Lean is a New Approach to Managing Enterprises

- Origin and evolution of lean concepts
- Core lean principles & practices
- How lean differs from craft and mass production models of industrial organization
- Lean implementation steps
- Value stream mapping
Lean Enterprise Value: The Central Concept

Lean is a process of eliminating waste with the goal of creating value for enterprise stakeholders.

-Lean Enterprise Value, Murman et al

Lean Works Everywhere

- Export licensing:
  - 56 steps to 21 steps
  - 52 handoffs to 5 handoffs
  - Cycle time from 60 days to 30 days
  - 50% 1st pass yield to >90% 1st pass yield

- Payroll:
  - Reduced non-value added steps by 50%
  - 15 forms to 1 form
  - Reduced signatures/approvals by 25%

- Recruiting:
  - Cycle time from 14 days to 48 hours
  - 50% reduction of paper resumes

- Proposal:
  - Cycle time from 30.6 days to 7 days

- Program support:
  - $3M savings

- Interface management:
  - Proposal, contract, billing, and collection steps
  - Generated $21M additional cash

- Engineering order release:
  - Cycle time from 76 to 4 days
  - Total queue time from 56 days to 60 minutes

- Process definition:
  - Work package completion cycle from 4 months to 3 weeks

- Financial reporting:
  - 13 weeks to 3 weeks
Lean was Born out of Necessity

August 15, 1945 -- end of war with Japan

- Toyota faced a daunting challenge: How to succeed against Western mass production auto giants poised to enter Japanese market?
- Kiichiro Toyoda to Taiichi Ohno: “Catch up with America in three years.”
- Ohno’s challenge: How to design a production system exploiting central weaknesses of mass production model

Japan’s dilemmas

- Small & fragmented market, depleted workforce, scarce natural resources, little capital
- Lean evolved as a coherent response to this challenge over a number of decades -- a dynamic process of learning and adaptation later labeled as “lean production” by Western observers

Use Less, Offer Greater Variety, Higher Quality, and More Affordable Products in Less Time

- Best Japanese auto companies developed a fundamentally different way of making things
- These companies changed the dynamics of international competition
- New goals in manufacturing systems -- combined benefits of craft and mass production
  - Improved quality
  - High productivity
  - Efficiency at low volumes
  - Production flexibility
  - Rapid, efficient development cycle
  - Product mix diversity
- Lean production contrasts with traditional mass production paradigm
- Systemic principles are transferable
What is Lean Thinking?

The removal of *muda*!

Muda- is a Japanese word for waste

Waste- any activity that absorbs resources & creates *no value!*

*Source: Lean Thinking* by Womack & Jones

More Japanese Terms

- **Kaikaku**- radical improvement

- **Kaizen**- continuous incremental improvement
Types of Muda

- Mistakes which require recertification
- Production of items no one wants
- Processing steps which really aren’t needed
- Employee or goods movement/transport from one place or another without any purpose
- People in downstream activity waiting because upstream activity has not delivered on time
- Goods and services that don’t meet the need of customer

Antidote to Muda: Lean Thinking

- Provides way to specify value
- Line up value creating actions in best sequence
- Conduct activities without interruption whenever someone requests them
- Perform them more and more effectively
- Provides a way to make work more satisfying
Lean Thinking: Eliminating Waste with the Goal of Creating Value

- **Customer-focused**: Customer needs and expectations “pull” enterprise activities
- **Knowledge-driven**: Draws upon knowledge and innovation from everyone - workers, suppliers
- **Eliminating waste**: Stresses elimination, not just reduction, of all types of waste
- **Creating value**: Puts premium on “growing the pie”, not just reducing costs, to benefit all stakeholders
- **Dynamic and continuous**: Pursues on-going systemic as well as incremental improvement - both innovation and continual improvement

Lean Provides Positively-Reinforcing Concepts, Practices and Tools

- **Delivering just-in-time**: “Pull” based production
- **Striving for perfect quality**: Completely defect-free parts must flow to each subsequent process; quality designed-in, not based on inspection, mistake proofing
- **Flexibility and responsiveness**: Small processing sizes and quick set-up times; ability to respond to shifts in demand
- **Trust-based relationships**: Mutual commitments and obligations, internally and externally with suppliers
- **Continuous improvement (Kaizen)**: Continuous improvement through work standardization, productive maintenance, root cause analysis, and worker training and empowerment
5 Steps to Becoming Lean

