

Implementation of Lean Tools in Apparel Industry to Improve Productivity and Quality



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Abstract

The rapid change in apparel styles, deviation of order quantities and increasing quality levels at the lowest possible cut-rate, demand the apparel manufacturing industry to be focused on more effective and efficient manufacturing processes for survival in an immensely competitive market. To increase the productivity of the apparel industries we need to reduce the wastage of the manufacturing and time to manufacture the product. Lean is the tool to reduce the wastage in all process of apparel manufacturing, reducing cost and value added to the product. This paper proposes the lean tool for the apparel industry to reduce the overall wastage of the industries.

Keywords: Apparel industry; Eco-efficiency; Industrial wastes; Lean tools

Abbreviations: FMEA: Failure Mode and Effect Analysis; SFPS: Single Failure Points; TPM: Total Productive Maintenance; OEE: Overall Equipment Effectiveness; PDCA: Plan-Do-Check-Act or Plan-Do-Check-Adjust; PDSA: Plan-Do-Study-Act

Introduction

TappingD [1] observed that lean strategy is to eliminate wastes from the process. Any excess in equipment's, materials, parts, and working period beyond the requirement is generally referred as waste. Taj S [2] observed that waste ("muda" in Japanese) has seven types: waste from overproduction than required quantity, waste of waiting time for subsequent operations, transportation wastage, inventory of goods, processing waste, the waste of motion, and waste from product defects. The apparel industry exists more number of wastes so that, there must implement the lean tools. This industry comprises majorly three departments cutting department, sewing department, ironing and packing department. Karthikadevi M [3] suggested that with the help of lean manufacturing tool the apparel industry can provide a high-quality product to their customer by satisfying their requirements.

This paper presents a review of literature on lean manufacturing tools for the apparel industries suggested by previous researchers which will improve the productivity as well as quality in apparel/garment industries.

Lean tools

Lean 'tools' assist in the identification and steady elimination of waste (muda), the improvement of quality, and production time and cost reduction. Figure 1 shows the common lean tools [4].

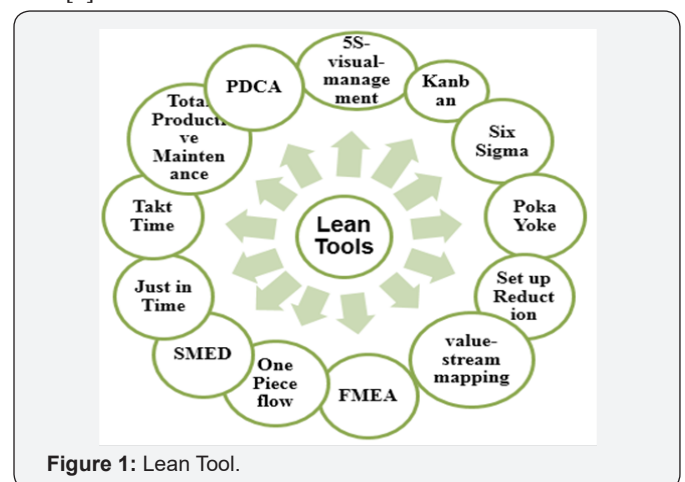


Figure 1: Lean Tool.

5S-visual-management

5S visual management is one of the lean tools which make an improvement in process as shown in Figure 2 which is originated by the Japanese to create a workplace that supports company-wide integration of workplace organization, standardization, visual control, visual display, and visual metrics.

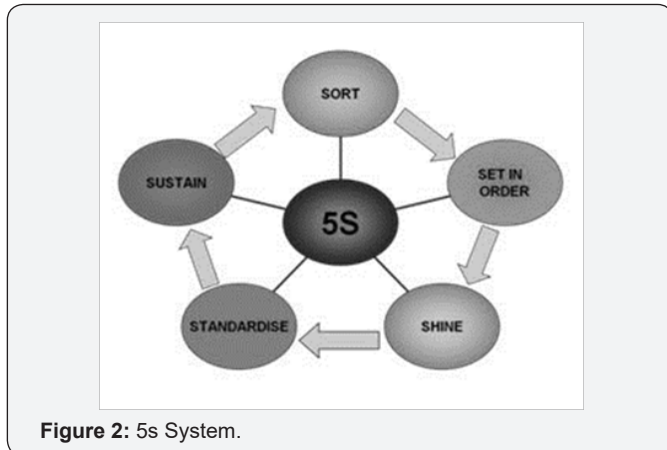


Figure 2: 5s System.

