USMC Lean Six Sigma
Yellow Belt Training
Course Agenda

- Introduction
- Lean Six Sigma Module
  - Define
  - Measure
  - Analyze
  - Improve
  - Control
- Wrap-Up
What Can Lean Six Sigma Do for Me?

**At the end of this course you will be able to:**

- Recognize areas for tremendous improvement in your workplace setting.
- Identify and begin to eliminate waste in your job.

**Job satisfaction**

- Flexibility: work/life
- Satisfactory salary
- Job security
- Work itself
- Career advancement
- Working conditions
Course Goals

At the end of this course you will be able to:

1. Advance the culture of Continuous Process Improvement (CPI).
2. Understand CPI tools.
3. Be an effective Team Member on CPI Events.
Learning Objectives

At the end of this lesson you will be able to:

- Understand the barriers against change
- Be familiar with the objectives, tasks and deliverables for each phase of the Define, Measure, Analyze, Improve and Control (DMAIC) framework.
- Understand how the DMAIC framework is used to address process improvements.
- Understand the basic principles of Lean Thinking.
- Be prepared to apply some of the most commonly used DMAIC tools as a team member on a Rapid Improvement Event (RIE) or project.
Journey to Effective Learning

“Fear makes the wolf bigger than he is.”
– German Proverb

✓ Function as a team. Everyone participates with equal voice.

✓ Ask Questions!!

✓ Relate concepts learned to your processes.

✓ Take notes. You are 7 times more likely to remember something when you write it down.

✓ Have fun!
Change Management

“It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change.” – Charles Darwin

Purpose of Change Management
Improve the effectiveness and efficiency of the organization through:
- Continuous Process Improvement (CPI)
- Continuous quest for excellence.

Change Principles
- Change is continuously occurring.
- A Process is required to manage change.
Change Management Barriers

What stops change?

- Empire building
- Excuses / scapegoats
- **Change resistance (Fear)**
- Culture of privacy (keeping quiet about problems)
- Politics and bureaucracy
- **Authoritarian, autocratic management**
- Little to no employee empowerment

Change within organizations can not be successful if the culture does not embrace the changes.
Success Factors for Change

Building a Culture of Change with a systematic approach to:

- **Change Management**: starts with the culture of the organization, not a stand alone project.

- **Communication**: what is being worked, and who is responsible for it.

- **Metrics**: ensure that everyone knows what performance measures matter and if progress is being made.

- **Accountability**: ensures that the right actions are rewarded and the wrong actions (or inaction) are identified and corrected.

Organizations need a process to manage change. Lean Six Sigma is the vehicle for change management!
For successful organizational change, attention should be given to both:

**Process Side**
- Activities to move from current to future state
  - Develop plans
  - Process or system changes
  - Infrastructure changes, etc.

**Human Side**
- Assist employees to understand and adapt
  - Alleviate staff resistance
  - Secure buy-in

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**Change Management**

**Continuous Process Improvement (CPI)**

**Lean**
- Lean Principles
  - Value
  - Value Stream
  - Flow
  - Pull
  - Perfection

**Lean Six Sigma (LSS)**
- Six Sigma Methodology
  - Define
  - Measure
  - Analyze
  - Improve
  - Control
Change in Focus

“It is not necessary to change. Survival is not mandatory.” - Edward Deming

Before CPI
- Non-Value Added: 96%
- Value Added: 4%

After CPI
- Non-Value Added: 84%
- Value Added: 16%
What is Lean?

Tools and Methodology to:

WAR ON WASTE!

Eliminate Waste

Improve Flow

By using:

Just-in-Time

Pull/Kanban

Batch Reduction

Standard Work

Value Stream Mapping

Lean Toolbox

Set Up Reduction

Visual Controls

6S

Poka-Yoke

Cellular Flow

Yellow Belt Training 15
What is Six Sigma?

Tools and Methodology to:

Eliminate Defects
Reduce Variation

By using:

- Measurement Systems Analysis
- DMAIC
- Pareto Charts
- Statistical Process Control
- Value Stream Mapping
- Analysis of Variance
- Control Charts
- Histograms
- Voice of the Customer
- Cause and Effect Diagrams
Lean Six Sigma Defined

**Lean**
- Eliminate Waste
- Improve Flow

**Six Sigma**
- Reduce Variation
- Eliminate Defects

**Lean Six Sigma**
Together providing the customer with the best possible Value in Quality, Cost and Time
History of Lean and Six Sigma

• **Henry Ford**: Continuous Improvement; reduce waste; improve flow; and improve value.

• **Toyota Production System (TPS)**: Developed Lean by focusing on People, Quality, and Efficiency; Mistake proofing, reduced set-ups.

