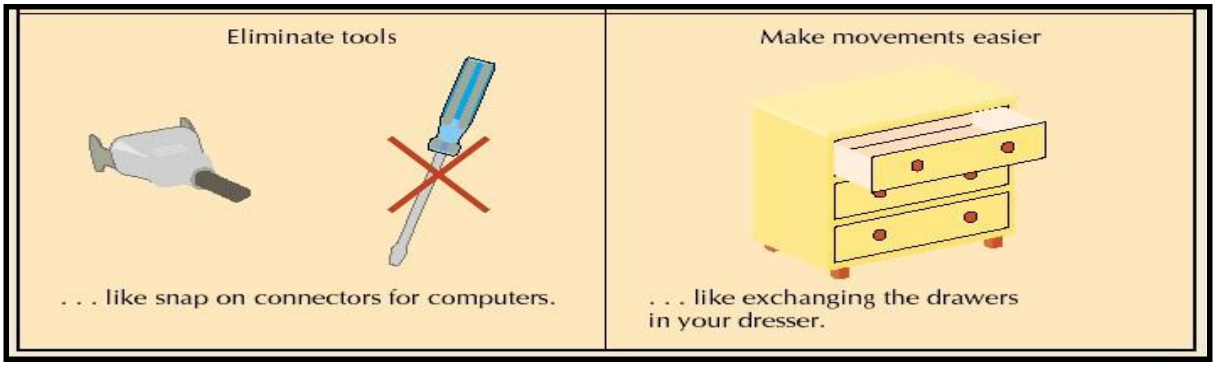
One of Lean's major objectives is reduction of lead time. To achieve this, the size of batches often needs reduction, which, in turn, creates a focus on reducing changeover times – i.e., the time from the last piece of one batch to the first piece of the next batch.

Changeover time can have several components; e.g., internal, when a machine is stopped, and external, which involves preparation. Other types of changeovers are manufacturing line changeover, maintenance operations, vehicle/aircraft loading/unloading, and office operations. The classic changeover is, of course, the Grand Prix pit stop! It's important not only to reduce the mean changeover time, but also to reduce its variability using a standardized process. Moving internal activities to external ones, when possible, permits more up time for a machine since the maximum amount of preparation is accomplished before it is stopped. Example applications for improving external activities are placing tools on carts near a die and using color codes to avoid confusion. Example applications for improving internal activities are quick-change nuts and standardization of activities [11].

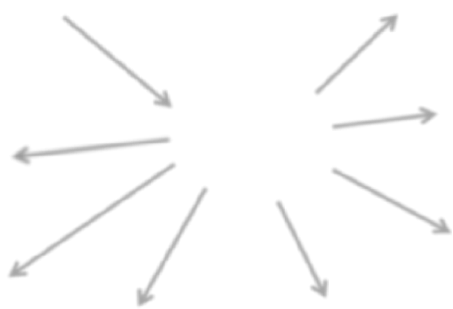
Common Techniques for Reducing Setup Time:







Why quick change over?



4.2 Lean Tools and Six Sigma; the Relationship:

Traditionally, Six Sigma is a project-based methodology led by Black and Green Belts who work with teams of area experts and those involved in overall day-to-day enterprise operations. Lean movers and shakers believe their hands-on approach works better than a single project-based approach led by Black and Green Belts. The general consensus seems to be that Six Sigma project execution takes longer, but is more sustainable than most Lean events.

Overall, the revolutionary Integrated Enterprise Excellence (IEE) management system offers more than either Lean or Six Sigma. IEE tightly interconnects all corporate and operational processes, using the strengths of both

Lean and Six Sigma so that each methodology is used at the right time in the right way to achieve the right result relative to true measured and quantified business needs [8].

4.3 Batch vs. Lean Manufacturing:

Batch Characteristics:
• Expensive Machinery with high throughput capability.

• Machine Utilization is usually high; the machine runs.
Whether there is a demand for the part or not.
• Long Setup Times which lead to Large Lot Sizes.

• Push System are prevalent creating excessive W.I.P.

Results:
• High Capital investment

• Overproduction

• Lack of Flexibility to meet customer demands

• Long Lead –Times

• Excessive W.I.P.

• Poor utilization of Floor Space

• Excessive Rework

Lean Characteristics:
• Kaizen – Quick Step

• Pull Systems

• Waste Elimination

• Tact Time/Line Balancing

• Point of Use / Kanban

• Work Cells – O.P.F.

• Error Proofing – Source Inspection

• Visual Factory

• Flexible Low Cost Automation
Results [13]:
• Reduced Costs

• Reduced inventory

• Reduced Obsolescence

• Reduced WIP

• Reduced Cycle Times

• Reduced Scrap

• Improved Quality

• Increased Productivity

• Improved Utilization of Space

• Reduced Lead – Times

• Reduced Material Handling

4.4 Lean strategic approach [1]:

Phase 1: Lean assessment

Phase 2: Skill enhancement

Phase3: Awareness program

Phase 4: Develop new concept

Phase 5: Implementation & trail new concept

Phase 6: Follow up new concept.

