

IE431
Industrial
Quality Control

Session III

***“LEAN Enterprise
and Six Sigma”***

LEAN Enterprise

Is a methodology that relies on a collaborative team effort to improve performance by systematically removing waste; combining Lean Manufacturing, lean enterprise and six sigma to eliminate the eight kinds of waste; defects, overproduction, waiting, non-utilized talent, transportation, inventory, motion, extra-processing

Lean Fundamentals

- Types of waste
- Categories of waste
- Workplace organization
- Concept of flow
- Inventory control
- Visual management
- Kaizen
- Value stream

Types of Waste

- Non-value added and unnecessary for the system to function.
- Non-value added and necessary for the system to function.
- Non-value added due to variation in quality, cost, or delivery.
- Non-value added due to overstressing people, equipment, or system.

Categories of Waste

- **Overproduction**; Producing more, earlier, or faster than required by the next process.
- **Waiting**; Any idle time or delay waiting for materials.
- **Transportation**; Any movement of material.
- **Defects**; Products or services that do not conform to specifications.
- **Inventory**; Any inventory in the value stream.
- **Motion**; Any motion of a person's body.
- **Extra Processing**; Processing that does not add value.

Workplace Organization

“5S’s”

- **Sort**; Divide items into three piles: necessary, belong to another process, and unknown.
- **Straighten**; Arrange remaining items to reduce or eliminate motion.
- **Shine**; Practice good housekeeping.
- **Standardize**; Document the process.
- **Sustain**; Maintain by charts, checklists, and audits.
- ***Sometimes Safety***

Concept of Flow

- Continuous with a minimum of variation.
- Forces employees to concentrate on the process.
- Equipment needs to be flexible & make changeovers quickly.
- Cell technology is applicable.

Concept of Flow

This utopian situation requires one-piece flow. It

- *Reduces time between order and delivery,*
- *Prevents wait time and delays,*
- *Reduces labor & space to store and move materials,*
- *Reveals any defects & problems early in the process,*
- *Reduces damage,*
- *Provides production flexibility,*
- *Reveals non-value activity.*

Inventory Control

- JIT; Right material arrives at the right time in the right amount.
- Items are pulled through the system to the internal or external customer.
- *Kanban* is used as a signal to replenish items.
- *Takti* (beat) time, which is the rate of production based on customer demand.
- IT system controls the entire logistics from raw materials to consumer purchase.

Visual Management

- A picture is worth a thousand words.
- Visual displays are used to inform people about customers, projects, performance, goals, etc.
- Signals are used to alert people about problems.

Kaizen

- Management encourages the continual activity of small process improvements by operators.
- Kaizen Blitz is a highly focused action-oriented 3-5 day improvement workshop by a multifunction team to improve a specific process.

Value Stream

- The specific flow of activities required to design, order, produce, and deliver a product or service to customer(s).
- May be more than one value stream in an organization.
- Ideally it will only include value-added activities.