1. Define Value  ➔  Customer
2. Identify the Value Stream  ➔  Follow the Product Stream
3. Flow the Product  ➔  Eliminate Waste
4. Pull  ➔  Produce Just-in-Time
5. Strive for Perfection  ➔  Continuously Improve

Five Lean Fundamentals

- **Specify value:** Value is defined by customer in terms of specific products & services
- **Identify the value stream:** Map out all end-to-end linked actions, processes and functions necessary for transforming inputs to outputs to identify and eliminate waste
- **Make value flow continuously:** Having eliminated waste, make remaining value-creating steps “flow”
- **Let customers pull value:** Customer’s “pull” cascades all the way back to the lowest level supplier, enabling just-in-time production
- **Pursue perfection:** Pursue continuous process of improvement striving for perfection

1. Define Value

**Definition**

Information/Material in a Form That the **Customer** Is Willing to Pay for

Value is **Defined** by the Customer
Value is **Created** by the Producer

Who’s the Customer?

- **C** user
- **C** shareholder
- **C** employee
- **C** environmental
The Value Stream Consists of the Actual Tasks Required to Bring a Specific Product Through Three Critical Processes:

- **Design** - Problem-solving From Concept Through Detailed Design and Engineering to Production Launch
- **Order** - Information Management From Order-taking Through Detailed Scheduling to Delivery
- **Make** - Physical Transformation from Raw Materials to Finished Product In the Hands Of the Customer
What Is a Value-Added Activity?

**Definition**

A value-added activity is any action that transforms information/material into a capability for our ultimate customer at the right time and the right quality.

---

Waste

**Definition**

Any Activity That Consumes Resources Yet Adds No Value
3. Flow the Product

1. Eliminate Activities That Are Pure Waste
2. Prefer One Piece Flow Where possible
3. Focus on the Product and Its Needs Rather Than the Organization or the Equipment
4. Focus on actual object and never let it out of sight from beginning to completion
5. Ignore traditional boundaries of jobs, careers, functions, and organizations to form a Lean enterprise removing all impediments to the continuous flow of the product
6. Rethink specific work practices and tools to eliminate backflows, scrap, and all stoppages

Batch Production Example

Throughput Time (5 Units) =
5x1 + 5x1 + 5x1 + 5x1 =
20 Min.

Work in Process
5 + 5 + 5 + 5 =
20 Units

Processes - Oriented Layout
With Transfer Lot Size of Five

<table>
<thead>
<tr>
<th>Time</th>
<th>Process</th>
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</table>

A B C D = Different Processes
Processing Time = 1 Min./ Unit
**Batch Production Example**

Processes - Oriented Layout
With Transfer Lot Size of Five

Throughput Time (5 Units) = \(5 \times 1 + 5 \times 1 + 5 \times 1 + 5 \times 1 = 20\) Min.

<table>
<thead>
<tr>
<th>Time</th>
<th>A</th>
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</table>

Work in Process = 5 + 5 + 5 + 5 = 20 Units

A B C D = Different Processes
Processing Time = 1 Min./Unit

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**One - Piece Flow Example**

Product-Oriented Layout
With Lot Size Of One

Throughput Time (5 Units) = \(1 \times 4 + 1 \times 1 + 1 \times 1 + 1 \times 1 + 1 \times 1 = 8\) Min.

<table>
<thead>
<tr>
<th>Time</th>
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<td>8</td>
<td>A</td>
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</tbody>
</table>

A B C D = Different Processes
Processing Time = 1 Min./Unit
4. Pull

- Definition

- Letting the Customer Pull Value from the Enterprise
  - Don’t Make Anything Until It Is Needed
  - Then Make It As Quickly As Possible

**One - Piece Flow Example**

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</tr>
</tbody>
</table>

**Throughput Time (5 Units)**

\[ 1 \times 4 + 1 \times 1 + 1 \times 1 + 1 \times 1 + 1 \times 1 = 8 \text{ Min.} \]

**Work in Process**

\[ 1 + 1 + 1 + 1 = 4 \text{ Units} \]