The five principles of 5S system

Seiri (sort) means to separate needed tools, parts, and instructions from the unneeded. The goal is to keep only what is required and eliminate everything else. Seiton (set in order) means to neatly arrange and identify parts, processes, and tools for ease of use. Seiso (shine) means to clean, shine, and inspect the workplace by eliminating contamination. Seiketsu (standardize) means to require as the norm sort, set in order, and shine activities daily to keep the workplace in perfect condition and also to make use of visual control systems to maintain compliance with the established standards. Shitsuke (sustain) means to maintain the 5S gains by training and encouraging workers to form the habit of always following the first four S's.

Benefits of 5S: Reduce workflow problems, increases product quality and productivity, as well as improve communication. Improves workplace safety by eliminating hazards and establishing compliance to work standards. Align employee efforts with goals and strategies for eliminating waste. The improve appearance of the facility and expectation of compliance to maintain that condition. Established standards for operating equipment and conducting processes. Reduce training time for new employees. Improve quality from preventing defects and errors from occurring. Reduce changeover time, tool search time, lead time, cycle time & materials handling. Increase floor space. Improve morale and pride in the workplace. Decrease work flow distance. Reduce equipment breakdowns yield better equipment utilization[5].

Kanban

Kanban is a Japanese word that means a card or signal. This is an important tool for improving production from a push to a pull system. As shown in Figure 3 at the core of pull production,

upstream operations signal the prior operation to deliver what is needed, in the quantity needed, and when needed. A kanban system can be manual or automated. A pull system can use various signal methods to trigger replenishment such as physical, min/max levels, and cards, electronic, interplant, and single enterprise.

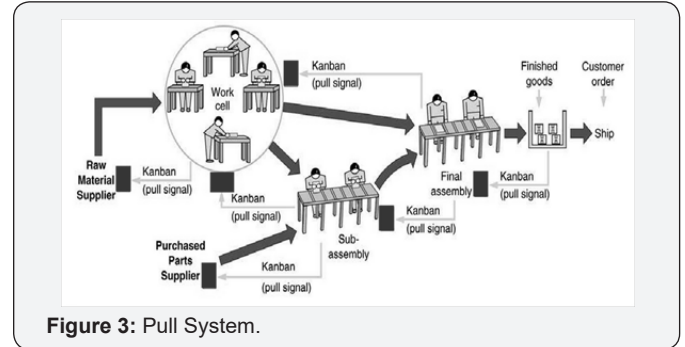


Figure 3: Pull System.

Benefits of Kanban: Integrate all processes into one another and connects the value stream to your customer demand. Improve flexibility to respond to customer demand. Simplify the procurement process. Uncover hidden waste in processes. Empower employees to produce based on customer demand. Improve production scheduling. Eliminate unnecessary paperwork. Eliminate overproduction. Reduce inventory of finished goods, raw materials, and subassemblies.

Six Sigma

Six Sigma means a measure of quality that strives for near perfection. Six Sigma is a disciplined, data-driven approach and methodology for eliminating defects (driving toward six standard deviations between the mean and the nearest specification limit) in any process from manufacturing to transactional and from product to service (Figure4).

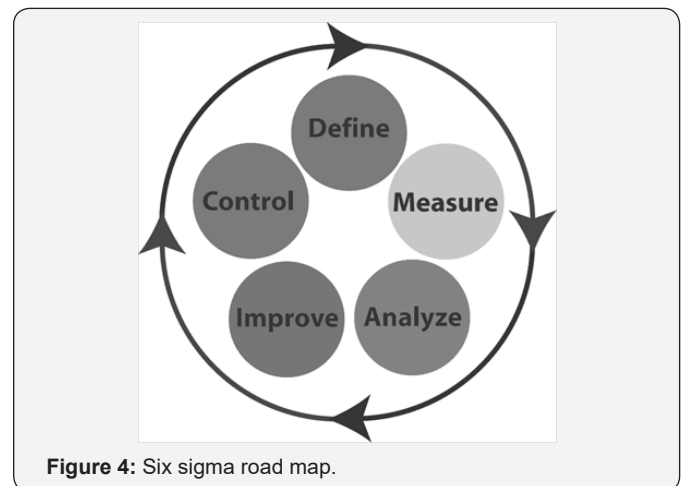


Figure 4: Six sigma road map.

