Implementation of Quick Changeover in Garment Manufacturing Units

Dr. Amit Kumar Anjanee, Associate Professor
Department of Fashion Technology,
National Institute of Fashion Technology (NIFT), Chennai, India
amit.anjanee@nift.ac.in

Introduction-

In this fast fashion industry where the order lead time pays a crucial role in getting and executing the order, the concept and tools of Lean Manufacturing become inevitable. Lean manufacturing or lean production, which is often known simply as "Lean", is a production practice that considers the expenditure of resources for any goal other than the creation of value for the end customer to be wasteful, and thus a target for elimination. Working from the perspective of the customer who consumes a product or service, 'value' is defined as any action or process that a customer would be willing to pay for.

The Changeover Process

In order to explain SMED, the changeover process should be explained first.
Changeover: A changeover is the complete process of changing between the manufacture of one product to the manufacture of an alternative product to the point of meeting specified production and quality rates.

Single Minute Exchange of Die (**SMED**) is one of the lean tools for reducing waste in a manufacturing process. It provides a rapid and efficient way of converting a manufacturing process from running the current product to running the next product. This rapid changeover is essential to reduce production lot sizes and thereby improve flow which is a 'Lean' aim. It is also often referred to as **Quick Changeover (QCO)**. The phrase "single minute" does not mean that all changeovers and startups should take only *one* minute, but that they should take less than 10 minutes (in other words, "single digit minute").

Theoretically SMED is defined in four steps:
1. Suppress useless operations
2. Work together
3. Simplify fittings and fasteners
4. Suppress adjustments and trials

Note: These steps are non-sequential.
Steps 1 and 2 focus on *organizational* improvement; steps 3 and 4 focus on *design* improvement.

Organizational Improvement

Organizational changes are those changes which are people or procedure based. Organizational improvement is concerned only with reallocating or modifying tasks—not equipment or product. It tends to rely on high level of training and motivation. Organizational changes are most important to achieve SMED in apparel industry, as design improvements are limited.
There are several approaches for organizational improvement.
Considering when to perform the task:

- Tasks can be re-allocated from internal time to external time because fewer tasks within internal time will reduce the setup time. For example, loading of parts before end of old style or template preparation in advance.
- Tasks can be reallocated so that they are conducted more in parallel keeping in mind that the tasks must not be dependent upon each other. Usually, the creation of parallel tasks requires more manpower, so

increased personnel must be considered. For example, set-up of operations in different sections simultaneously (front and back sections).

- Tasks can be "compacted" together. Often during a changeover, there will be times when certain personal experiences a "waiting" time between his or her tasks. A simple reallocation or reorganization of group tasks may help reduce this waiting time. For example, performing bottom hem operation before waistband attach in a denim for starting few bundles, as set up of waistband operation consumes more time.

Additionally, changeover procedures can be modified by broadening the scope of a technician's abilities through training programs. This will allow a technician to perform tasks he or she was not previously allowed to do—and thus remove dependency on another technician for completion of a task.

It is equally important to consider *how* the tasks should be performed.

For example, trials and controls can be minimized by formalizing procedures and utilizing standards. Checklists can be used, and technicians can be held accountable for key procedures by signing off on the checklists. Perhaps the biggest influence on how tasks are performed is to change the design of the equipment to better accommodate the changeover procedure.

Design Improvement

Another way to decrease setup time is through design improvement. Design based changes are those which depend on new equipment or machine changes/improvements.

Design improvement can be applied in one or both of the following ways:

- Improve the design of the manufacturing equipment.
- Improve the design of the product of manufacture to accommodate the changeover process and reduce setup time. For example, increasing/ decreasing SPI by a unit as the specified SPI cannot be produced on some machines or to increase the width of J stitch so that it can be easily performed on J Stitch machine. But it is difficult to do such improvements as buyer's permission is required.

Unlike organizational changes, however, a large commitment company-wide may be required to conduct design improvements. In comparison to design improvement, organizational improvement is cheaper, easy to implement, and it produces very noticeable reductions in changeover time.

