

Lean System Engineering

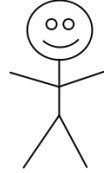
Chapter Four

Standardized Work

“Establishing World Class Manufacturing Practices”

By Rukiya Nuray

The Challenge of Change



Where we are

- **Comfort**
- **Fear**
- **Anger**
- **Anxiety**
- **Sabotage**
- **Loss of status**
- **Denial**
- **Blame**
- **Past Patterns**

Where we want to be

WIIFM?

(What's in it for me?)

Chaos

**“...no meaningful
change occurs
without chaos”**

Margaret Wheatley

Reject \longleftrightarrow Accept

“Improvement is endless and eternal.”

Toyota Proverb

- **Standardized work** is the safest, easiest, and most effective way of doing the job.
- **Standardized work** is a tool for *developing, confirming, and improving our method (processes)*.
- **A process** is simply a set of **steps or actions with a clearly defined goal**. The process tells the team member **what to do, when to do it, and in what order**.
- **Method** is the mix of **man/woman, machine, and material**

Overview of Standard Work

Used as a tool, standard work accomplishes the following:

- It establishes a routine for **repetitive tasks**.
- It makes managing **resource allocation and scheduling** easier.
- It establishes a relationship between a **person and the environment** (both the machine and materials).
- It provides a **basis for improvement**
- It prohibits **backsliding, or relapse** into previous bad habits.

Standardized Work

➤ Objectives

- Establish and clarify the guidelines for manufacturing
 - **QUALITY, QUANTITY, COST, INVENTORY, AND SAFETY**
- Provide a tool for Kaizen
 - **YOU CANNOT MANAGE WHAT YOU DO NOT MEASURE**
 - **WHERE THERE IS NO STANDARD, THERE CAN BE NO KAIZEN**



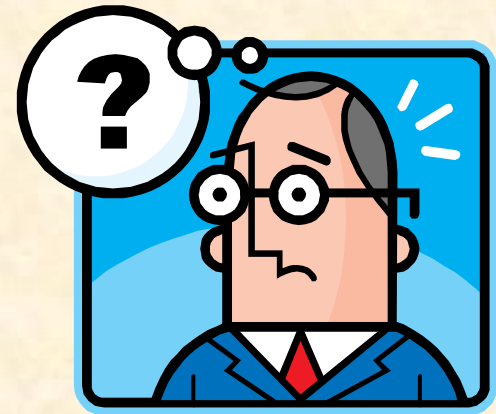
Prerequisites for Standard Work

- To implement standard work,
- The operation must be observable, repetitive, and based on human motion.
- The process must be standardized with all variable processes reduced.
- The floor supervisor must be responsible for the implementation of standard work.

Advantages of Standard Work

- Repeatable Processes.
- Operator Training.
- Repeatable Quality
- Improved Safety.

Disadvantages of Standard Work



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Why Standardized Work?

- Standardized work provides great benefits:

1. **Process stability:** Stability means **repeatability**. We need to meet our **productivity, quality, cost, lead time, safety, and environmental targets every time.**

2. **Clear stop and start points for each process:**

- These and knowledge of our takt, that is, our pace of production rationalized with our rate of sales and cycle times, allow us to see our production condition at a glance.

- Are we ahead or behind?

- Is there a problem?

3. **Organizational learning:** Standardized work preserves **know-how and expertise.**

- If a veteran employee leaves, we won't lose his or her experience.

4. **Audit and problem solving:** Standardized work allows us to **assess our current condition and identify problems.**

- Checkpoints and vital process steps are easy to track. We are able to ask important questions:
 - a. Are team members able to do the process smoothly or are they falling behind?
 - b. If they are falling behind, by how much and in what job elements?
 - c. How can we improve these elements?

5. Employee involvement and poka-yoke:

- In the Lean system team members develop standardized work, supported by **supervisors and engineers**.
- Moreover, team members **identify opportunities** for simple, inexpensive error-proofing or poka-yoke devices.

6. Kaizen: Our processes are mainly muda.

- Once we have achieved process stability, we are ready to improve.
- Standardized work provides the **baseline against which we measure improvement**

7. Training: Standardized work provides a **basis for employee training.**

- a. Once operators are familiar with standardized work formats, it becomes second nature for them to do the job according to standards.
- b. Vital steps and checkpoints serve as constant reminders.
 - Because process training is easier, we can more easily respond to changes in demand (and the corresponding changes in takt time and process steps).



Steps to Create Standard Work

- Evaluate the current situation
- Identify areas of opportunity
- Modify the existing process
- Quantify improvements
- Implement new standard work

Standardized Work

➤ Three elements

- “Takt” time / Cycle time
- Work Sequence
- Standard WIP

➤ Four Tools

- Time Observation
- Process Capacity
- Standard Work Combination Sheet
- Standard Work Layout



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1. Takt Time

- **Takt time** is how frequently a product must be **completed to meet customers' expectations**. It is calculated using customer demand and available time.
- Takt time sets the **rhythm for standard work**.
- **Operator cycle time (CTO)** is the total time required for an operator to complete **one cycle of operation**, including time needed for
 - **Walking,**
 - **Loading and unloading, and**
 - **Inspecting products.**

Takt Time cont...