Benefits of six sigma: Bottom line cost savings (5%-20% of turnover per annum). Improved quality of product or service as perceived by the customer (internal and external customers). Reduction in process cycle times. Development of staff skills.

Common language throughout the organization. World class standard. Ability to use a wide range of tools and techniques.

Poka Yoke

Poka Yoke is a Japanese term which was coined by a Japanese Engineer named Shigeo Shingo. This was originally called as Baka Yoke during 1961 which means “foolproofing”. This was not liked by employees because of its negative connotation. Poka-yoke is the conviction that it is not acceptable to produce even a small number of defective goods (Figure5). To become a world-class competitor, a company must adapt not only a philosophy, but a practice of producing zero defects. Poka-yoke methods are simple concepts for achieving this goal.

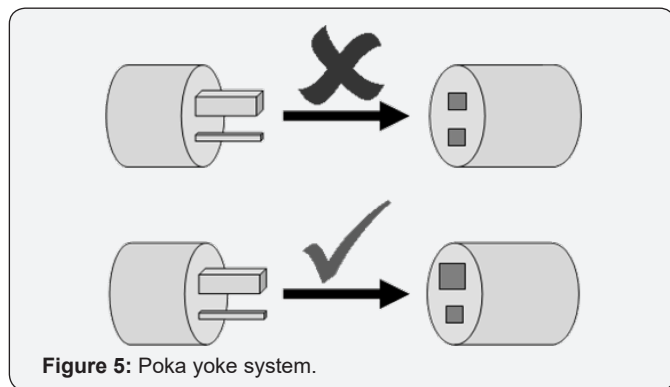


Figure 5: Poka yoke system.

Benefits of Poka yoke: Reduction in waste and associated machining as nonconforming material is identified at each stage rather than an inspection stage between several pairs of stages. Reduction of waste in the system leads to a reduction in inventory holdings. Improvements in customer satisfaction levels because the better-quality product is delivered to them. Improvement in employees’ relationships as it encourages more involvement of operators and team members[6].

One-Piece-Flow

One-piece flow means production of the product moves from one stage to the next stage one piece at a time as shown in the Figure 6. Compare that to lot production where several units are made at a given stage and then all are moved to the next stage at the same time. Most operational excellence practitioners promote one piece movement.

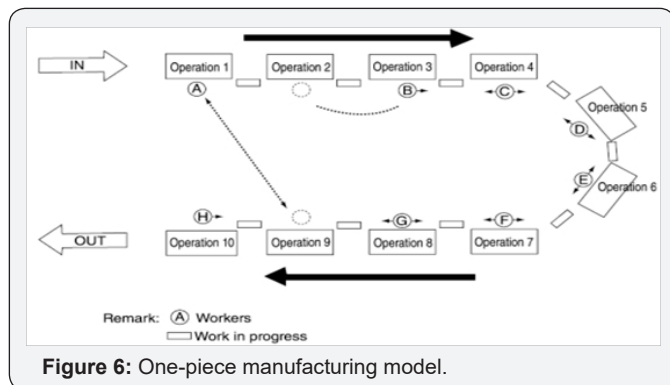


Figure 6: One-piece manufacturing model.

Benefits of one piece flow: Reduce throughput time and increases velocity for customer orders from order receipt through production and shipment. Improve value-added ratio through elimination of non-value-added activities which reduces operating costs. Allow the company higher degrees of flexibility to accommodate changes in customer demand. Save space in the factory. Promote continuous improvement as problems are exposed. Reduce transportation, waiting, overproduction, processing, inventory, and motion waste that occurs with batch processing. Lower the risks of product damage, deterioration, and obsolescence. Simplify scheduling. Support high-variety production. Reduce cycle time through increased production velocity. Support quality production.