4.5 Formula for Successful Implementation:

1. Define the Goals & Establish a Baseline
2. Choose The Pilot
3. Study and Evaluate the Pilot Process
4. Operator Training
5. Pilot Implementation
6. Run Pilot and Refine
7. Full Implementation

Step 1: Define Goals & Establish a Baseline
With management define the goals and objectives of the program:

• Improve profit margin by 20%

• Improve lead time to the customer by 50%

- Improve quality by 30%
- Reduce inventory by 40%
- Increase productivity 30%

Identify obvious problems:

- Long Lead times
- Bottlenecks
- Excessive inventory
- Quality issues (internal & external)
- High Costs (labor materials & overhead)

Step 2: Choose The Pilot Pick an important product, product family, or customer. Perform a Pareto Analysis:

- By Volume (QTY)
- By Sales Dollars
- By Scrap
- By Costs
- By Customer

Divide and Conquer:

- Based on Pareto Analysis choose 1 item for study
- Pick an Item with high probability of success

Step 3: Study and Evaluate the Pilot Process:

- Gather data
- Observe processes
- Flow Chart the Process
- Perform engineering studies: capacity analysis, labor analysis, Tact time analysis, methods analysis, handling analysis, space analysis and value engineering analysis
- Interview Key People and identify Key assumptions
- Identify Bottlenecks in the process
- Identify Waste in the process
- Brainstorm with key personnel
- Document short and long-term improvements

• Make recommendations

• Quantify savings and benefits • Summarize Capital Costs

• Perform an R.O.I.

• Present to management for approval

Step 4: Operator Training:

• Expose required personnel to techniques of Lean Manufacturing. View training films developed by professional associations such as AME, SME, and IIE.

• Review proposed operating procedures, layouts and equipment with personnel.

• Emphasize the expected savings and benefits.

Step 5: Pilot Implementation:

Establish Core Project Team For Implementation:

• Review scope and objectives for validation

• Select team leader

• Select team facilitator Specify, Bid and Select Equipment:

• Develop detailed specs for equipment

• Source vendors for competitive bid

• Coordinate site visits with vendors

• Make recommendations in regard to equipment & vendors

Establish Core Project Team For Implementation:

• Review scope and objectives for validation

• Select team leader

• Select team facilitator

Specify, Bid and Select Equipment:

• Develop detailed specs for equipment

• Source vendors for competitive bid

• Coordinate site visits with vendors

• Make recommendations in regard to equipment & vendors

Develop Detailed Project Schedule:

• Establish detailed move sequence

• Coordinate in-house activities to plan

• Coordinate vendor activities to plan

• Conduct weekly / bi-weekly meetings as required

Install Equipment:

• Interface with vendors for proper installation

• Assure equipment conforms to customer specs

• Develop punch list

Step 6: Run Pilot and Refine:

• Run pilot for process validation, debug and training of personnel

• Run production. Refine and make adjustments as necessary.

• Identify opportunities for full implementation.

• Measure results

• Sign–off and approval

Step 7: Full Implementation [14]:

• Integrate pilot project into total Lean Program.

• Define goals and objectives of the total Lean Program.

• Identify areas for improvement and study.

• Establish a baseline to measure expected savings and benefits.

• Perform detailed engineering studies and analysis to include savings, benefits, costs and ROI.

• Document current conditions and area for improvement to eliminate "waste".

• Establish "Project Team" and train in the techniques and principles of Lean Manufacturing.

• Divide Lean Program into manageable and focused projects.

• Develop executive plan for each project.

• Facilitate weekly or bi-weekly team meetings to keep teams focused on a schedule.

• Provide project management for full implementation of each project.

• Monitor and measure each project after implementation, measure and post results.

• Make the necessary revisions and adjustment to ensure success.

4.6 An example program [7]:

In summary, an example of a lean implementation program could be:

With a tools-based approach	With a muri or flow based approach (as used in the TPS with suppliers)
• Senior management to agree and discuss their lean vision • Management brainstorm to identify project leader and set objectives • Communicate plan and vision to the workforce • Ask for volunteers to form the Lean Implementation team (5-7 works best, all from different departments) • Appoint members of the Lean Manufacturing Implementation Team • Train the Implementation Team in the various lean tools • Select a Pilot Project to implement – 5S is a good place to start • Run the pilot for 2–3 months - evaluate, review and learn from the mistakes • Roll out pilot to other factory areas • Evaluate results, encourage feedback • Stabilize the positive results by teaching supervisors how to train the new standards have developed with TWI methodology (Training Within Industry) • Once we are satisfied that we have consider introducing the next lean tool.	• Sort out as many of the visible quality problems as we can, as well as downtime and other instability problems, and get the internal scrap acknowledged and its management started. • Make the flow of parts through the system or process as continuous as possible using work cells and market locations where necessary and avoiding variations in the operators work cycle. • Introduce standard work and stabilize the work place through the system • Start pulling work through the system, look at the production scheduling and move toward daily orders with kanban cards • Even out the production flow by reducing batch sizes, increase delivery frequency internally and if possible externally, level internal demand • Improve exposed quality issues using the tools • Remove some people (or increase quotas) and go through this work again

