RZESZOW UNIVERSITY OF TECHNOLOGY

TET

# CHAPTER 4

# SMED

## LEAN MANUFACTURING

Co-funded by the European Union

TET - The Evolving Textbook
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# Definition of SMED (Single Minute Exchange of Dies)

**SMED** is a Lean Manufacturing method aimed at reducing machine changeover times between different production runs. It focuses on minimizing downtime and shortening setup times, enabling smaller batch production and enhancing process flexibility. The approach involves separating internal tasks (performed when the machine is stopped) from external tasks (performed while the machine is running), standardizing procedures, and streamlining operations. Implementing SMED improves productivity, reduces waste, and allows for faster responses to customer needs. It is particularly effective in accommodating diverse product types and increasing operational efficiency.

**Stadnicka D., Antosz K. (2015).** The investigation of setups and development of decision support model for setups selection to SMED analysis. Journal of Business and Economics. Vol. 6, No 7, pp. 1334-1347.

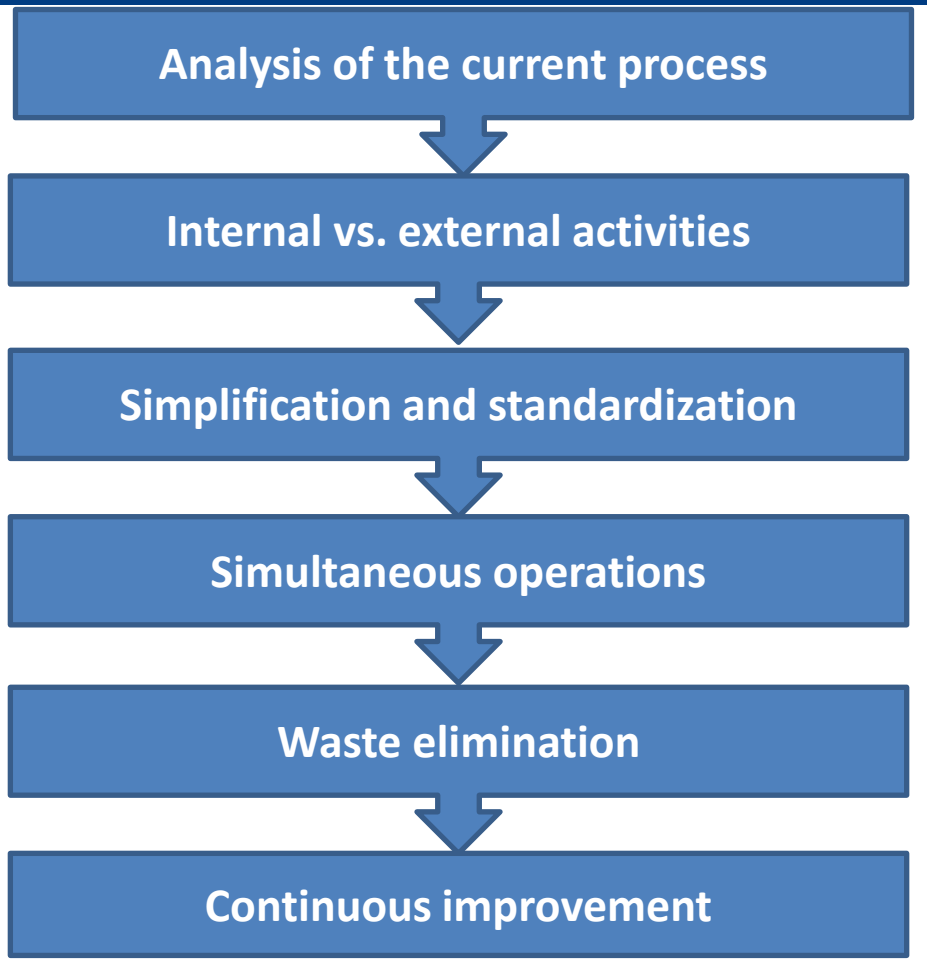
**Stadnicka D. (2015).** *Setup analysis - combining SMED with other tools*. Management and Production Engineering Review. Vol. 6, No. 1, 2015, 36-50.

# The stages of implementing the SMED method

The stages of implementing the SMED method are as follows:

1. **Analysis of the current changeover process**
2. **Separation of internal and external activities**
3. **Simplification and standardization of tasks**
4. **Introduction of simultaneous operations**
5. **Improvement and elimination of waste**
6. **Testing and continuous improvement**

Each stage of SMED aims to eliminate waste, increase productivity, and maximize the utilization of available resources in production processes.



# 1. Analysis of the current changeover process

The first step in analysing the current changeover process involves closely observing the entire workflow to gain a comprehensive understanding of its structure and sequence. Each activity performed during the changeover should be recorded and documented in detail, including tools used, movement patterns, and time spent on each task. Categorize these activities as either internal (requiring the machine to be stopped) or external (performed while the machine is running). This analysis helps identify bottlenecks, inefficiencies, and unnecessary actions, providing a clear foundation for improvements.