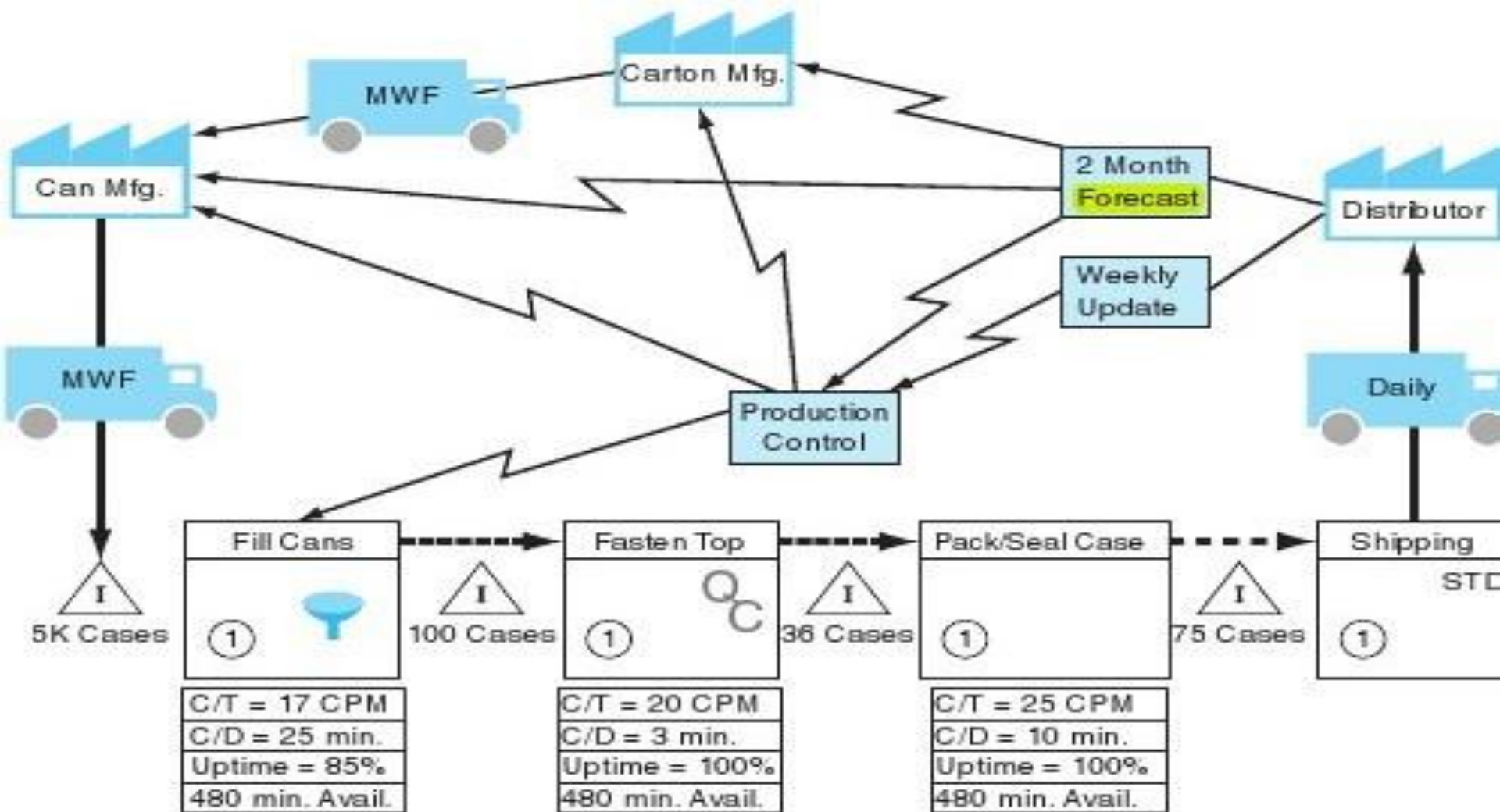
Value Stream

- All operations are:
 - Capable of meeting quality requirements.
 - Available with no downtime.
 - Efficient to eliminate unnecessary use of energy and materials.
 - Able to meet customer demand.

Value Stream Map

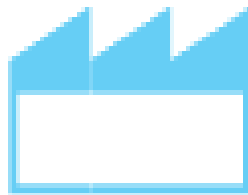
- VSM graphically describes the sequence and movement of the activities.
- First develop map of current state.
- Next develop map of ideal state with only value-added activities.
- Difference provides opportunities for improvement.

Value Stream Map





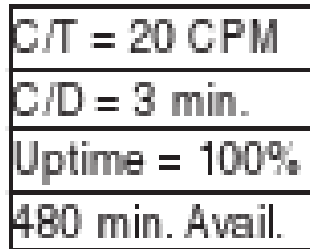
Process Box



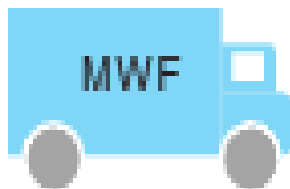
Organization



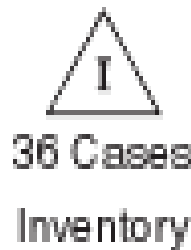
Information



Data Box



Shipping



Inventory



Push Mat'l Flow



Pull Mat'l Flow



Auto Mat'l Flow



Electronic Info.



