USMC Lean Six Sigma
Yellow Belt Training
Introductions & Expectations

• What is your name?
• Where do you work?
• What are your expectations from this training?
• Do you have experience with the CPI toolset?
• Starting / ending times
• Restrooms
• Refreshments
• Lunch / Breaks
• Class evaluations
• Parking Lot
• In case of fire muster at _________
• Terminology Sheet
Code of Conduct

- Everyone participates with equal voice.
- High level of participation needed for success.
- Single discussions (respect the speaker).
- *All* ideas welcome (what happens here stays here!)
- Respect our time together – return from breaks/lunch on time.
- Blackberries / Phones / electronics off or on vibrate.
- Handle outside business on breaks.
- Function as a team.
- **Have fun!**
Lean Six Sigma (LSS) is widely accepted as the most effective Continuous Process Improvement (CPI) method.

LSS is a proven problem solving methodology.

Performance & Innovation (P&I) has experienced CPI support staff.
Change in Focus

Transactional or Production Processes

**80's**
- Before CPI: Value Added 4%
  - Non-Value Added 96%
- Today: Value Added 16%
  - Non-Value Added 84%

**Today**
- After CPI: Value Added 16%
  - Non-Value Added 84%
Change Management

• Change Management Purpose - improve the effectiveness and efficiency of the organization.
  • Process Improvement Culture Development.
  • Continuous quest for excellence.

• Change Principles
  • Change is continuously occurring.
  • Process required to manage change.
  • Ongoing process - not a stand alone project.

“It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change.” – Charles Darwin
• For successful organizational change, attention, should be given to both:
  • The “process” side, and
  • The “human” side

• **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 adopt
    • Alleviate staff resistance
    • Meet training needs (GB)
    • Secure buy-in

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

Tools and Methodology to:

WAR ON WASTE!

By using:

Eliminate Waste

Improve Flow

Just-in-Time

Batch Reduction

Pull/Kanban

Standard Work

Value Stream Mapping

Set Up Reduction

Visual Controls

5S + 1

Poka-Yoke

Cellular Flow

Lean Toolbox
What is Six Sigma?

Tools and Methodology to:

WAR ON VARIATION!

Eliminate Defects

Reduce Variation

By using:

Measurement Systems Analysis

DMAIC

Pareto Charts

Statistical Process Control

Control Charts

Analysis of Variance

Histograms

Voice of the Customer

Cause and Effect Diagrams

Six Sigma Toolbox

Value Stream Mapping
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
Lean Six Sigma Delivers Results

• LSS/CPI enables organizations to remove waste (Muda) which improves mission capability. (Process Side)

• Helps organizations reduce variation (Mura) and eliminate defects through standardize work. This helps to provide consistency and reliability. Mura drives Muda. (Process Side)

• Reduces overburden (Muri) for staff. This helps to relieve stress, reduce mistakes, improve efficiency and quality of life. (Process and Human Side)
History of Lean and Six Sigma

- Henry Ford: Continuous Improvement; reduce waste; improve flow; and improve value.
- Kiichiro Toyoda and Taiichi Ohno: Low inventory, Pull system (Supermarkets).
- Toyota Production System (TPS): People, Quality, and Efficiency. TPS incorporated the most productive methods to create the highest value.
- Shigeo Shingo: Mistake proofing, reduced set-up.
- Mikel Harry: Took Six Sigma from Motorola to Allied Signal and General Electric.
- Maytag: Lean & Six Sigma integrated, developed LeanSigma.
- GE implemented LSS in the broad spectrum of business applications.

Yellow Belt Training
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
- Replenishment Pull/Kanban
- Stocking Strategy
- Process Flow Improvement
- Process Balancing
- Analytical Batch Sizing
- Total Productive Maintenance
- Design of Experiments (DOE)
- Solution Selection Matrix
- Piloting and Simulation

- 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
Why Use CPI?