• **Mikel Harry**: Took Six Sigma from Motorola to Allied Signal and GE.

• **Jack Welch**: Utilized Six Sigma to eliminate variation from lean business operations to drive gains in productivity and financial performance for GE.

• **Maytag**: Lean & Six Sigma integrated. Quality so good, the repairman has nothing to do.
DMAIC Improvement Process Road Map

**Activities**
- Review Project Charter
- Validate Problem Statement and Goals
- Validate Voice of the Customer and Voice of the Business
- Validate Financial Benefits
- Validate High-Level Value Stream Map and Scope
- Create Communication Plan
- Select and Launch Team
- Develop Project Schedule
- Complete Define Gate
- Identify Potential Root Causes
- Reduce List of Potential Root Causes
- Confirm Root Cause to Output Relationship
- Estimate Impact of Root Causes on Key Outputs
- Prioritize Root Causes
- Complete Analyze Gate
- Develop Potential Solutions
- Evaluate, Select, and Optimize Best Solutions
- Develop ‘To-Be’ Value Stream Map(s)
- Develop and Implement Pilot Solution
- Confirm Attainment of Project Goals
- Develop Full Scale Implementation Plan
- Complete Improve Gate
- Implement Mistake Proofing
- Develop SOP’s, Training Plan and Process Controls
- Implement Solution and Ongoing Process Measurements
- Identify Project Replication Opportunities
- Complete Control Gate
- Transition Project to Process Owner

**Tools**
- Project Charter
- Voice of the Customer and Kano Analysis
- SIPOC Map
- Project Valuation / ROIC Analysis Tools
- RACI and Quad Charts
- Stakeholder Analysis
- Communication Plan
- Effective Meeting Tools
- Inquiry and Advocacy Skills
- Time Lines, Milestones, and Gantt Charting
- Pareto Analysis
- Belbin Analysis
- Value Stream Mapping
- Value of Speed (Process Cycle Efficiency / Little’s Law)
- Operational Definitions
- Data Collection Plan
- Statistical Sampling
- Measurement System Analysis (MSA)
- Gage R&R
- Kappa Studies
- Control Charts
- Histograms
- Normality Test
- Process Capability Analysis
- Process Constraint ID and Takt Time Analysis
- Cause and Effect Analysis
- FMEA
- Hypothesis Tests/Conf. Intervals
- Simple and Multiple Regression
- ANOVA
- Components of Variation
- Conquering Product and Process Complexity
- Queuing Theory
- RIE/Kaizen, 5S, Value Analysis, Generic Pull Systems, Four Step Rapid Setup Method
- Mistake-Proofing/Zero Defects
- Standard Operating Procedures (SOP’s)
- Process Control Plans
- Visual Process Control Tools
- Statistical Process Controls (SPC)
- Solution Replication
- Project Transition Model
- Team Feedback Session

Identify and Implement Quick Improvements

Yellow Belt Training
Most U.S. companies operate @ 3-4 Sigma

97.7% performance (or up to 25% total revenue in defects).

### Difference Between 3 and 6 Sigma

<table>
<thead>
<tr>
<th>THREE SIGMA</th>
<th>SIX SIGMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 40,500 newborn babies dropped in hospitals each year.</td>
<td>Three newborn babies dropped in hospitals in 100 years.</td>
</tr>
<tr>
<td>Unsafe drinking water about two hours each month.</td>
<td>Unsafe drinking water one second every six years.</td>
</tr>
<tr>
<td>Nearly 1,350 incorrect surgical operations per week.</td>
<td>One incorrect surgical operation in 20 years.</td>
</tr>
<tr>
<td>Five short or long landings at O'Hare each day.</td>
<td>One short or long landing in 10 years in all the airports in the United States.</td>
</tr>
<tr>
<td><strong>2.3 Defects per <strong>hundred</strong> opportunities.</strong></td>
<td><strong>3.4 Defects per <strong>million</strong> opportunities.</strong></td>
</tr>
</tbody>
</table>
“There are four purposes for continuous process improvement: easier, better, faster, cheaper – and they appear in that order of priority.” – Shigeo Shingo

1. **Easier** – Reduce frustrations for employees, work smarter; not harder.
2. **Better** – Make a process more efficient/effective, improve quality.
3. **Faster** – Reduce lead time to fulfill customer demand.
4. **Cheaper** – Reduce cost to customer.
Project Management Constraints

Triple Constraints of Projects

➢ Quality (Better)
  ✓ Clear and Specific

➢ Time (Faster)
  ✓ Amount of time to complete process tasks

➢ Cost (Cheaper)
  ✓ Money and Effort

➢ Prioritizing Constraints
  ✓ Should be based on the view of the customer.
Critical Elements for CPI Implementation

- Leadership commitment.
- Improvement events aligned with the organizational strategy, objectives and customer requirements.
- Be Open-Minded
  - Program training & support.
  - Sharing information and knowledge.
  - Learn by doing, with use comes comfort.
Team Member Responsibilities

As a Yellow Belt you’re expected to:

✓ Act as an change agent for the organization you’re a member of and not yourself.