Set up Reduction

Setup time is defined as the time to change from the last item of the previous order to the first good item on the next order. Setup includes preparation, replacement, location and adjustment activities (Figure 7). When analyzing setup activities, note whether the activity is internal or external. Internal setup activities require an inactive (shut down) process, meaning that no orders can run while the setup activity is taking place. External setup activities may be done while the process is operational. They are offline activities.

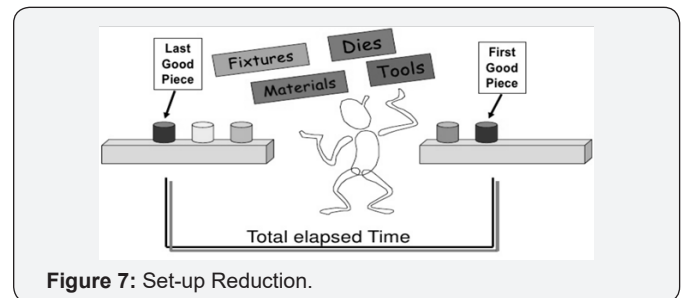


Figure 7: Set-up Reduction.

Benefits of setup reduction: Shorter lead time, increased capacity & flexibility. Capital equipment purchases avoided or delayed. Better quality/more-consistent processes & better workforce utilization. Lower manufacturing costs and improved cash flow. Less process variability & inventory.

Value-stream-mapping

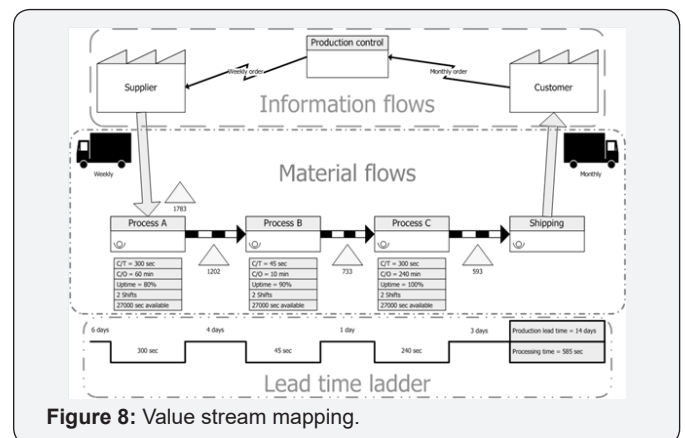


Figure 8: Value stream mapping.

Value stream mapping is a visual diagram that represents the activities to produce a product or service through the design, source, make, and deliver functions (Figure 8). Creating a value stream is the first step required in any lean improvement[7].

Benefits of Value stream mapping: Create a graphic visualization of the entire material and information flow for the current-state value stream. Show linkages and connections between information flow and material flow. Identify non-value-added steps, lead time, distances travelled, and amount of inventory for a process & sources of waste in the value stream. Provide a common language for talking about the processes. Make decisions about the apparent flow. Form the basis of an implementation plan to identify and eliminate wastes. Provide a common language for discussing the future-state value stream and identifying gaps between the current state and future state.

FMEA

Failure Mode and Effect Analysis (FMEA) model to prioritize potential defects based on their severity, expected frequency, and likelihood of detection. The Failure Mode and Effect Analysis highlight weaknesses in the current design or process. This tool prioritizes and organizes continuous improvement efforts on areas which offer the greatest return. From the Table 1 it has shown that the failure mode number two has an RPN of 144. This issue has the highest priority for process improvement.

Table 1: Example of Failure Mode & Effects Analysis.

Failure Mode	A) Severity	B) Probability of Occurrence	C) Probability of Detection	Risk Preference Number (RPN) A*B*C
1) Selecting wrong colour Button	5	4	3	60
2) Size of buttons is uneven	9	2	8	144
3) Trim cover clip Misaligned	2	3	4	24

Note: Rate from 1-10 where 10=Lowest probability

Benefits of FMEA: It provides a documented method for selecting a design with a high probability of successful operation and safety. A documented uniform method of assessing potential failure mechanisms, failure modes and their impact on system operation, resulting in a list of failure modes ranked according to the seriousness of their system impact and likelihood of occurrence. Early identification of Single Failure Points (SFPS) and system interface problems, which may be critical to mission success and/or safety. They also provide a method of verifying that switching between redundant elements is not jeopardized by postulated single failures. An effective method for evaluating the effect of proposed changes to the design and/or operational procedures on mission success and safety. A basis for in-flight

troubleshooting procedures and for locating performance monitoring and fault-detection devices. Criteria for early planning of tests.