“There are four purposes for continuous process improvement: easier, better, faster, cheaper – and they appear in that order of priority.” – Shigeo Shingo

• **Easier** – Reduce frustrations for employees, work smarter; not harder.
• **Better** – Make a process more efficient / effective, improve quality.
• **Faster** – Reduce lead time to fulfill customer demand.
• **Cheaper** – Reduce cost to customer.
Triple Constraints of Projects

- **Project Management Constraints**
  - 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.
• CPI Projects aligned to customers critical requirements.
• Personnel with the attitude for CPI are selected & trained.
• Program training & support.
• Sharing information and knowledge.
Course Agenda

• Introduction
• Lean Six Sigma Module
  • Define
  • Measure
  • Analyze
  • Improve
  • Control
• Wrap-Up
Course Goals

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

• Understand Continuous Process Improvement (CPI) tools.
• Be an effective Team Member on CPI Events
• Define the various roles and responsibilities of the Yellow Belt.
• Advance the culture of CPI.
• Participate part time as a CPI team member and help to sustain the improvement gains.
• As a Yellow Belt you’re expected to:
  • Act as an change agent for the organization you’re a member of and not yourself.
  • Ensure communication is maintained with the groups you represent.
  • Participate in CPI events.
  • Become familiar with the basic CPI tools, LEAN and Six Sigma.
  • 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)
Master Black Belts (MBB)
- Lead Complex projects.
  - “Go To” subject matter experts.
  - Transition results ownership and improvement solution to Sponsor.
  - Mentors lower level belts.
  - 5 Weeks of Training.

Green Belts
- 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.

Yellow Belts
- Team members who assist in executing projects/RIEs
  - Collect data.
  - Sustain results.
  - Leverage/replicate opportunities.
  - 1 day of Training.
Are there any comments or questions?
Yellow Belt Training
Lean Six Sigma Module
Learning Objectives

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

• Be familiar with the objectives, tasks and deliverables for each phase of the Define, Measure, Analyze, Improve and Control (DMAIC) framework.

• Understand the basic principles of Lean Thinking.

• Understand how the DMAIC framework is used to address process improvements.

• Be familiar with some of the most commonly used Lean Six Sigma tools.

• Be prepared to apply some of the most commonly used DMAIC tools as a team member on a project or RIE.
Lean Six Sigma Overview: DMAIC Methodology

**Define**
- Identify Opportunity
- Define as-Is Condition
- Identify Key Causes

**Measure**
- Propose & Implement Solutions

**Analyze**
- Sustain the Gain

**Improve**
- Validate & Replicate Changes

**Control**
- Maintain and continuously improve the process.
Six Sigma is focused on the reduction of variation using process improvement tools, with the ultimate idea of removing defects (i.e. rework, waste).

<table>
<thead>
<tr>
<th>Sigma Level</th>
<th>Defects per Million</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>3.4</td>
<td>99.99966%</td>
</tr>
<tr>
<td>5</td>
<td>230</td>
<td>99.977%</td>
</tr>
<tr>
<td>4</td>
<td>6,210</td>
<td>99.38%</td>
</tr>
<tr>
<td>3</td>
<td>66,800</td>
<td>93.32%</td>
</tr>
<tr>
<td>2</td>
<td>308,000</td>
<td>69.15%</td>
</tr>
<tr>
<td>1</td>
<td>690,000</td>
<td>30.85%</td>
</tr>
</tbody>
</table>
Most U.S. companies operate @ 3-4 Sigma
97.7% performance (or up to 25% total revenue in defects).

<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 hundred opportunities.</strong></td>
<td><strong>3.4 Defects per million opportunities.</strong></td>
</tr>
</tbody>
</table>
Define Phase
Define Phase

Objectives:
• Identify what adds value to the process from both the business and customer perspective (VOB, VOC).
• Develop the business processes, define the critical customer requirements.