Phases in Quick Changeover

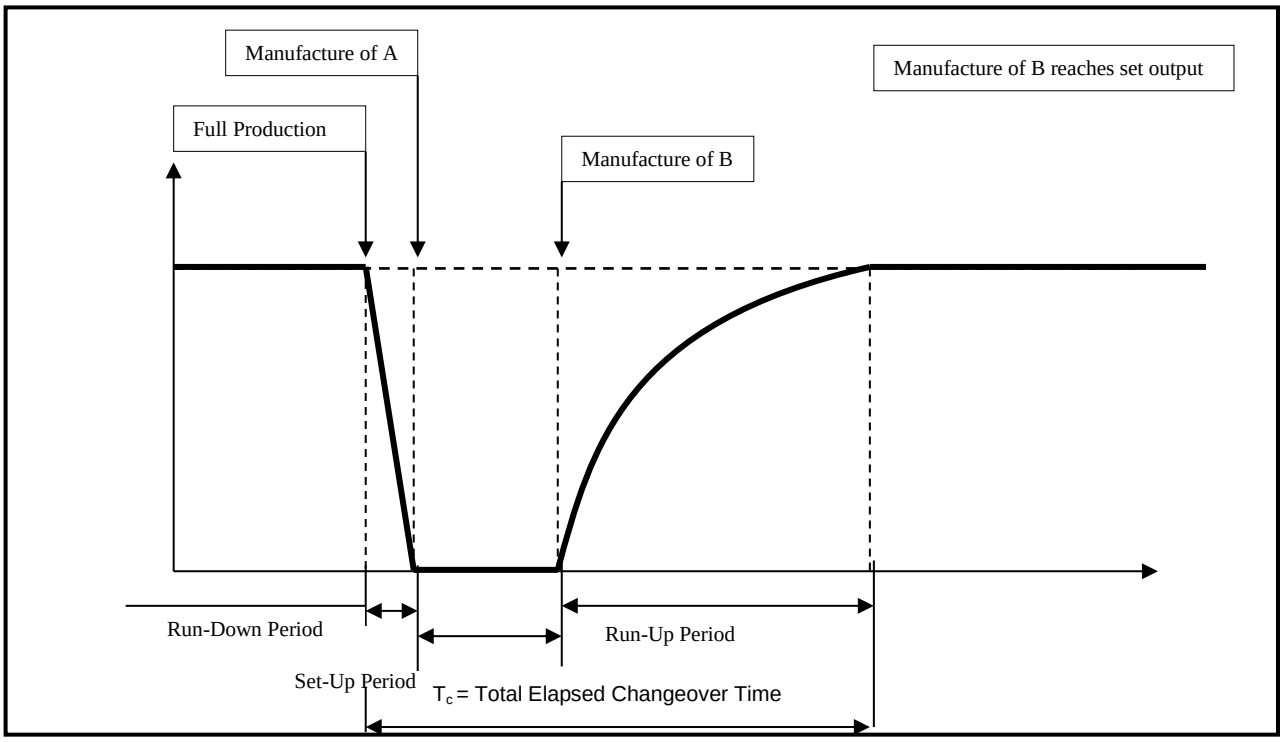

Figure 1- Line output during changeover

As explained in the Figure 1, the total elapsed changeover time, T_c, consists of three phases:

1) Run-down period- It is the interval when production of old product is complete but set up for new product cannot be started as some of the pieces of old product are inline for alterations or waiting for some parts/ trims. In ideal situations, run-down period should be zero. For example, production of style *Orsay* is finished but some of the pieces are inline for alterations and for some other pieces waistbands are missing. So Run-down period will stretch till all the pieces are out from the line.

2) Set-up period- It is defined as interval when no manufacturing occurs. In this phase, the equipments are being adjusted to manufacture new product. This interval is critical, because there is no output from the line, and potential revenues are lost. There are two kinds of activities required to carry out a changeover: Internal and External activities.

- **Internal Activities:** These are the activities which are performed in the interval when no product is being manufactured. For example, when sewing machines present inline are being set for gauge, SPI, folder adjustment etc. for a new style at that time no production is happening in line. The time taken to complete all the internal activities constitutes set-up Period.
- **External Activities:** These are the activities which can be performed outside the line without disturbing the production inline. For example, pre setting of a sewing machine for early loading of cut parts without disturbing the production of running style.

3) Run-up period- It starts when production is commenced again and continues until consistent output at full capacity occurs. It is often difficult to determine at what point full production capacity is reached as the line performance is still fluctuating at this time. It is quite likely that the production line will be halted at intervals during the run-up period as adjustments still take place at this point of time. For example, production of denims of new style 'B' has started but output from a particular operation is very low because it is a new operation. So, the interval till the consistent output is achieved at that operation constitutes run-up period.

The SMED Methodology

The SMED methodology can be easily defined in six steps. Practically high quality of analytical ability and devotion is required to follow the steps. It consists of **:**

- Observing the current changeover process
- Identifying internal and external activities
- Converting activities from internal to external set up
- Increasing efficiency of the remaining internal activities
- Optimizing the start up time
- Increasing efficiency of external activities

Getting Started With SMED

There are series of activities which should be performed before changeover to reduce the set up time. All these activities are important and should be performed timely by the responsible person. These activities can be divided in three phases:

- **Planning Phase**: The activities in this phase are essential prerequisite to the activities of preparatory phase.
- **Preparation Phase**: The activities in this phase involve completion of external activities.
- **Operating Phase**: The activities in this phase involve execution of changeover.