SMED

SMED stands for Single Minute Exchange of Dies and was devised by Shigeo Shingo. It is a key component of rapid changeover (Figure 9). "SMED=Exchange dies in less than 10 minutes". Changeover time is the actual clock time, not labour time or work content. It is used to control and decrease downtime due to changeovers. SMED supports the concept of continuous improvement through the removal of waste. SMED will make the job more structured, repeatable.

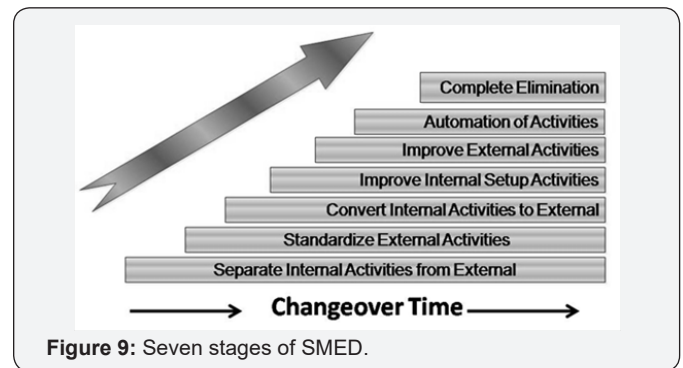


Figure 9: Seven stages of SMED.

Benefit of SMED: Reduced setup time and Work in progress. Higher efficiencies, increased capacity, flexibility & safety. Lower batch sizes which eliminate the waiting time. Achieve stockless production.

Just in Time

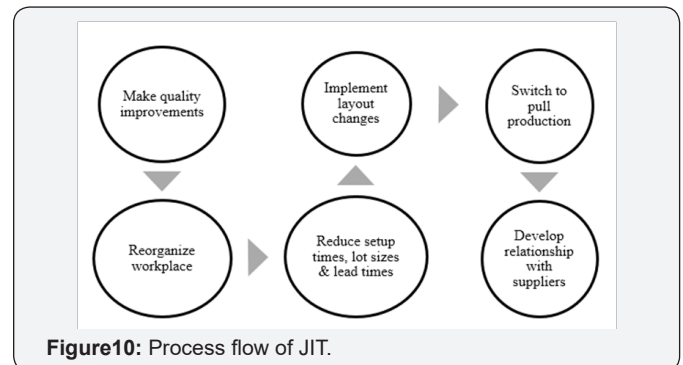


Figure 10: Process flow of JIT.

JIT philosophy means getting the right quantity of goods at the right place and the right time. JIT exceeds the concept of inventory reduction. It is an all-encompassing philosophy geared to eliminate waste, anything that does not add value. The process flow of JIT shown in Figure 10. JIT is achieved by focusing the element like Inventory reduction - exposes problems, Kanbans& pull production systems, Small lots & quick setups, Uniform plant loading, Flexible resources, Efficient facility layouts.

Implement the sequence of seven steps

1. Make quality improvements
2. Reorganize workplace

3. Reduce setup times, lot sizes & lead times
4. Implement layout changes
5. Switch to pull production
6. Develop relationship with suppliers

Benefit of JIT: Reduction in inventories & space requirements. Improved quality & flexibility. Shorter lead times. Lower production costs. Increased productivity & machine utilization.

Takt Time

Takt Time is defined as «The rate at which the end product or service must be produced and delivered in order to satisfy a definite customer demand within a given period of time. It is calculated:

$$\text{Takt Time} = \frac{\text{Available Work Time in Period}}{\text{Average Demand in Period}}$$

For example, if a process runs 24 hours a day and the market demand is 240 entities per day then:

$$\text{Takt Time} = \frac{(24 * 60) \text{ minutes}}{240 \text{ units}} = 6 \text{ minutes/unit}$$

Benefits of Takt Time: Production Stability which helps for Work cell Design. Receiving immediate feedback on performance.