Chapter 05

CASE STUDY

5.1 Summary:

- ❖ Productivity is measured by the ratio of inputs (labor, capital, etc.) used to outputs produced.
- ❖ Major improvements can be realized from the elimination of waste (i.e. all non-valueadded activities) through standardization of work practices and efficient use of the work force, space and machinery.
- ❖ Other substantial improvements (innovations) may emerge from machinery upgrading, quality system enhancement and adopting more economical production methods.
- ❖ Overall productivity levels of the Bangladesh RMG sector are low compared to regional competitors. Hence, there is a significant potential to increase the competitiveness of the industry.
- ❖ One way to improve productivity and to make more efficient use of physical and human resources are through lean manufacturing, introduced by PROGRESS and its partners.

5.2 Brief Overview:

Lean manufacturing is a whole-systems approach that creates a culture in which everyone in the organization Continuously works to improve processes and production, to minimize delays, reduce costs and improve quality, providing maximum value to customers.

Lean manufacturing is based on “just-in-time” production achieved in the following three stages: ✓ Customer demand (when it is required, in the quantity required)

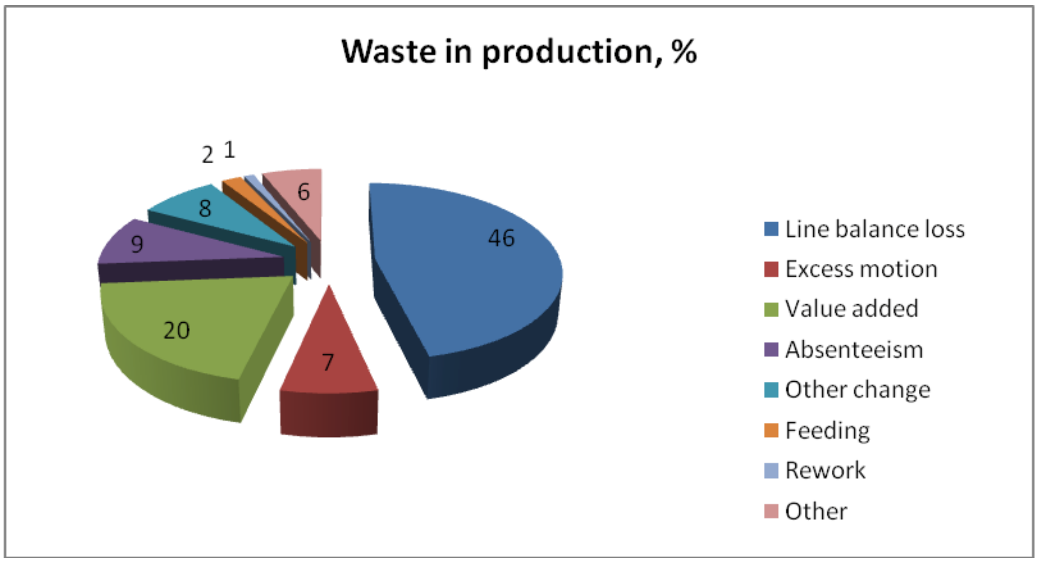
✓ Continuous flow (flowing work to ensure that the right work unit arrives at the right time) ✓ Leveling work (flexibility to distribute work evenly and effectively).

Main implementation steps are:

- Commit to lean (top management).
- Learn about lean (the balancing act).
- Map the current state, carry out baseline survey (time studies, value stream mapping etc.) and define lean metrics.
- Develop the basic knowledge and skill for industrial engineering and quality control.
- Design the future state and set milestones to form a trial concept from dock to dock (incoming fabric to shipping).

- Implement trial concept.
- Monitor, evaluate and adjust implementation of modular line (trial concept)
- Develop roll-out plan and follow-up
- Retrain surplus staff and integrate them into the new production process.

While the implementation time of the modular line concept stretches over six months, global, factory-wide Lean manufacturing is regarded as a continuous process.



Graph Result:

- Waste in production occurs mainly due to losses in line balancing (46%).
- Average labor productivity level in pilot factories hovers around 29%.
- Non-value-added activities comprise up to 80% of the total production process.
- In monetary terms, this means that the US$3.00 cost of manufacturing (CM) contains up to US$2.40 related to waste, which could be saved and transformed into profit. Lean manufacturing introduces improvement measures that reengineer the entire production process from cutting the fabric to packaging the product, including skill enhancement and training of factory staff, workers and line supervisors.