- The machine cycle time (CT_m) is the time between the instant an operator presses the “on” or “start” button and the point at which the machine returns to its original position after completing the target operation.
- Takt time is equal to the total daily operating time divided by the total daily requirements.
- The variables include customer demand and available work time.
- Therefore, you should recalculate takt time when your customer demand available work time changes.

$$\text{Takt time} = \frac{\text{Available time}}{\text{Customer demand}}$$

Takt time cont...

- The total cycle time (TCT) is the rate of completion of a process or operation.
- This is a summation of operator cycle time and machine cycle time for all processes in the operation.

$$TCT = \sum_{i=1}^n i = (CT_o + CT_m)$$

- Where i is the machine number and n is the total number of machines.
- If takt time is known, computing TCT will provide an understanding of how many operators may be needed for line balancing needs.

$$\text{Number of operators needed} = \frac{TCT}{\text{Takt time}}$$

2. Work Sequence

- The work sequence defines the order in which the work is done in a given process. For example, the team member might have to
 - Pick up the part
 - Walk to the machine
 - Place the part in the machine and process the part
 - Take the part to the next machine

2. Work Sequence cont..

- We have to clearly define the **best way to do each job action** and the proper sequence. possible, used pictures and drawings to show
 - Proper posture
 - How the hands and feet should move
 - How to hold the tools
 - Accumulated know-how or the ins and outs of the job
 - Critical quality or safety item

3. In-Process Stock

- In-process stock is the minimum number of unfinished work pieces required for the operator to complete the process without standing in front of a machine.
- The determining factor is that work cannot progress without a certain number of pieces on hand.
- Defining in-process stock establishes work-in-process (WIP) standards per process and, again, makes abnormalities obvious.

Charts Used to Define Standardized Work

- Three charts are used to define standardized works are
 1. Production capacity chart
 2. Standardized work combination table
 3. Standardized work analysis chart
- Each is a tool for analyzing and defining a process and for identifying improvement points.

1. Production Capacity Chart

- This chart determines the capacity of the **machines** in a process.
- It documents **machine and manual times** and allows us to identify bottlenecks at a glance.
- **Production capacity** for a given machine is calculated using the following formula:
$$\text{Capacity} = \frac{\text{Operational time per shift}}{(\text{Process time} + \text{Setup time/interval})}$$

1. Production Capacity Chart cont...

- Setup time refers to the time required to change from one machine setting to another.
- **Setup** for a bobbin thread might include winding bobbin thread, adjusting with bobbin case, and replacing bobbin to machine
- The **interval** refers to the frequency of setup in terms of number of parts.

The production capacity of the sewing machine used in process 2 may be calculated as follows:

- a) Operational time = 460 minutes per shift (27,600 seconds)
- b) Process time = 24 seconds per part
- c) Time needed to replace bobbin = 60 seconds
- d) Interval = every 300 parts

Solution: Capacity = $27,600 \text{ seconds} \div (24 + 60/300) = 1,140.5 \text{ parts}$

○ The capacity of the sewing machine is **1,141** parts per shift.

2. Standardized Work Combination Table

- This chart shows
 - Work elements and their sequence
 - Time per work element
 - Operator and machine time
 - The interaction between operators and machines or between different operators
- The chart makes **kaizen easier** by breaking down the movements of the operator and relating them to machine time.

3. Standardized Work Analysis Chart

- This chart helps to rationalize layout and to train workers. It comprises
 - Work layout
 - Process steps and times
 - Critical quality and safety items
 - Standardized WIP stock

Standardized Work and Kaizen

- Standardized work is a process whose goal is kaizen. If standardized work doesn't change, we are regressing.
- The leader's responsibility is to maintain a **good condition and to improve.**
- Sometimes kaizen opportunities are obvious.
 - These include **obvious muda** such as recurring defects, machine breakdowns, or excessive WIP.
 - **Hard-to-do work (muri) or unevenness (mura)** are other obvious targets.

Standardized Work and Kaizen Cont...

○The following sections describe design guidelines that can help us find kaizen opportunities.

- ✓ **Guidelines for Layout and Equipment**
- ✓ **Guidelines for Economy of Motion**
- ✓ **Guidelines for Tools and Jigs**

A. Guidelines for Economy of Motion

- Hand movements should be **symmetrical and concurrent**.
- **Light work** should be done with the **hands** rather than the **upper arms and shoulders**.
- **Motion should flow freely**.
- Work should be done in the “**strong circle**” a yard in diameter and directly in front of the worker. Maintain appropriate **body posture**.
- Keep hands free as much as possible.

B. Guidelines for Layout and Equipment

- Identify home positions for tools and materials.
- Build flexibility into the layout to accommodate demand changes and taller or shorter operators.
- Move parts horizontally. Avoid vertical part movement.
- Use gravity to move parts (e.g., with sloping parts racks).
- Place tools and materials conveniently.
- Ensure adequate lighting.
- Use colors.
- Use U-shaped layouts so that process start and end points are side by side.

C. Guidelines for Tools and Jigs

- Develop **jigs** to eliminate manual holding of materials.

- Use **ergonomic tools**

(i.e., tools that are easy to grip, encourage good hand/wrist posture, and minimize forces and vibration).

- **Combine tools where possible**

(e.g., use a T-wrench instead of a socket wrench and screwdriver).

- Where possible, use balancers that automatically **withdraw the tool from point of use.**