Manual Info.



Quick Change



Constraint



No. of People



Standard

Implementing Lean

1. Establish cross-function team.
2. Train in lean fundamentals.
3. Construct VSM for current and ideal.
4. Analyze maps for best place to start.
5. Train people in lean and simple SPC tools.
6. Apply 5S and Kaizen.
7. Use Kaizen blitz where appropriate.
8. Expand to other areas.
9. Standardize the improvements.

Six Sigma

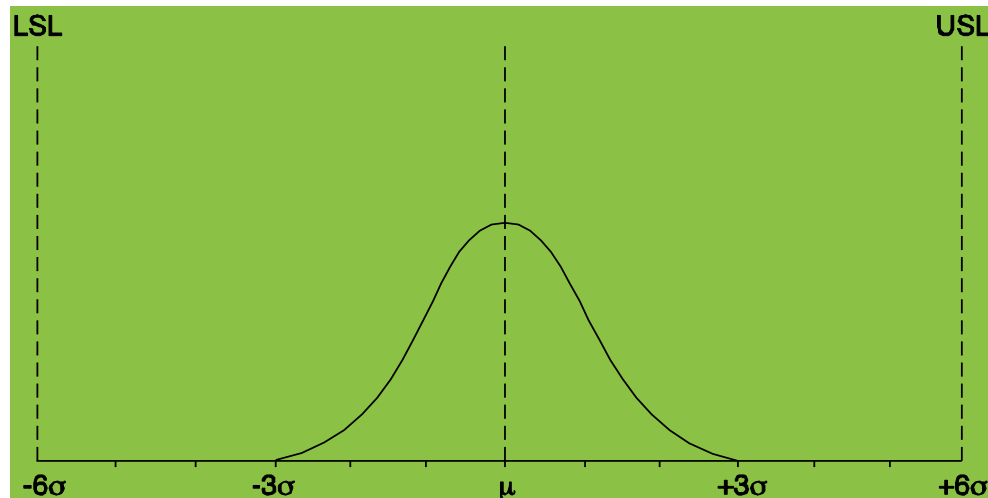
- 1980's at Motorola, which won the Baldrige National Quality Award in 1988
- Significant improvement in quality.
- Mid 1990's other companies obtained similar results.
- Six Sigma is both a quality management philosophy and a methodology that focuses on reducing variation, measuring defects, and improving quality of products, processes and services.

Statistical Aspects

- Sigma, σ , is the Greek symbol for population standard deviation, which is the best measure of variation.
- If we can reduce variation to the point that the specifications are at $\pm 6\sigma$, then 99.9999998% of the items are satisfactory.
- The nonconformance rate is .002 ppm.
- According to the philosophy processes shift $\pm 1.5\sigma$, which gives a conformance rate of 99.9996600% or a nonconformance rate of 3.4 ppm.

Centered Processes

SPECIFICATION LIMIT	PERCENT CONFORMANCE	NONCONFORMANCE RATE	PROCESS CAPABILITY
$\pm 1\sigma$	68.7	317,300	0.33
$\pm 2\sigma$	95.45	485,500	0.67
$\pm 3\sigma$	99.73	2,700	1.00
$\pm 4\sigma$	99.9937	63	1.33
$\pm 5\sigma$	99.999943	0.57	1.67
$\pm 6\sigma$	99.9999998	0.002	2.00



Off Centered Processes

SPECIFICATION LIMIT	PERCENT CONFORMANCE	NONCONFORMANCE RATE (PPM)	PROCESS CAPABILITY (C_{PK})
$\pm 1\sigma$	30.23	697,700	-0.167
$\pm 2\sigma$	69.13	308,700	0.167
$\pm 3\sigma$	93.32	66,810	0.500
$\pm 4\sigma$	99.3790	6,210	0.834
$\pm 5\sigma$	99.97670	2,330	1.167
$\pm 6\sigma$	99.9996600	3.4	1.500