Main improvements realized per re-engineered production line were:

- Labor productivity improvements of 85%
- Production costs reduced by 39%
- Reduction of lead time by 75%
- Floor space utilization improvement of 51%

Other benefits of Lean manufacturing implementation:

- Better utilization of labor (70% reduction in numbers of helpers per production line)
- Higher income per worker due to higher productivity
- Retention of surplus labor through upgrading helpers to operators

5.3 Manufacturing Performance Improvement through Lean Practice:

Savings Resulting from Lean Practices:
It is a usual expectation that lean practices would result in considerable savings. An attempt was made to elicit information regarding the amount of savings that the companies could achieve during the one year. The respondents in all companies did not agree to provide actual data regarding amount of savings. However, an analysis of the views of the respondents suggests that 44% of the sample companies made significant savings over 12 month's period through the reduction of labor costs in the production process.

Total Productivity Improvement:
In response to a question - "What is the average productivity increase in the company after implementation of lean?"-
The sample companies indicated that their productivity improved by a maximum of 60% and minimum of 10%. The majority (67%) of the companies had 10% to 20% productivity improvement whereas the remaining had 40% to 60% improvement.
Lead Time:
The time taken is expressed in terms of the average number of days, known as lead time. The shorter the lead time, the more gain for a company and better the satisfaction of customers. The collected data are tabulated. An analysis of the tabulated data shows that the lead time in the companies ranged from 16 days to 120 days before implementation of the lean production system, while the corresponding lead time reduced within the range of 13 days to 105 days—the minimum reduction being three days and maximum 30 days. Through implementing lean, the companies focused on JIT delivery of raw materials, proper equipment layout etc. which ultimately reduced the overall lead time to complete an order.

Quality Improvement:
In response to a question-"What is the average quality improvements in the company due to lean implementation?"- The surveyed company reported that their quality improved to a maximum of 80% and minimum of 10%. While 33% of the companies had 10% to 20% quality improvement, similar proportion of the companies achieved quality improvement ranging from 41% to 60%. About one-fifth of the companies had 21%

to 40% improvement in quality while only one company showed 61% to 80% improvements. From the discussion it is revealed that this was achieved by following the buyers' prescribed quality system as well as quality control process. [15]

5.4 Experimental Discussion:

Main concentration of this study was in the Viyellatex garment's production line. It was observed that the floor condition was not good and in a haphazard situation. There were lots of In-process inventories and waiting time between almost every sequential operation. As a result it could not cover the daily production. Its output was quite less than the target production. So there is a huge In-process inventory. No strict and precise work distribution was followed by many workers. Materials used to travel large distance from input receiving to needle check and cartooning. Many of these movements and handlings are totally unnecessary. As a result, the productivity was hampered. There also observed that, iron men often are not accused of their wrong ironing; the line supervisors are not strict enough to control the quality right at the first time. So lots of reworks are there and the total completion time is delayed and the proportion of non –value- added time is increased. Sometimes there were delays than the buyer's required dates. So, the company has to pay significant amount of compensations for delayed shipment. This situation is very horrible and must not likely to occur. So, a smooth, streamlined and continuous flow is really necessary to avoid all such unexpected occurrence. The Proposed scenario of the garment production line section can be visualized more accurately from the schematic figure shown in the attached appendix.

5.5 Experimental Data:

Table 1: Lean Production Metrics: before and after implementation with future targeted gains

Sl.	Lean Metrics	Unit of measure	Before Improvement	After 1 Improvement	Improvement Ratio	Future Targets within 6 month
1.	Labor Productivity	%	32	69	119	85
2.	Production Cost	Tk/hour	254	98	39	60

st

3.	Trough put time	Minutes	1200	15	99	Reflects performance of all other areas
4.	Lead time	Days	20	5	75	3
5.	Floors speed/workers speed	Sq ft	68	35	51	32
6.	Line Balancing	%	63	83	32	95
7.	Labor Utilization	%	30	83	174	90
8.	Retention time	%	91	55	40	20
9.	Processing time	%	9	47	426	80

- Labor Productivity: The average performance of the team members (output versus target).
- Production Cost: The actual cost of the labor excluding overhead.
- Throughput Time: The manufacturing pace at which the first piece reaches the shipping. This includes order changeover.
- Lead Time: The amount of time required to produce a single product, from the time of customer order to shipping which is the sum of retention and processing time. In this case it only covers from cutting to shipping.
- Floor space / worker: This includes area of manufacturing along with relevant support services divided by total direct labor.
- Line Balancing: The level of balancing between workers due to variation in workers pace and operations difficulty.
- Labor Utilization: The effective time worked of the direct labor minus their availability.
- Retention Time: This covers the time of materials stop flowing (idle) due to inventories, WIP or over-processing. Retention time is the first element to extend time-delivery.
- Processing Time: The time spent on producing value added activities by the team members of which is paid the buyer.