Planning Phase:

- **Line Plan**

  Planning of line plan should be done in a manner that loading of upcoming style will occur four days after receiving updated line plan. Loading of styles similar to previous running styles in the respective lines helps in achieving quicker changeover and better productivity.

Activity	Department	Objective	Performed By	Starting day	Format
Production Planning	PPC	To prepare Line Plan	PPC Head	Day 4	Line Plan

- **Operation Bulletin:**

  Operation Bulletin of upcoming style should be revised on the basis of line plan by IE 3 days prior to style loading. Operation Bulletin developed at sampling room should be crosschecked with the reference sample by IE executive and updated for required changes. After finalizing operation bulletin, Machine layout should be developed by IE Executive.

Activity	Department	Objective	Performed By	Starting day	Format
Style Analysis	IE	To prepare Operation Bulletin and Machine Layout	IE Executive	Day 4	Operation Bulletin & Machine Layout

- **Mock Sample:**

  Supervisor should be informed about upcoming style, on the basis of line plan, 3 days prior to style loading, to prepare the mock sample. It is the replica of upcoming style in terms of design details. The purpose of mock sample preparation is to make supervisor acquainted with all the operations. It is beneficial as it helps in early identification of:

  - Critical operations
  - Necessary templates.
  - Method details

Preparation of mock sample should be completed on the same day.

Activity	Department	Objective	Performed By	Starting day	Format
Mock Sample Preparation	Sewing	Style Analysis	Supervisor	Day 4	___

- **Machine Plan:**

  Machine Plan preparation is a fundamental planning tool for SMED. It involves internal and external element segregation for new style by comparing operation bulletin of old and new style. It should be prepared 3 days prior to loading.

It is a record of:

- Operation Type
- Machine Type (Segregated as internal/external)
- Machine Number
- SPI
- Required Settings
- Critical/External Independent Operation
- Additional Operator/Helper

All the details, except additional operator/helper are documented by Industrial Engineer. The machine plan is then handed over to supervisor who is responsible to complete the remaining details and to crosscheck if all the details filled are correct.

Activity	Department	Objective	Performed By	Starting day	Format
Machine Plan Preparation	IE	Segregation of Internal & External Activities	IE Executive & Supervisor	Day 4	Machine Plan

➢ **Status Check:**

Status of *Cutting, Outsourcing and Trims* should be checked by the supervisor 3 days prior to loading of new style and related issues should be discussed in Internal PPM. It is necessary to check the status of all the inputs in advance, to prevent off standard time arising due to waiting for raw material inline.

Activity	Department	Objective	Performed By	Starting day	Format
Status Check	Sewing	To check status of all the inputs	IE Executive & Supervisor	Day 3	Machine Plan

➢ **Internal Pre Production Meeting:**

Internal PPM should be held 2 days prior to style loading, after completion of preliminary activities (OB, Mock sample & Status check). The purpose of Internal PPM is to discuss new style in advance to anticipate problems and their respective measures. The duration of PPM should be less than 10 minutes. Internal Pre Production Meeting is not mandatory for repeat styles.

Internal PPM is held in the presence of:

- Production Manager
- Quality Head
- Floor In-charge
- Maintenance Head
- Industrial Engineer.
- Supervisor
- Preparatory Head

Internal PPM involves discussion on following topics:

- **Mock Sample:** Sample prepared by supervisor should be checked by Quality Head and CTP (Critical to Production) operations should be discussed.

- **Cutting and Trim status:** Cutting and outsourcing status issues should be discussed and Production Manager should be held responsible to get them sorted. Trim status issues should be communicated to merchandising department by Production Manager.
- **Quality Specifications:** CTQ (Critical to Quality) operations and PP comments are discussed by Quality Head. Any changes in the specifications from the reference sample should also be conveyed.
- **Machine, Folder and Attachment Status:** Requirement for any *new folder, attachment or machine* for new style, analyzed during machine plan preparation, is also discussed by IE in the meeting. The order should be placed for the same after crosschecking with maintenance department on the same day.
- **Template Preparation:** QC should discuss about templates required.
- **Operator Allocation Plan:** Based on the machine plan Floor In-charge will decide operator allocation. Only discussion for operator allocation at critical operations is held in the meeting.

A PPM report should be documented in the meeting by Industrial Engineer and concerned issues are solved by the responsible persons. Machine plan is handed over to maintenance department in the Internal PPM. All the concerns regarding upcoming style are discussed and solved in Internal PPM.