✓ Participate in CPI events.

✓ Become familiar with the basic CPI and Lean Six Sigma tools.

✓ Assist in project reviews.

✓ Function in teams between 2 and 8 members
MCINCR-MCBQ Command Level Infrastructure

- **Leaders**
  - Owns vision, direction, integration, business results.
  - **Leads change, provide strategic direction.**
  - **Coordinates implementation of CPI efforts.**
  - Communicates standards and guidelines.
  - Develops supporting implementation plans.
  - Coordinate / oversee Toll Gate Review Meetings, go/no go.
  - Provide support & help remove barriers to success.
  - Implement improvement solutions & sustain results.
  - 1 Day of Training.

- **Black Belts (BB)**
  - **Lead Complex projects.**
  - “Go To” subject matter experts.
  - Transition results ownership and improvement solution to Sponsor.
  - Mentors lower level belts.
  - 5 Weeks of Training.

- **Master Black Belts (MBB)**
  - Focus on Rapid Improvement Events.
  - May participate on Black Belt teams.
  - Close to business process.
  - May assist Project Sponsor in implementing improvement solution.
  - 1 Week of Training.

- **Green Belts**
  - Team members who assist in executing projects/RIEs
  - Collect data.
  - Sustain results.
  - Leverage/replicate opportunities.
  - 1 day of Training.

- **Yellow Belts**
  - Owns vision, direction, integration, business results.
  - Leads change, provide strategic direction.
  - Coordinates implementation of CPI efforts.
  - Communicates standards and guidelines.
  - Develops supporting implementation plans.
  - Coordinate / oversee Toll Gate Review Meetings, go/no go.
  - Provide support & help remove barriers to success.
  - Implement improvement solutions & sustain results.
  - 1 Day of Training.
Where Can I Use Lean Six Sigma?

- Administration
- Information Systems
- Equipment Maintenance
- Services
- Logistics
- Food and Drug

Customers are experiencing any:
- Defects
- Mistakes/errors
- Delays
- Slowness of service
Lean Six Sigma Delivers Results

MCINCR-MCBQ G-7 Support Agreements

Agreement Managers

Before Lean Six Sigma

10

Finalized

Agreements/Year

With Lean Six Sigma

37

Finalized
Lean Six Sigma Delivers Results

MCINCR-MCBQ G-7 Support Agreements

50% staff

AND

270% Productivity

HOW?

- Enabled us to work through a difficult process
- Created systematic way for us to achieve our objectives.
- End result: Doing more with less people, allowed us to hire an additional person for our CPI section!
Define Phase
Define Phase

Objectives:

- Identify what adds value to the process from both the business and customer perspective.
- Develop the business processes, define the critical customer requirements.

Activities:

- Create a project charter.
- Assemble a project team.
- Develop high-level process map.
- Communication Plan.
- Leadership approval (Review).
## Types of Improvement Opportunities

<table>
<thead>
<tr>
<th>Name</th>
<th>Duration</th>
<th>Scope of Change</th>
<th>Size of Team</th>
<th>Time to Implement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Just Do It</strong></td>
<td>1 – 2 Days</td>
<td>Solution ready to implement – problem well defined</td>
<td>Project Sponsor</td>
<td>Immediate</td>
</tr>
<tr>
<td><strong>Kaizen / Rapid Improvement Event (RIE)</strong></td>
<td>3 – 5 Days</td>
<td>Short term, high intensity effort to address a specific problem</td>
<td>4 – 12 (Full-Time During Event)</td>
<td>Immediate to Short Term</td>
</tr>
<tr>
<td><strong>Project</strong></td>
<td>3 – 6 Months</td>
<td>Complex problem, no apparent root cause</td>
<td>3 – 15 (Part-Time)</td>
<td>Mid to Long Term</td>
</tr>
</tbody>
</table>
Voice of the Customer (VOC)

VOC is obtained as part of the Define and Measure phase.

You must:
- Identify all customers.
- Prioritize customers.
- Gather the Voice of the Customer.
- Translate customer wants into critical customer requirements and prioritize them.