Activities:
• Create a project charter.
• Assemble a project team.
• Develop high-level process map (SIPOC).
• Define project goals.
• Leadership approval (Review).
Define Phase Tools

- Tools
  - Project Charter
  - Supplier-Input-Process-Output-Customer (SIPOC)
  - Voice of the Customer (VOC)
  - Communication Plan
  - Framework and Timelines
## 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>Just Do It</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>Kaizen/Rapid Improvement Event (RIE)</td>
<td>3-5 Days</td>
<td>Short Term, High Intensity Effort to Address a Specific Problem</td>
<td>2-8 (Full-Time During Event)</td>
<td>Immediate to Short Term</td>
</tr>
<tr>
<td>Project</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>
• The team’s commencement document.
• Defines the team’s project plan and mission.
• The charter does not solve the problem.
• Charters are living documents that are subject to change.
• Charters cover 3 critical elements:
  • Problem / Opportunity Statements
  • Goal Statements
  • Scope Statements
Opportunity / Problem Statements

• Improvement opportunity / problem statements should provide the following information:
  • What, Where, When, Extent and Impact.

• 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.
Examples of Opportunity or Problem Statement

Example of a bad opportunity or problem statement.

It takes too long to process a material order form and wrong parts are ordered.

Example of a better opportunity or problem statement.

- **WHAT**: The material ordering process for Navy Base Southwest 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. This has resulted in the postponement of 60 projects in the last 6 months.
SIPOC

- SIPOC stands for Suppliers, Inputs, Process, Outputs and Customers.
- A process snapshot that captures information to a project.

**Suppliers**
- SUB
- NAVSEA
- TYCOMS
- OPNAV/CNO
- NUWC
- NRL
- JHU
- NSWC

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

**Process**
- See Below

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

**Customers**
- Fleet
- NAVSEA
- Shipyards
- NSWC
- TYCOMs
- Business Office

**Steps**

1. **Step 1:** Generate Request
2. **Step 2:** Transport Request
3. **Step 3:** Create Orders
4. **Step 4:** Execute Travel
5. **Step 5:** File Claim
Voice of the Customer (VOC)

- CPI projects obtain VOC 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!**
- VOC must be gathered, translated and prioritized.
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.
Effective Communications

• **Must have the following characteristics:**
  • A consistent formal process.
  • Simple and understood by all.
  • Contain current information.
  • Have a feedback loop built into the process.

• **Will help:**
  • Build and maintain trust.
  • Prevent rumors.
  • Enlist and enroll the participation of employees in the pursuit of achieving objectives.

• **Manage expectations**
Measure Phase

CONTINUOUS PROCESS IMPROVEMENT

DEFINE - MEASURE - ANALYZE - CONTROL - IMPROVE

Measure Phase

CONTINUOUS PROCESS IMPROVEMENT

DEFINE - MEASURE - ANALYZE - CONTROL - IMPROVE
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).
Measure Phase Tools

• Tools
  • Data collection plan
  • Walk the Gemba
  • Process Maps
  • Spaghetti Diagrams
• **Common cause** (inherent) **variation** 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** (assignable) **variation** 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
Beside the following examples, write either “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:
  • What are we measuring?
  • How will we gather the data?
  • Who will gather the data?
  • When / how often will the data be gathered?
  • Who needs to see the data?
  • What is the desired or required level of performance?

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

Yellow Belt Training
Walk The Gemba

- 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
Process Maps

Standard Process Map Symbols:

- Process Step
- Decision Point
- Wait (Inventory)
- Start/Stop
- Redirect
- Project Burst

Yellow Belt Training
Process Map Example

Customer
1. START: Submit application

Passport Agent
2. Receive application
3. Check for completeness using checklist
4. Are all supporting documents attached?
   - Yes: Take photo
   - No: Return to customer with instructions on how to complete
5. Complete DD1056
6. Add entry in log book
7. Prepare package for courier pick-up

Courier
8. Pick-up package
9. Sign log book
10. END: Deliver to State Dept/HQMC
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.
• Use Post-it® to allow for steps to be moved easily.
Spaghetti Diagrams

• Graphically describes the production layout, standard in-process inventory, and other factors in standard operations.

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

• Shows the physical area layout, flow of product through a series of process steps, or maps where a 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).
Analyze Phase Tools

- **Tools**
  - Pareto Charts
  - Cause and Effect Analysis
  - FMEA (Failure Mode Effects Analysis)
  - Statistics
  - Process Capability
• 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.
Fishbone 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
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.
Example 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

• Similar to histograms.
  • Aligns categories in descending order.