Table: 2: The different lean techniques the company has adopted

Lean techniques	Percentage
Kanban	66
Daily schedule adherence	100
Small lot size	100
Just-in-Time	100
Physical arrangement of equipment	89
Application of preventive maintenance	89
Pull production systems	100
Continuous improvement	78
5S	44
Other quality practices (QC)	100

Table 3: Benefits from Lean Implementation

Areas of benefits	Percentages of responses
Increase in sales and profits	89
Reduction in order processing errors and paper works	67
Reduction in manufacturing cost	100
Reduction of staff demands allowing the same number of office staff to handle large number of orders	78
Increase in overall revenue without increasing labor or overhead costs	56

Table 4: Three Stages of Improvement

	Phase 1:The initial approach	Phase II: Beginning of Kaizen	Phase III: A Team approach to Kaizen
Lead Time	Ten weeks	Six weeks	Four weeks

Inventory Holding	30% of sales	WIP reduced total 30% of sales	WIP reduced total 30% of sales
Involvement of People	5 % of staff	10% of staff	30% of staff
Skill development	None	Ad hoc	Workshops
Benchmarking	None	None	Two plant visits conducted
Team Orientation	None	None	Two cross functional teams set up

Table 5: Supply related information

Particulars of supply	Percentage
Company intends to maintain long stable relationship with suppliers	100
The main suppliers are in close proximity	44
The company has reduced the number of suppliers over the last five years	22
Suppliers are dependable in terms of timely delivery	100

Table 6: Savings resulting from lean practices

Nature of savings	Percentage
10%-20%	67%
40%- 60%	33%

Table 7: Quality improvements resulting from lean practices

Views about quality increase	Responses (%)
The average (%) quality increase in the c ompany after lean implementation	
10%-20%	33
21%-40%	22
41%-60%	33

61%-80%	11

Table 8: Business challenges those have driven the company to practice lean

Types of challenges	Percentage
Pressure from customer company	22
To beat the competitors	56
Cost reduction	22
Reduced order/ loosing market demand	22

Table 9: Reasons towards lean production practice

Element	Percentage
Customer satisfaction	11
Minimization of cost by reducing inventory	22
Motivation from buyers	11
Motivation from customers	11
Motivation from promoters/employees	11
High Competition	22
To improve the current condition	11
Searching for best practices	11

Table 10: The changes required to be addressed while implementing lean those have been experienced by the company

Required changes to be addressed	Percentage
Cultural change	22
Education of workers and suppliers	22
Empowerment of employees	1
Commitment of top level managers	1
Relationship with suppliers	1
Rearranging the manufacturing process	1
Changes in the traditional work environment	1
Creating awareness	1

Table 11: Areas of organization where changes were made

Areas of changes	Percentages
Product design	78
Inbound logistics	11
Outbound logistics	11
Manufacturing Processes	78
Supplier network	44
Factory management	22

5.6 Result Analysis:

1. Result Analysis for existing BURTON (T-Shirt)

Total value added time= 196.7 sec and Total non-value added time=8765.7 sec

Total time=VA time + NVA time =196.7+8765.7 =8962.4 sec

% of value added time= 2.19% and % of non-value added time= 97.81%

2. Result Analysis for proposed BURTON (T-Shirt)

Total value added time = 215 sec and Total non-value added time =917 sec

Total time =VA time + NVA time = 215 + 917 = 1132 sec

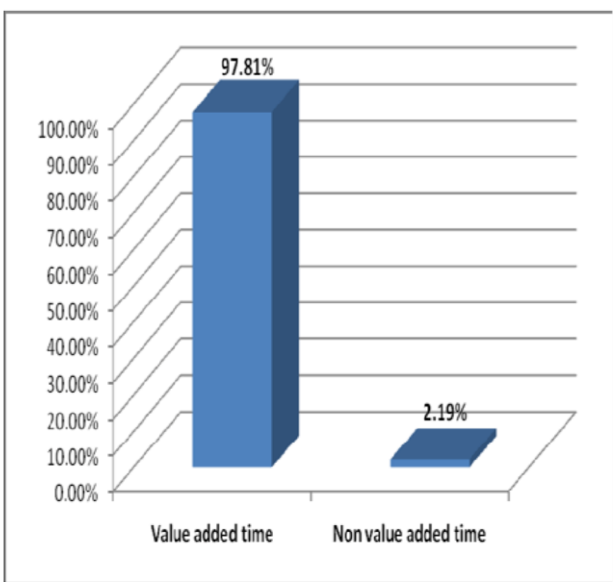
% of value added time = 19% and % of non-value added time = 81%

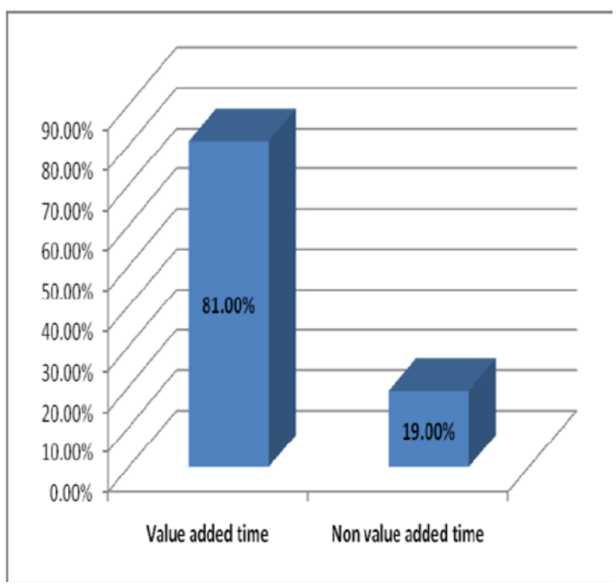
Table 12: Comparison of Operation Times between Existing & Proposed VSM