Capturing Voice of Customer is one of the critical elements of the methodology – understanding what requirements must be satisfied

**Your Customer defines your success!**
Translating VOC into Customer Requirements

Customer requirements must:

- Relate directly to the process of producing a service or product.
- Be measurable and specific.
- Cannot be vague and incomplete.
- Not be biased toward a particular solution or approach.

Example:

- Customer comment:
  - “We are unable to depend on delivery time when we need to get our parts”

- Customers Key Issue:
  - There is too much variation in delivery days, and the delivery must fit within a specific window of time.

- Customer requirement:
  - Delivery products no earlier than three days and no greater than five days from the date of the confirmed order.
A process snapshot that captures information to a project.

SIPOC stands for:

- Suppliers
- Inputs
- Process
- Outputs
- Customers
SIPOC Example: Streamlining a Travel Request

**Suppliers**
- Traveler
- Unit Rep
- HQMC
- TECOM

**Inputs**
- Destination
- Transportation Mode(s)
- Job Order Number
- Travel Dates

**Process**
- See Below

**Outputs**
- Travel Orders
- Advances
- E-Tickets
- Emails
- Itinerary
- Claim Forms

**Customers**
- Traveler
- DTS
- TECOM
- Business Office

### Steps

**Step 1:** Generate Request

**Step 2:** Transport Request

**Step 3:** Create Orders

**Step 4:** Execute Travel

**Step 5:** File Claim
The team’s commencement document.

Defines the team’s project plan and mission.

Covers 3 critical elements:
• Problem / Opportunity Statements
• Goal Statements
• Scope Statements

Living documents that are subject to change.
Goal Statements should follow the SMART criteria:

- Specific
- Measurable
- Achievable
- Realistic
- Time bound

Scope Statements should provide awareness of specific boundaries of your improvement opportunity.
The material ordering process for Marine Corps Base Quantico takes in excess of 30 days. The problem has existed for the past year. 85% of the orders require rework due to wrong parts. This has resulted in the postponement of 60 projects in the last 6 months.

Example of a better opportunity or problem statement.

- WHAT: The material ordering process for Marine Corps Base Quantico takes in excess of 30 days. The problem has existed for the past year.
- WHERE: 85% of the orders require rework due to wrong parts.
- WHEN: This has resulted in the postponement of 60 projects in the last 6 months.
- EXTENT: 85% of the orders require rework due to wrong parts.
- IMPACT: This has resulted in the postponement of 60 projects in the last 6 months.
Effective Communications

Must have the following characteristics:

- Simple and understood by all.
- A consistent formal process.
- Contain current information.
- Have a feedback loop built into the process.

Will help:

- Build and maintain trust.
- Prevent rumors.
- Manage expectations.
Measure Phase

CONTINUOUS PROCESS IMPROVEMENT

DEFINE
MEASURE
CONTROL
ANALYZE
IMPROVE
Measure Phase

Objectives:
- Identify critical measurements.
- Understand the data calculations.

Activities:
- Map process and identify inputs and Outputs.
- Establish Measurement plan.
- Collect baseline performance data.
- Validate measurement system.
- Leadership approval (Review).
Understanding Variation

- **Common Cause Variation** (inherent) is always present in a process.
  - A process that exhibits only common cause variation is a **stable** process.
  - A stable process is **predictable**.

- **Special Cause Variation** (assignable) is some unusual, uncommon event.
  - A process that exhibits special cause variation is an **unstable** process.
  - An unstable process is **unpredictable**.
Data Types

Data (Da’ tä, Dä’tä) pl n. (singular or plural in number) – Information, usually organized for analysis.

Variable Data

- Data that could be measured on an infinitely divisible scale or continuum. There are no gaps between possible values.

- Examples:
  - Tire pressure (lbs/sq.in.)
  - Cycle Time (minutes)
  - Speed (mph)
  - Length (inches)
  - Response time (milliseconds)

Attribute Data

- Discrete data measures attributes, qualitative conditions, and counts. There are gaps between possible values.

- Examples:
  - # defects per unit
  - PO’s placed per day
  - Number of calls on hold per hour
  - Shoe Size
  - Number of employees
Data Types Quiz

Beside the following examples, determine if: "Variable" (continuous) or "Attribute" (discrete).

- Average Labor Hours
- Data input accuracy
- Responsible organization
- Hole diameter using a "go/no-go" gage
- Hole diameter
- Order turnaround time
- Weight of refrigeration charge (grams)
- Cycle Time
- Certification Defects
Measurement Properties

Accuracy
without
Precision

Precision
without
Accuracy

Accuracy
and
Precision
Data Collection Plan

Key questions to consider:

- **Why** are we measuring?
- **What** are we measuring?
- **How** will we gather the data?
- **Where** will gather the data?
- **When** / how often will the data be gathered?
- **Who** needs to see the data?

|----------------|----------------------|-------------------------------|----------------------|---------------|-------------------------|

*Yellow Belt Training*
Gemba means “real place” or “go see”.