Total Productive Maintenance

Total Productive Maintenance (TPM) emphasizes total participation of employees to achieve maintenance free operations through prevention of six major equipment losses such as equipment failures, set-up & adjustment losses, idling & minor stoppages, reduced speed, process defect losses, yield losses and through development of eight plus one major TPM pillars (Figure 11). Measuring and monitoring overall performance using Overall Equipment Effectiveness (OEE).

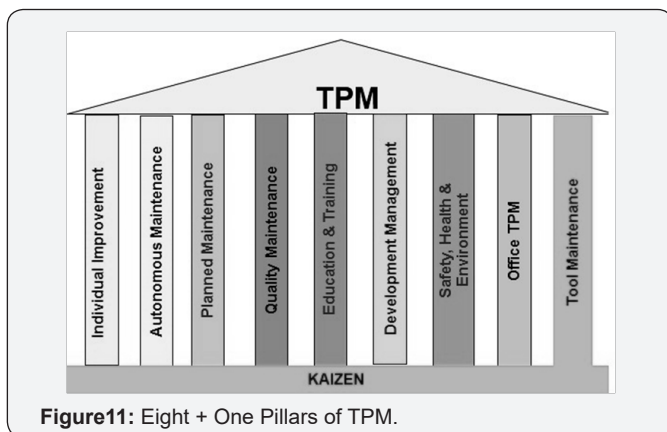


Figure 11: Eight + One Pillars of TPM.

Calculation of OEE

$$\text{OEE} = \text{Availability} \times \text{Performance rate} \times \text{Quality rate}$$

$$\text{Availability} = \frac{(\text{Loading time} - \text{Set-up time} - \text{Down time})}{\text{Loading time}} \times 100$$

$$\text{Performance rate} = \frac{(\text{Average cycle time} \times \text{Number of good units made})}{\text{Operating time}} \times 100$$

$$\text{Quality rate} = \frac{(\text{Total units produced} - \text{Rejected units}) \times 100}{\text{Total units produced}}$$

Benefits of TPM: Zero Unplanned Downtime, Defects, Speed Losses and Accidents. Productivity Improvement and cost Reduction. Employee Ownership & confidence. Improved working environment and increased Plant Reliability with customer Satisfaction

PDCA

PDCA (plan-do-check-act or plan-do-check-adjust) is an iterative four-step management method used in apparel manufacturing for the control and continuous improvement of processes and products. It is also known as the deming circle/cycle/wheel, Shewhart cycle, control circle/cycle, or plan-do-study-act (PDSA) (Figure 12). Another version of this PDCA cycle is OPDCA. The added «O» stands for observation or as some versions say, «Grasp the current condition.»

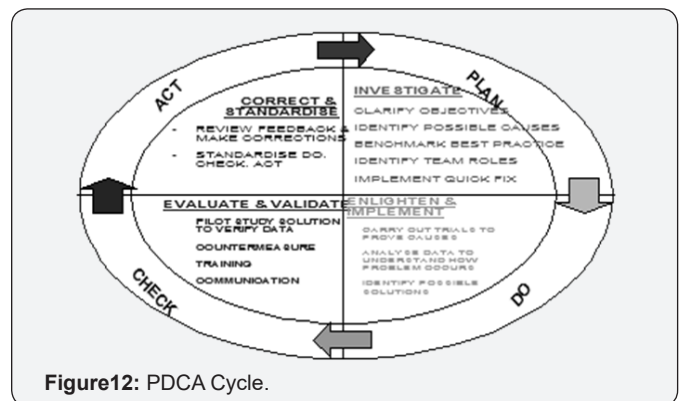


Figure 12: PDCA Cycle.

Benefits of PDCA: Daily routine management for the individual and/or the team. Problem-solving process. Project management and continuous development. Vendor and human resources development. New product development as well can see the process trials.

Conclusion

Due to increased customer expectations and severe global competition, the Indian apparel manufacturer tries to eliminate the waste, increase productivity at lower cost and to produce with the best product and service quality. Under these considerations, the authors have reviewed the lean manufacturing tools to improve the process environment by elimination of waste with a reasonable investment. The lean tools are well suited for reducing and managing the apparel manufacturing waste. In this paper, the effectiveness of lean tools is substantiated in systematic manner with the help of various systems, such as Value Stream Maps, SMED, JIT & etc...we hope that this paper contains its worth for practitioners in the apparel manufacturing.

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