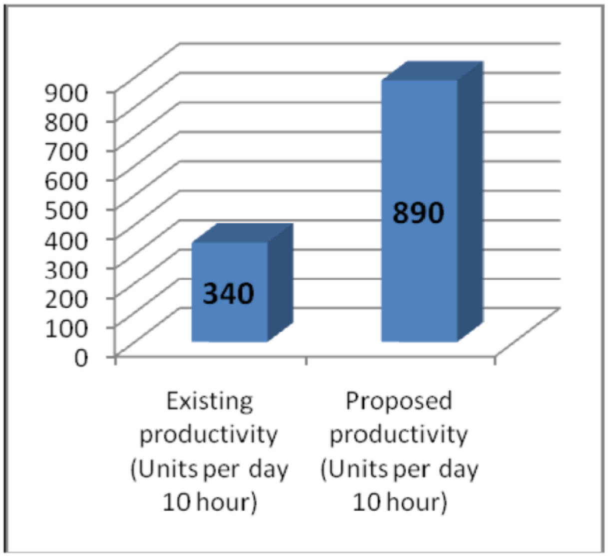
Buyer	Existing		Proposed		Improvement (% value added)
	% Non-value added	% Value-added	% Non-value added	% Value-added	

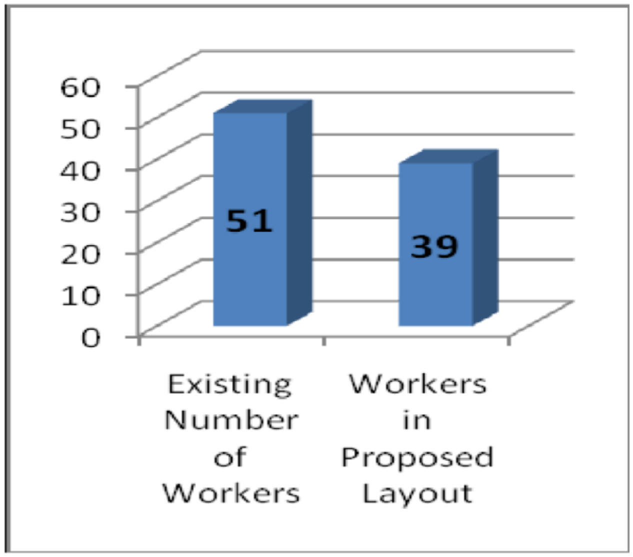
Burton	97.81%	2.19%	81%	19%	16.81%

Buyer	Existing		Proposed		Improvement (% value added)
	% Non-value added	% Value-added	% Non-value added	% Value-added	
Burton	97.81%	2.19%	93%	7%	4.81%









Graph Discussion:

After some calculations, some comparison was shown between the current situations and the proposed situations. From the value stream mapping of current situation the value added time and non-value added time for BURTON was calculated. Where the value added time for existing layout was found 2.19%. As focus was to reduce non-value added time as much as possible and to do so the tools and techniques of lean manufacturing was used. All the processes required were made grouped and made cells to reduce the In-process inventory, smooth production flow and pull system so that the much of the idle time can be saved. By doing so it eventually reduced the non-value added time significantly. For instance, for BURTON existing value-added time is

2.19% and improved value added time is 19%. Therefore Value added time is increased about 16.81%. If a comparison is made, it can shows that the existing output for BURTON is 340pcs daily and the output from our proposed layout is 890pcs. So there is an increment of 550pcs daily which is about 61%. Another important improvement is associating workers. By incorporating multi skilled workers and with the help of cellular layout designing number of worker needed was reduced. The benefit of multi skilled workers is that they are able to perform two or more different types of work that can results minimum material handling with a minimum or no Inprocess inventory. Here it was found that existing workers for BURTON is 51 where in the proposal it is 39. Therefore it saves an extra 12 persons here.

5.6 Results and Discussion:

The summary of the improvements of the three phases: Through gradual introduction of kaizen, multi skilling and team approach. This company reduced the lead-time from 10 weeks to 4 weeks, and increased employee involvement from 5% to 30%. Under the present study the companies also introduced several lean tools such as JIT, kaizen, pull production, TPM, 5S etc. and gained several benefits. These companies reduced lead-time, inventory holding time, manufacturing cycle time etc. compared to pre-lean period. Overall, the companies gained improvement in productivity and quality, reduction in lead time by 26.7%, inventory holding time by 30.1%, manufacturing cycle time by 26.1% and also reduced delivery time. The best company obtained a 50% reduction in lead-time which is consistent with this survey.

The study also shows the necessity of supplier's relationship in supply chain management. The study indicated that textile and apparel is a volatile market where holding small quantities of stock is not a viable option and companies need to be very responsive to the customers' demand. The lean and agile approaches to supply chain effectively manage the manufacturing process and in turn reduce lead times.