Example

| Step Number | Description | Duration (s) | Activity Type | Notes/Issues |
|---|---|---|---|---|
| **1** | Retrieving tools from storage | 120 | External | Time-consuming due to distant location |
| **2** | Installing a new die | 300 | Internal | Lack of a standard tool kit |
| **3** | Machine calibration | 180 | Internal | Need for improved instructions |
| **4** | Setting parameters on the panel | 90 | Internal | Complex user interface |

# 2. Separation of internal and external activities

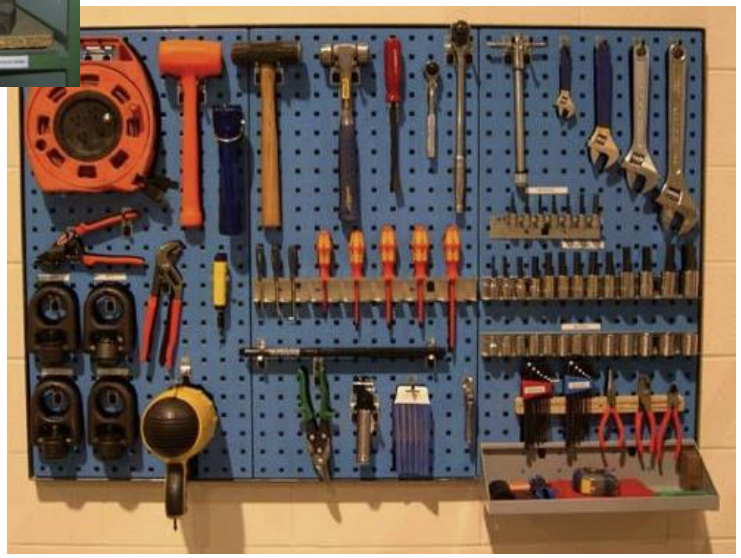
This step focuses on distinguishing between tasks that require the machine to be stopped (internal activities) and those that can be performed while the machine is running (external activities). Internal activities include operations such as die changes or machine calibration, which can only occur during downtime. External activities, like tool preparation or documentation updates, are completed independently of the machine's operational state. The goal is to analyse all tasks and convert as many internal activities as possible into external ones. This shift minimizes machine downtime and significantly improves overall efficiency.

## Examples of Internal and External Activities in the SMED Process

| Activity Type | Examples of Activities |
|---|---|
| **Internal Activities** | |
| - Tool change | Removing the old tool and installing the new one |
| - Machine calibration | Setting parameters according to the requirements of the new product |
| - Trial run | Checking the machine's performance after the changeover |
| - Manual adjustments | Adjusting mechanical components such as dies or axes |
| **External Activities** | |
| - Tool preparation | Bringing the necessary tools and parts from storage |
| - Material transport | Delivering raw materials or components needed for the new production |
| - Documentation update | Completing reports related to configuration or production |
| - Quality check of tools | Inspecting tools for readiness before starting the changeover |

# 3. Simplification and Standardization of Tasks

Simplification and standardization of tasks focus on improving the changeover process by eliminating unnecessary steps and redundant activities that do not add value. This involves analysing each task to identify inefficiencies or complexities that can be removed. Standardized tools, procedures, and solutions are then introduced to ensure consistency and reduce variability in operations. Examples include creating detailed work instructions, using universal tools, and implementing visual management systems. By streamlining tasks and promoting uniformity, this step minimizes errors, reduces time spent on changeovers, and enhances overall process efficiency.



# Examples of Standardized Solutions in SMED

**Standard Tools and Equipment:**
- Use of universal tools that fit various machines and configurations.
- Quick couplings for connecting hydraulic, pneumatic, or electrical lines.

**Standardization of Procedures:**
- Detailed work instructions describing each step of the changeover process.
- Checklists for operators to ensure no steps are overlooked.

**Visual Management:**
- Color-coded labels on tools and machines for faster identification.
- Information boards displaying the changeover plan.

**Predefined Machine Settings:**
- Use of stoppers that automatically position components in the correct places.
- Storing ready-to-use parameters in machine controllers.

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**Workplace Organization:**
- Arranging tools according to the 5S principle (Sort, Set in order, Shine, Standardize, Sustain).
- Dedicated carts or toolsets placed near the workstation.

**Use of Technology:**
- Automated changeover systems (e.g., quick die change systems in presses).
- Monitoring parameters through computer systems and saving settings.

**Parallel Activities:**
- Clear role division among operators, allowing simultaneous execution of different tasks.

# 4. Simultaneous operations

- Divide tasks among operators or teams to perform different activities simultaneously.
- Enable parallel operations to minimize downtime.

**1. Simultaneous tool change in different locations:**
Two operators change tools simultaneously at opposite ends of the machine (e.g., the left and right sides of a CNC machine).

**2. Parallel preparation of tools and machine setup:**
One operator prepares tools and parts at an external workstation, while another operator sets parameters on the machine's control panel.