The work place is where value is created.

Management has a responsibility to “get the facts” from the work space.

The Five Actuals

1. Go to the actual workplace.
2. Engage the people who do the actual work.
3. Observe the actual process.
4. Collect the actual data.
5. Understand the actual value stream.

Direct Observation Leads to Better Understanding.
Process Maps

- Used for visualizing a system or process (sequence of events, tasks, activities, steps).
  - Can be used to identify opportunities for improvement such as streamlining or combining operations.
- Drawn with standard symbols representing different types of activities or operations.
- Several Types: Linear, Top-Down, Swim Lane, Value Stream
Standard Process Map Symbols:

- **Process Step**
- **Decision Point**
- **Wait (Inventory)**
- **Start/Stop Redirect**
- **Call Out**

Process Maps
How to Build a Process Map

- Walk the Gemba (workplace/process), noting process steps, decision points and inventory (wait points).
- Keep track of forms/documents used, and obvious improvement areas with project bursts or call outs.
- Use Post-it® to allow for steps to be moved easily.
Technology Acquisition Process

1. Document need for acquisition
2. Approve requirements project
3. Research and document requirements
4. Review requirements
5. Approve project

Legend
- **Status**
  - Completed
  - In Progress
  - Not Started
  - Waiting on Input

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Spaghetti Diagram

- Used to depict where there is wasted product, travel, people movement, queues, etc.

- Graphically describes:
  - physical area layout,
  - flow of product through a series of process steps,
  - The path person walks to complete their process.
Analyze Phase
Objectives:
- Data Analysis
- Determine Root Cause

Activities:
- Identify and validate Root Causes.
- Determine impact of root causes to process output.
- Prioritize root causes.
- Leadership approval (Review).
Examples of Data Tools

Control/Run/Trend Chart: Shows change over time.

Frequency Plot/Histogram: Shows distribution of variation and range.

Pareto Chart: Helps focus on key problems.
Pareto Charts

Used to prioritize problems to be solved

The “80/20” Rule:

Illustrates the concept that, for any given distribution of the results:

The majority of the distribution (80%) is determined by

a small part (20%) of the potential contributors or causes.

---

80% Problems

20% Marines

80% Revenue

20% Customers

Yellow Belt Training
Pareto Charts - Example

Errors by Department

Count
Type
Custom Design
Prototyping
Systems Engineering
Standard Design
PMO
Other

Count
150
42
15
9
4
3

Percent
67.3
18.8
6.7
4.0
1.8
1.3

Cum %
67.3
86.1
92.8
96.9
98.7
100.0

Cumulative % line
% against this axis
Categories
 Root cause analysis is where the real cause of the problem is uncovered.
 A root cause is one that, if corrected would prevent a recurrence of the problem.
 A technique used is asking “Why” 5 times

“It's not that I'm so smart, it's just that I stay with problems longer. – Albert Einstein
Problem: Lincoln memorial deteriorating at a high rate.

1. **Why?** We wash this memorial more than the others.
2. **Why?** Bird droppings make it unsanitary for tourists.
3. **Why?** Birds eat the Spiders that gather in masse.
4. **Why?** Spiders gather to eat the flying midges that swarm.
5. **Why?** Midges swarm around the bright, warm lights that are turned on at dusk.

**Answer:** Delay turning on the lights for one hour
Fishbone/Ishikawa Diagram

- Breaks problems down into bite-sized pieces.
- Displays many possible causes in a graphic manner.
- Shows how causes interact.

**Suggested Causes:**
- Man
- Method
- Machine
- Material
- Measurement
- Mother Nature

[Diagram of a Fishbone Diagram showing various causes and effects related to missed free-throws in basketball.]
Six Sigma is focused on the **reduction of variation** using process improvement tools, with the ultimate idea of removing defects (i.e. rework, waste).
Population - a complete set; all items of interest
Sample - a subset of elements from the population
We can characterize a population or sample in 3 ways:

1. Measure of central tendency (location of center or middle).
2. Measure of variation (spread or width).
3. Measure of distribution (shape).
Data Characteristics

- **Central Tendency (location)** – defines center or middle of data.
  - Examples: Mean, Median and Mode

- **Variation** – defines the width of the data.
  - Examples: Range, Variance, Standard Deviation

- **Distribution** – defines the shape of the data
  - Examples: Histogram, Stem & Leaf plots, Boxplots
Process Capability

A measure of how close a process is running to its specification limits.