Activity	Department	Objective	Performed By	Starting day	Format
Internal PPM	Sewing, IE, Quality & Maintenance	Discussion of critical points regarding new style	Production Manager, Quality Head, IE, Supervisor, Mechanic, Preparatory Head & Floor In charge.	Day 3	PPM Report

All the above activities complete the planning phase of SMED.

Preparation Phase:

➢ **External Machine Setting:**

External machines should be set by the mechanic according to the machine plan. The settings should be complete a day prior to loading of new style.

Machine setting includes:

- Gauge change
- Folder/ Presser Foot change,
- Needle addition /removal
- SPI adjustment
- Programming

The stitch quality should be approved by Quality Checker. After completion of machine setting the machine should be tagged indicating the line and style for which the machine is set.

Activity	Department	Objective	Performed By	Starting day	Format
External M/c Setting	Maintenance	Early m/c setting to reduce off standard time	Mechanic	Day 3	—

➢ **Preparatory Section Status:**

Preparatory Section status should be checked by supervisor one day prior to style loading and problems should be discussed with preparatory head and solved to get timely loading.

Activity	Department	Objective	Performed By	Starting day	Format
Preparatory Section Status Check	Sewing	To check status of preparatory section	Supervisor	Day 2	__

- **Template Preparation:**
  Patterns should be issued by supervisor one day prior to style loading. The number of patterns should be checked and requirements of any other pattern should be communicated to CAD/ Sampling room immediately. The templates should be prepared by supervisor and approved by QC.

Activity	Department	Objective	Performed By	Starting day	Format
Template Preparation	Sewing	Early template preparation to reduce off standard time	Supervisor	Day 2	__

Day of Changeover:

- **Inline Loading**
  - **Trims Issue:**
    Trims like threads, zippers labels, buttons etc. should be issued at least 2 hours before old style ends at first operation.
  - **Cut part loading:**
    Cut part loading should also be done at the same time. It should be checked by feeding helper while loading if all the parts are present. Parts coming from preparatory section should be counted before loading so that any missing parts can be communicated to preparatory section at the earliest. Early inline loading is necessary to reduce the off standard time.

Activity	Department	Objective	Performed By	Starting day	Format
In Line Loading	Sewing	Early loading of inputs to reduce off standard time	Supervisor	Day 1	__

- **Start of Independent Operations:**
  Presence of Floor In-charge, Supervisor, QC and Mechanic is necessary during complete changeover.
  - **Manual operations:**
    Manual operations such as ironing and marking should start before the succeeding operation ends to create enough WIP at the first operation.
  - **External Independent Operations:**
    External Independent operations, as the name suggests, are independent of the style running in the line, so these can be started before completion of old style. It helps in creating enough WIP and reducing off standard time as all the trials can be done outside the line.

Activity	Department	Objective	Performed By	Starting day	Format
Starting Independent Operations	Sewing	To start independent operations for the new style	Operator	Day 1	__

All the above activities complete preparation phase of SMED. To achieve goal of single minute changeover, all the activities in preparation phase should be completed on time.

Operating Phase:

- **Start of Dependent Operations:**

When the operation of old style ends, the machine settings for new style should be done by the mechanic inline. The operation should be demonstrated by supervisor to operator and the operator should start the operation

Activity	Department	Objective	Performed By	Starting day	Format
Starting Dependent Operations	Sewing	To start dependent operations for the new style	Operator	Day 1	__

Procedure for starting operation of new style:

- Internal Machine Setting by Mechanic according to specifications.
- Operation Demonstration by Supervisor.
- First piece by the Quality Check.
- Machine setting, if required.
- Operation performed by operator.
- Quality Check for the complete bundle.
- For CTQ operations bundle check for initial 5-10 bundles should be done by QC in-charge, so that no faulty piece is passed to the next operation. The close attention given to quality at critical operations helps to improve the quality of work performed leading to reduced off standard time. If quality is not consistent even after checking of 10 bundles then the operation should be analyzed by supervisor to identify the root cause of problem and solve.

- **Style Change Analysis**

  Style change analysis report should be documented for each style by IE person to analyze the problems faced during the changeover. All the problems faced during style analysis should be discussed in the style review meeting which will be held a day after completion of changeover.

Conclusion

The SMED is one of important and impactful lean tools for reducing waste in a manufacturing process. It provides a rapid and efficient way of converting a manufacturing process from running the current product to running the next product. This rapid changeover is essential to reduce production lot sizes and thereby improve flow which is a 'Lean' aim.

The step and phases explained in this paper will be useful any garment manufacturing facilities working on assembly line production system, to come up with solution of delay in the getting the out put due to style change over. This quick changeover process will be

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