• The “80/20” Rule:
  • Pareto charts illustrate 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.
Pareto Charts - Example

Errors by Department

- Custom Design: Count = 150, Percent = 67.3, Cum % = 67.3
- Prototyping: Count = 42, Percent = 18.8, Cum % = 86.1
- Systems Engineering: Count = 15, Percent = 6.7, Cum % = 92.8
- Standard Design: Count = 9, Percent = 4.0, Cum % = 96.9
- PMO: Count = 4, Percent = 1.8, Cum % = 98.7
- Other: Count = 3, Percent = 1.3, Cum % = 100.0

Cumulative % line
% against this axis
Categories

Pareto Charts - Example
Statistical Terminology

- **Population** - a complete set; all items of interest
  - The number of elements in a population is denoted by $N$.

- **Sample** - a subset of elements from the population
  - The number of elements in the sample is denoted by $n$.

- We can characterize a population or sample in 3 ways:
  - Measure of central tendency (location of center or middle).
  - Measure of variation (spread or width).
  - Measure of distribution (what does the set look like when viewed graphically (shape)).
Data Characteristics

- **Central Tendency (location)** – defines the location or 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, and a visual that can be more descriptive than just numbers.
  - 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

• Control charts are very similar to Run Charts, but have additional information.
  • Centerline (mean)
  • Control Limits

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

• Used to determine if variation is inherent to the system (common cause) or caused by an assignable event (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
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).
Improve Phase Tools

• Tools
  • Lean
    • 5S
    • Waste elimination (TIMWOOD & U)
  • Improve workplace layout
  • Standardized Work practices
  • Remove non-value added work
• Reduce Variation (Mistake Proofing)
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
  • Right Sizing
  • 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**.
• 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?

\[
Value = \frac{Features \times Performance \times Quality}{Cost \times Time}
\]
**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.
Those Elements of a process that Do Not Increase the Value of a Product as Perceived by the Customer, but increases Cost and Process times.

Anything other than the minimum amount of equipment, materials, parts, space, and worker’s time which are absolutely essential to add value to the product.
Identify and Eliminate these Wastes:

Types of Waste:

- Transportation
- Inventory (Excess)
- Motion
- Waiting
- Over-Production
- Over-Processing
- Defects
- Under Utilization of people
Transportation

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

Primary Causes:
- Inefficient Facility Layout
- Process Islands vs. Continuous Flow
- Batch (Push) Mentality
- Lack of Right-Sizing
- Long Setup Times
- Lack of Multi-Skilled Workers
Inventory (Excess)

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

- Increases Cycle Time & Process Lead Time.
Inventory Hides Problems!

Boat = Production System

Water Level = Inventory Level

Rocks = Hidden Problems (Uncovered as Inventory is Reduced)
• Waste 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**

The Waste of waiting occurs whenever the hands of an employee are idle.

**Over Production**

Waste caused by producing more than the customer needs (Push). This type of waste 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

Waste that occurs when a process, product, or data does not conform to proper specifications. The result could cause product rework, scrap, or the 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.
Under utilization of employees

ULTIMATE WASTE

Waste of a person’s time
<table>
<thead>
<tr>
<th>Type of Waste</th>
<th>Physical Process</th>
<th>Transactional Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transporting</strong></td>
<td>Parts Moving to Warehouse and Back</td>
<td>Data Handoffs</td>
</tr>
<tr>
<td><strong>Inventory (Excess)</strong></td>
<td>Excessive Work-in-Process</td>
<td>Backlog of Design or Tooling Changes</td>
</tr>
<tr>
<td><strong>Motion</strong></td>
<td>Retrieving Parts, Tools, Information</td>
<td>Poor Office Lay-Out</td>
</tr>
<tr>
<td><strong>Waiting</strong></td>
<td>Out of supplies, Lack of Information</td>
<td>Meetings, Approval, System Down Time</td>
</tr>
<tr>
<td><strong>Over-Processing</strong></td>
<td>Performing Unneeded Operations</td>
<td>Approvals (Too Many Sign-offs)</td>
</tr>
<tr>
<td><strong>Over-Production</strong></td>
<td>Working Ahead of Schedule</td>
<td>Printing Paper Too Soon</td>
</tr>
<tr>
<td><strong>Defects</strong></td>
<td>Scrap or Rework</td>
<td>Drawing or Planning Errors, Rework</td>
</tr>
<tr>
<td><strong>Under utilization of employees</strong></td>
<td>More people involved than required to perform physical or transactional tasks.</td>
<td></td>
</tr>
</tbody>
</table>
• **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.
Value Stream Map (VSM)