Process Capability Values

• Process Capability < 1 indicates a process that is unable to meet specifications.
• Process Capability = 1 indicates a process that is able to meet specifications, but has no room for variation.
• Process Capability > 1 indicates a process that is able to meet specifications, and can allow for additional variation.
Control Charts

- Run Charts with additional information.
  - Centerline (mean)
  - Control Limits

- Data types determines control chart.

- Used to analyze variation in a process.
  - Attribute (count) based
  - Variable (measurement) based

- Used to determine if variation common cause or special cause.
In Control & Out of Control Conditions

- In control processes demonstrate common cause variation.

- Out of control demonstrate special cause variation conditions including:
  - Extreme Points, Trends & Shifts, Oscillation.
Improve Phase
Improve Phase

Objectives:
- Identify Potential solutions.
- Map out “TO BE” process.
- Develop an implementation Plan.
- Pilot solution.

Activities:
- Brainstorm potential solutions.
- Evaluate and select best solution.
- Identify solution impacts.
- Produce “TO BE” process maps and present implementation plan.
- Communicate solutions to all stakeholders.
- Leadership approval (Review).
Lean Overview

- Lean Principles
- Types of waste within processes.
  - TIMWOOD and U
- Basic lean methods of process improvement.
  - Value Stream Mapping
  - Little’s law
  - Mistake proofing
  - 5S + 1
  - Visual controls
  - Standard Work
  - TAKT Time
“Becoming ‘lean’ is a process of eliminating waste with a goal of creating value.”

- **Value** specified from the customer’s perspective.
- The **Value Stream** has been identified for each service.
- The product / service **Flows** without interruptions.
- The customer can **Pull** value through the process.
- Continuous pursuit of **Perfection**.
Lean Principles – Value

➢ Critical starting point for Lean.

➢ Can only ultimately be defined by the customer.
  – NO two customers define Value identically.

➢ Critical questions we must ask ourselves.
  • Do we truly understand Value from our customer’s perspective?
  • Are we truly focused on providing that Value?
  • What are the barriers & obstacles preventing us from focusing on and providing that Value?
Value Added

The customer wants it (and is willing to pay for it) AND, it changes form, fit, or function of a product or service AND, it is done right the first time.

Business Value

No value is created but customer is willing to pay for it.
Required by Law / Statute / Unchangeable Policy.

Non-Value Added - Waste

Consumes resources but creates no value in the eyes of the customer.
If you can’t get rid of the activity, reduce it.
Definitions of Waste (Muda)

Anything that adds cost or time and does not add value to the customer.

Or

Anything other than the minimum amount of:

- Equipment,
- Materials,
- Parts,
- Space
- Worker’s time

Is considered wasteful activities!!
Identify and Eliminate these Wastes:

Types of Waste:
- T: Transportation
- I: Inventory (Excess)
- M: Motion
- W: Waiting
- O: Over-Production
- D: Over-Processing
- &: Defects
- U: Under Utilization of people
Transportation

Waste caused by **unnecessary** movement of material or product.

Primary Causes:
- Inefficient Facility Layout
- Multiple Storage Locations
- Batch (Push) Mentality
- Complex material handling systems
Inventory (Excess)

Waste of materials, parts and assembled goods, when purchased or produced **in advance** of customer requirements.

**Increases Cycle Time & Process Lead Time**
8 Wastes – Inventory (Excess)

Inventory Hides Problems!

Ship = Production System
Water Level = Inventory Level

Over Production
Wait Time
Defects
Caused by **non-value added movement** of workers and/or production machines.

Primary Causes:

- Inefficient workplace layouts.
- Inefficient tools and / or fixtures.
- Lack of Standard Work causing inconsistency.
- Batch movement of product.
Waiting & Over Production

**WAITING**

Occurs whenever the hands of an employee are idle.

![Actual footage of me waiting for Internet Explorer to come online](image)

**OVER PRODUCTION**

Caused by producing more than the customer needs (Push) and leads to **excessive inventories**.
The Waste of **Unnecessary** or Non-Optimized Processes and/or Operations.

“There is nothing so useless as doing efficiently that which should not be done at all.”  

*Peter Drucker*
Defects / Rework

Occurs when a process, product, or data \textit{does not conform} to proper specifications.

- Product rework
- Scrap
- Escape of a defect to the customer.

What Causes Defects?