**3. Concurrent lubrication and mechanical adjustment:**
One worker lubricates the machine's moving parts while another adjusts axes or tool positions.

**4. Simultaneous data input and testing:**
One operator inputs data into the control system while another performs a trial run of the new setup on the machine.

## Examples of Simultaneous Operations

**5. Use of team-based operations:**
Two or more operators perform different tasks simultaneously, e.g., one changes tools while another organizes the workspace around the machine.

**6. Concurrent actions using automation:**
An operator initiates an automatic machine reset process while simultaneously preparing raw materials or tools for the next stage.

**7. Documentation preparation during physical changeover:**
The supervisor completes technological documentation while the operator performs physical changeover tasks on the machine.

**Benefits:**

- **Reduction of total changeover time –** Simultaneous operations streamline processes, minimizing downtime and ensuring faster transitions.
- **Better utilization of resources –** Optimizes the use of personnel, tools, and machinery, reducing idle time and maximizing productivity.
- **Increased flexibility and responsiveness –** Enables quicker adjustments to production changes, improving the ability to meet shifting customer demands and market conditions.

# 5. Improvement and elimination of waste

- Reduce time losses by introducing tools and technologies.
- Optimize workplace layout and the accessibility of tools.

## Identification of Waste (Muda)

Common types of waste include:
• **Excessive movements –** Operators moving long distances to retrieve tools or materials.
• **Waiting –** Delays caused by waiting for tools, materials, decisions, or the completion of another operation.
• **Errors –** Activities requiring corrections or additional work due to mistakes.
• **Unnecessary steps –** Actions that are not essential to achieving the process objective.

## Automation and Technology

• **Introduction of automatic tool change systems –** Implementing solutions such as quick couplings or automated parameter settings to minimize manual intervention and save time.
• **Monitoring and saving machine settings –** Recording machine configurations to enable faster retrieval and setup for future operations.

## Workplace Organization Improvement (5S)

• **Sorting –** Removing unnecessary tools and items from the workstation to reduce clutter.
• **Systematization –** Arranging tools in a logical and easily accessible manner to enhance efficiency.
• **Shining –** Maintaining cleanliness regularly to prevent disruptions and ensure a safe work environment.
• **Standardization –** Implementing uniform organizational methods to ensure consistency across workstations.
• **Sustaining (Self-discipline) –** Encouraging employees to consistently maintain order and adhere to organizational practices.

## Visual Management

• **Color-coded markings –** Use of color-coded labels on tools, lines indicating material flow, and informational boards to improve clarity and efficiency.
• **Example –** Marking specific spots for each tool at the workstation to ensure proper organization and quick accessibility.

# 6. Testing and continuous improvement

- Implement the improved changeover process and analyse the results.
- Conduct regular reviews and optimizations to further reduce changeover time and adapt the process to production changes.

## Continuous Improvement (Kaizen)

• **Regular reviews of the changeover process –** Conducting frequent evaluations to identify areas for further improvement and opportunities to optimize efficiency.
• **Team involvement –** Engaging employees in suggesting improvements and testing new methods to foster innovation and ownership of processes.

## VIDEOS

• Automation of the changeover process for a packaging machine handling parts in plastic bags https://www.youtube.com/watch?v=qn7tK9GRlvU
• Robot changeover https://www.youtube.com/watch?v=0HvVM210f14
• Acceleration of machine changeover processes using linear motion mechanisms https://www.youtube.com/watch?v=PBcMU4sJHnM
•Changeover of the CMKS compact line using an automatic tool memory system https://www.youtube.com/watch?v=mcqS_zh0MZQ
• SMED: How to do a Quick Changeover https://www.youtube.com/watch?v=qzuBedo7eLw
• SMED Implementation Using Smartflow Products – SMARTFLOW https://www.youtube.com/watch?v=yewwCWU4M9c

# Q&A

**1. What is the main goal of the SMED method?**
a) Increasing the number of workers operating the machine
b) Reducing changeover time
c) Increasing the number of batches produced per hour

**2. What does separating internal and external activities in SMED mean?**
a) Performing all tasks while the machine is running
b) Dividing tasks into those done while the machine is stopped and those done while it is running
c) Assigning tasks to different operators

**3. Which of the following is an example of an external activity in SMED?**
a) Machine calibration
b) Installing a new tool on the machine
c) Preparing tools before stopping the machine

**4. Which of the following is NOT part of implementing SMED?**
a) Dividing the process into stages
b) Simplification and standardization of tasks
c) Eliminating waste

**5. What is a key step in the SMED process?**
a) Increasing the number of internal activities
b) Converting internal activities into external ones
c) Rearranging the layout of machines in the factory

**6. What is the outcome of implementing SMED?**
a) Increasing machine downtime
b) Reducing the number of tools needed for production
c) Reducing changeover time and increasing production flexibility

# Q&A

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## Thank you for your attention.

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