5.7 Lessons learned:

- ✓ The Lean manufacturing pilot project showed a rise in the overall productivity, especially in labor productivity.
- ✓ Increased productivity is a prerequisite for improving incomes and competitiveness.
- ✓ The trial concept is essential in order to evaluate staff behavior, resistance to change, support and weaknesses in the management system, prior to undertaking overall changes.
- ✓ To reap the benefits of Lean manufacturing, the industry has to invest in time and people.
- ✓ Workers demonstrated a high level of ability to learn and adapt with the support and encouragement of the management. Therefore, management must be ready to reward improvements.
- ✓ Management must be 100% committed to Lean manufacturing, providing the necessary support and designating a full-time core team to carry out the improvements.
- ✓ Beyond the pilot run, development of factory middle management is a must prior to any overall change (roll-out plan).

5.8 The Pictured view of before & after Lean:

Before Lean

VISUAL STATUS BOARD IN FRONT OF SEWING LINE

TRAFFIC LIGHT MANAGEMENT SYSTEM FOR QUALITY CONTROL

After Lean

Chapter 06

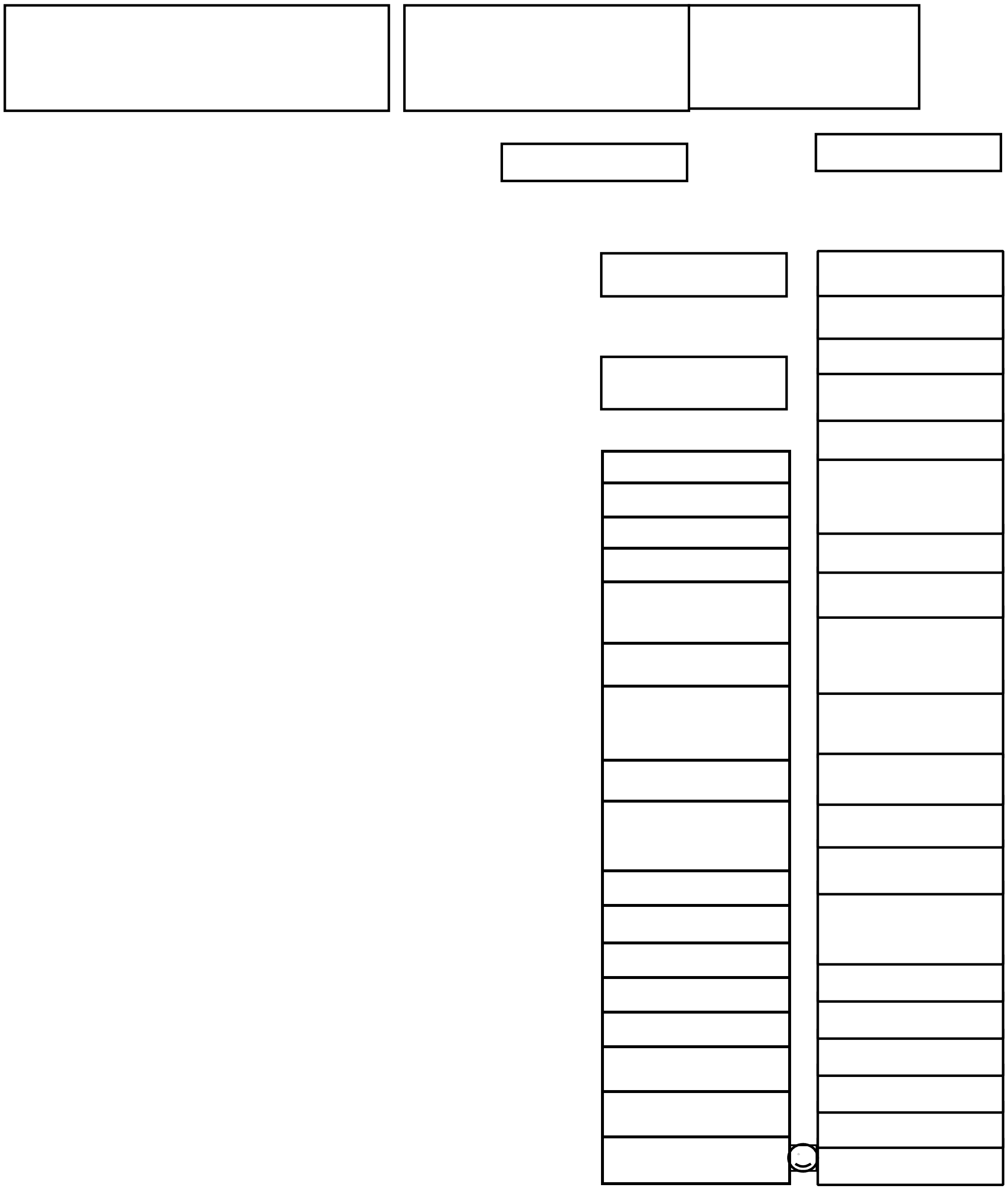
CONCLUSION

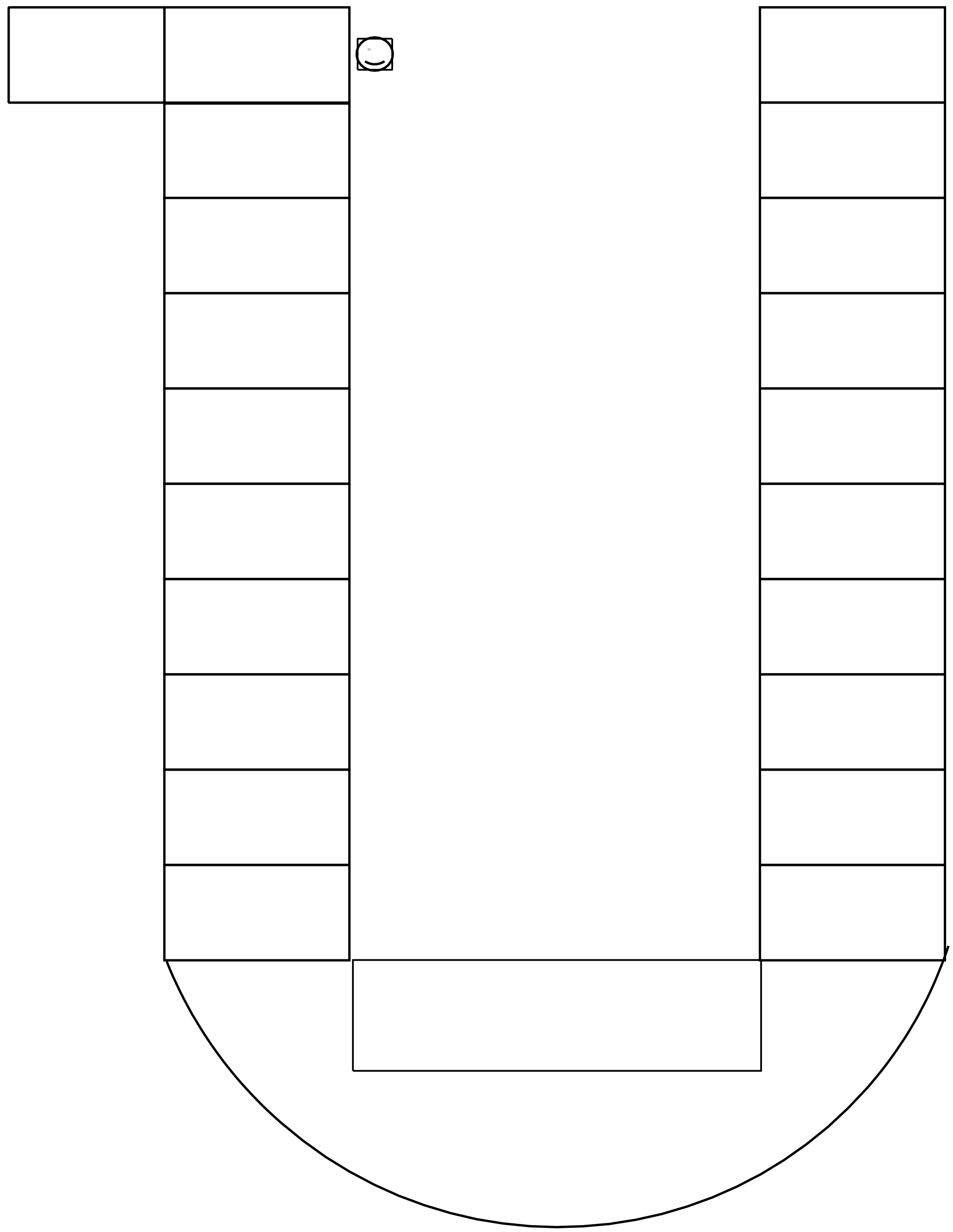
6.1 Conclusions:

The thesis work was on Study and Implementation of Lean Manufacturing in a Bangladeshi Ready Made Garment Manufacturing Industry. For the first few weeks I tried to learn the processes in the garments production line. Then those processes were studied as well as analyzed using some lean manufacturing tools and techniques where found some problems. Eventually some layouts and process flows is proposed that maximizes the productivity and minimizes cost. It also ensures the better utilization of manpower and factory floor space. At the same time these proposals will help to develop a good relationship among the workers and will provide an easier way for the management to coordinate and integrate the factory production with the current level of resources. It is hoped and believed that, if the management accepts these proposals and implement these techniques, it will certainly help them to increase the productivity with this existing level of resources.

6.2 Further Recommendations:

There have some recommendations for improving the paper works, and those are as follows: Here triangular distribution was used for performing Arena Simulation in some operation so the recommendation is to use normal distribution instead of using triangular distribution. Again using supermarket concepts in both cutting and packaging station will certainly give some accurate results. This work considered only production line, so the future recommendation is to consider the whole supply chain from order picking of raw-material to transportation of final product.





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