- Poor procedures or standards.
- Non-conforming materials.
- Worn or out of tolerance tooling.
- Human mistakes.
ULTIMATE WASTE

Waste of a person’s time
<table>
<thead>
<tr>
<th>Type of Waste</th>
<th>Physical Process</th>
<th>Example</th>
<th>Ways to Eliminate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transporting</td>
<td>Parts Moving to Warehouse and Back</td>
<td>Movement of Goods</td>
<td>Make the distance over which something is moved as short as possible</td>
</tr>
<tr>
<td>Inventory (Excess)</td>
<td>Excessive completed work or supplies</td>
<td>Supplies in a Warehouse that aren’t being used, taking up space</td>
<td>Produce or maintain only enough to satisfy the work requirements of the customer</td>
</tr>
<tr>
<td>Motion</td>
<td>Retrieving Parts, Tools, Information</td>
<td>Poor Office Lay-Out</td>
<td>Arrange your files, parts, or tools so you can easily retrieve them</td>
</tr>
<tr>
<td>Waiting</td>
<td>Out of supplies, Lack of Information</td>
<td>Meetings, Approval, System Down Time</td>
<td>Prepare agendas, standardize required signature approval process, make a plan for outages</td>
</tr>
<tr>
<td>Over-Processing</td>
<td>Performing Unneeded Operations</td>
<td>Approvals (Too Many Sign-offs)</td>
<td>Eliminate signature requirements where possible</td>
</tr>
<tr>
<td>Over-Production</td>
<td>Working Ahead of Schedule</td>
<td>Printing Paper Too Soon</td>
<td>Establish a workflow sequence for the production</td>
</tr>
<tr>
<td>Defects</td>
<td>Scrap or Rework</td>
<td>Drawing or Planning Errors, Rework</td>
<td>Establish standardized work procedures</td>
</tr>
<tr>
<td>Under utilization of employees</td>
<td>More people involved than required to perform physical or transactional tasks.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In addition to a lack of productivity, there are other side effects that need to be considered. A wasteful environment can take a heavy toll on employees.

### Toxic Effects of Waste on Employees
- Physical Fatigue
- Emotional Fatigue
- Increased Frustration
- Overworked
- Over-Stressed
- Decreased Level of self-worth.

When waste is identified in high volumes, it reduces the actual production of work.
Lean Principles – Value Stream

- Value specified from the customer’s perspective.
- The **Value Stream** has been identified for each service.
- The product / service **Flows** without interruptions.
- The customer can **Pull** value through the process.
- Continuous pursuit of **Perfection**.
Value Stream Analysis

- A “VISUAL” planning tool used to identify non-value added activity (NVA) and develop plans to eliminate the waste.
- Value Stream Analysis is the key to all improvement activities.
- Includes the entire set of activities running from requirement to finished product for a specific product or service.
- Seeks to optimize the whole from the standpoint of the final customer.

![Image showing the effect of visual information on the brain processing speed]

- You receive 90% of the information VISUAL.
- Your Brain processes visual information 60,000x faster than text.
Value Stream Map (VSM)

Customer

P/T = 3 min
Volume = 200

Incoming Buffer

Process 1

Process Control

SUPPLIERS

Completed Work

TAT = 188 days
Customer call time = 24 min

SUPPLIERS

Shipping

P/T = 3 min

Data Box

3 min

Volume = 200

Data Box

6 min

Data Box

6 min

Data Box

2 min

Data Box

120 min

5 min

240 min

2 min

5-5 days

5 min

Yellow Belt Training
VSM for Process 1 (Process Flow Map)

AS-IS METRICS
- 23 PROCESS STEPS
- 35 Queues
- 8 NVA STEPS
- TAT = 43 DAYS
- TOTAL DISTANCE = 5242 Ft

TO-BE METRICS
- 15 PROCESS STEPS
- 23 Queues
- 0 NVA STEPS
- TAT= 12 DAYS
- TOTAL DISTANCE=1528 Ft
Value specified from the customer’s perspective.

The Value Stream has been identified for each service.

The product / service Flows without interruptions.

The customer can Pull value through the process.

Continuous pursuit of Perfection.
What is Flow?

The continuous, progressive adding of Value in the eyes of the customer.

- Starts at receipt of customer request.
- Ends at delivery to customer.
- Flow utilizes the fewest number of steps with no interruptions.
- Eliminates waste.

People always working on the product and the product always being worked on.
Batching is the production of large lots of identical items to meet **anticipated demand** based on scheduled production.

- Increases inventory and cycle times.
- Increases wait times

**Examples of Batching**

- Waiting for a table at a restaurant (Table for 4).
- Waiting at IPAC to get CAC.
- On the telephone when on hold.

- Batching may be required in some instances
  - Providing a product / service to a specific group / crowd.
  - Examples: In-class training, Base tours, Award presentations, Carpooling, etc.
Toyota Production System

- Taiichi Ohno / Shigeo Shingo create continuous flow in "small-lot" production.