- **Customer**
- **Process Control**
- **Suppliers**
- **Completed Work**

**Incoming Buffer**
- **Process 1**
- **Data Box**
- **Process 2**
- **Data Box**
- **Process 3**
- **Data Box**
- **Process 4**
- **Data Box**
- **Shipping**

- **P/T = 3 min**
- **Volume = 200**
- **Customer call time = 24 min**
- **TAT = 168 days**

**Values:**
- 2 min
- 3 min
- 5 min
- 6 min
- 120 min
- 240 min

**Notes:**
- **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 Stream Map - Examples
• **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.
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Lean Principles – Womack & Jones 1996

Lean Principles – Womack & Jones 1996
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.
Typical Flow – Before Improvements

Workplace Layout

- Batch operations
- Isolated processes
- Unknown status
Batch and Queue

• Production of large lots of identical items to meet **anticipated demand**.
  • Production is to schedule, not to demand.
• Makes great efficiencies possible for equipment amortized over large quantities.
• Increases inventory and cycle 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 found the real challenge was to create continuous flow in "small-lot" production.

• Ohno achieved small lot continuous flow by:
  • Aligning equipment & resources to the Value Stream.
  • Physically locating machines close together.
  • **Driving down batch sizes.**
    • Single Minute Exchange of Die (SMED).
    • Splitting and right-sizing of operations.
  • Cross Training.
  • Simple production control processes – Pull / Kanban.
  • Aggressive root cause analysis.
  • Application of Lean tools such as Kitting, Point of Use Systems (POUS), and visual controls.
The Ideal State:
Produce and move one piece at a time.

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

Workplace Layout

ORDER PART

- Single-piece flow
- Visual status
- Reduced travel

INSPECT

TEST

INSTALL

SOLDER

REMOVE

TEST

INSPECT

SIGN-OFF
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
• **Value** specified from the customer’s perspective.
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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>106-0</th>
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<tbody>
<tr>
<td>ITEM #</td>
<td>406699</td>
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<tr>
<td>DESCRIPTION</td>
<td>TURBINE DISK</td>
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<table>
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<tr>
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<tbody>
<tr>
<td>OPER.</td>
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<table>
<thead>
<tr>
<th>BOX CAPACITY</th>
<th>BOX TYPE</th>
<th>ISSUED</th>
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<tbody>
<tr>
<td>2</td>
<td>C-04</td>
<td>1 OF 4</td>
</tr>
</tbody>
</table>

Yellow Belt Training
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

To-Be Ordered
Awaiting Delivery

Yellow Belt Training
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Pursue Perfection

• Begins with understanding Lean Principles & visualizing the “perfect” process at the outset.
• No matter how much you improve a process to make it leaner, there are always ways to continue to remove waste by eliminating effort, time, space and errors.
• 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**. That number, more than anything else, explains why Toyota appears to be in a league of their own, while their competitors remain caught in a cross-fire of cost-cutting”.

Here’s the thing: it’s not about the cars. It’s about ideas. And the people with those ideas. **But not just any ideas. Mostly tiny ones**, but effective ones none-the-less – elegant solutions to real world problems. Not grand slam homeruns, but groundball singles implemented all across the company by associates **that view their role not to be simply doing the work, but taking it to the next level...every day, in some little way. Good enough never is.**

**When an entire organization thinks like that, it becomes unstoppable.**