- Ohno achieved small lot continuous flow by:
  - Aggressive root cause analysis.
  - Aligning equipment & resources to the Value Stream.
  - Single Minute Exchange of Die (SMED).
  - Cross Training.
  - Simple production control processes – Pull / Kanban.
  - Visual controls.
One Piece Flow

The Ideal State:
Produce and move one piece at a time.

One order enters system → Route to correct person → Order part → Route part to customer → File

Segregate excess WIP away from the improved process; develop a plan to eliminate it.
Typical Flow – Before Improvements

**Workplace Layout**

- Batch operations
- Isolated processes
- Unknown status
Typical Flow – After Improvements

- Single-piece flow
- Visual status
- Reduced travel

Workplace Layout

ORDER PART

REMOVE TEST INDUCT

INSTALL

SOLDER

INSPECT TEST INSPECT SIGN-OFF
Before Lean
Shotgun Email Method

Problems:
- Confusing
- Wasted Time
- Increased Costs

Combining two documents into one with Tracked Changes takes a **MINIMUM** of **15** steps to complete.

In this example, you are combining 4 documents which means you would need to complete the combine process 3 times:

- Document 1 + 2
- Document (1 & 2) + 3
- Document (1 & 2 & 3) + 4

**TOTAL MINIMUM STEPS:** **45**
Lean Flow In the Office

Benefits:
- Reduce Errors
- Improved flow, less confusion
- Decreased Costs

All changes are in ONE DOCUMENT with Tracked Changes. Processing this document now takes a **MINIMUM** of 5 steps to complete.

**Before:**
TOTAL MINIMUM STEPS: **45**

**After:**
TOTAL MINIMUM STEPS: **5**

Total Reduction: 89% reduction

After Lean
SharePoint Workflow
Point of Use Systems (POUS)

POUS is a practice that ensures that the right information, parts, tools, equipment & people are available where & when needed. Are your workers treated like doctors in an operating room?

What Does It Take to Execute Your Process?
POUS/Kitting Examples

- First Aid Kit
- Fastenal Machine
- Assembly Line
- Orthodontist Office
Lean Principles - Pull

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- Continuous pursuit of **Perfection**.

![Diagram of Lean Principles - Pull](image)
Push vs. Pull

Push:

Work is pushed into the system or process based on forecasts or schedules.

Pull:

A customer-driven system that produces and moves a product/service **ONLY** when the customer needs it.
Pull Systems

Let Customer’s Pull Value

• No one upstream produces a good or service until the downstream customer asks for it.

• Replaces “Ready or not here I come” with “OK, Now I’m ready”.

Requirements for Pull System

• Elements
  • Upstream Supplier  
  • Downstream Customer  
  • Visual Trigger (Kanban)

Sequenced - Use First In First Out (FIFO) lanes
Replenished - Create supermarkets
Types of Pull Signals (Kanbans)

Square on Floor

- Lights
  - Out of parts!!
  - Low on parts!
  - Have parts

Containers (Kits)

- Cards

<table>
<thead>
<tr>
<th>STOCKING LOCATION</th>
<th>PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>106-0</td>
<td>FABRICATION CELL - 106</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ITEM #</th>
<th>DESCRIPTION</th>
<th>TURBINE DISK</th>
</tr>
</thead>
<tbody>
<tr>
<td>40699</td>
<td>TURBINE DISK</td>
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</table>

<table>
<thead>
<tr>
<th>OPER.</th>
<th>DESC</th>
<th>ROUGH TURN</th>
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<tbody>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
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<td>30</td>
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<tr>
<td>50</td>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>BOX CAPACITY</th>
<th>BOX TYPE</th>
<th>ISSUED #</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>C-04</td>
<td>1 OF 4</td>
</tr>
</tbody>
</table>
Pull System Example

Reordering Office Coffee

Step One: Remove Empty Box
Step Two: Locate New Box
Step Three: Pull Kanban
Step Four: Replace Box
Step Five: Place Kanban in Reorder Pouch
Step Six: Replace Stock
Lean Principles – Perfection

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Pursue Perfection

- Begins with understanding Lean Principles & visualizing the “perfect” process at the outset.
- Look for ways to reduce or eliminate waste.
- Achieving the “Lot Size of 1”.
- Achieving Continuous Flow.
- Achieving a CPI Culture.
One Million – That’s how many ideas Toyota implements each year. Do the math: 3,000 ideas a day.

 Mostly tiny ones by employees that view their role not to be simply doing the work, but taking it to the next level...every day, in some little way.

When an entire organization thinks lean, it becomes unstoppable.