**Product-Oriented Layout With Lot Size Of One**

- Different Processes
- Processing Time = 1 Min./Unit

\[ \text{Processing Time} = 1 \text{ Min./Unit} \]
5. Strive for Perfection

- Continuous radical and incremental improvement
- Continuous Banishment of muda
  - Pursue Perfection, Not the Competition
  - There Is No End to the Process of Reducing Efforts, Space, Costs and Mistakes

Lean Thinking Differs Sharply from Craft and Mass Production in Important Ways

<table>
<thead>
<tr>
<th>FOCUS</th>
<th>CRAFT</th>
<th>MASS PRODUCTION</th>
<th>LEAN THINKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus</td>
<td>Task</td>
<td>Product</td>
<td>Customer</td>
</tr>
<tr>
<td>Operations</td>
<td>Single items</td>
<td>Batch and queue</td>
<td>Synchronized flow and pull</td>
</tr>
<tr>
<td>Overall aim</td>
<td>Mastery of craft</td>
<td>Reduce cost and increase efficiency</td>
<td>Reduce waste and add value</td>
</tr>
<tr>
<td>Quality</td>
<td>Integration (part of craft)</td>
<td>Inspection (a second stage, after production)</td>
<td>Prevention (built in by design &amp; methods)</td>
</tr>
<tr>
<td>Business strategy</td>
<td>Customization</td>
<td>Economies of scale and automation</td>
<td>Flexibility and adaptability</td>
</tr>
<tr>
<td>Improvement</td>
<td>Master-driven continuous improvement</td>
<td>Expert-driven periodic improvement</td>
<td>Workforce-driven continuous improvement</td>
</tr>
</tbody>
</table>

Source: Lean Aerospace Initiative
Lean Thinking is Linked to & Complements Other Systemic Change Initiatives

<table>
<thead>
<tr>
<th></th>
<th>Total Quality Management</th>
<th>Reengineering</th>
<th>Traditional Six Sigma</th>
<th>Lean</th>
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</thead>
<tbody>
<tr>
<td><strong>Goal</strong></td>
<td>Meet Customer Expectations</td>
<td>Breakthrough Solutions</td>
<td>Reduce Variation in all Enterprise Operations</td>
<td>Eliminate Waste to Create Value</td>
</tr>
<tr>
<td><strong>Focus</strong></td>
<td>Product Quality</td>
<td>Business Processes</td>
<td>All Sources of Product Variation</td>
<td>All Enterprise Processes &amp; People</td>
</tr>
<tr>
<td><strong>Scope</strong></td>
<td>Business Unit</td>
<td>Business Unit</td>
<td>Enterprise</td>
<td>Enterprise Value Stream</td>
</tr>
<tr>
<td><strong>Change Process</strong></td>
<td>Incremental</td>
<td>Radical Change</td>
<td>Process-specific; continuous</td>
<td>Evolutionary Systemic Change</td>
</tr>
<tr>
<td><strong>Business Model</strong></td>
<td>Improve Efficiency &amp; Shareholder Value</td>
<td>Increase Enterprise Performance &amp; Customer Value</td>
<td>Minimize Waste &amp; Increase Customer Satisfaction</td>
<td>Deliver Value to all Stakeholders</td>
</tr>
</tbody>
</table>

Value Stream Mapping
Using the Value Stream Mapping Tool

- Understanding how the product currently flows
- Designing a lean flow
- How to get there
What is a Value Stream Map?

A Visual Representation of Every Process in the Product’s Path from Order to Delivery

- Information and Material Flow Integration
- Product Through-Put and Cycle Times
- Resources Utilized
- Value Added Times
- Location of Significant Waste

Why Value Stream Map?

- Systems Approach To:
  - Visualize the Entire Product Flow
  - Identifies the Sources of Waste
  - Basis of an Lean Implementation Plan
  - Determine Future Operating State
What Flows Through a Value Stream?

In Manufacturing... materials are what flows

“Material Flow”

In Services... internal and external customer needs and information are what flows

“Information Flow”

Identify and Remove Impediments to Flow

Why is VSM a Useful Tool?

- Helps visualize interactions and flows
- Helps identify not only wastes but their sources as well
- Provides a common language for talking about a process
- Makes decision flows apparent
- Forms the basis of an implementation plan
- Shows the linkages between information and material flows
- Identifies the constraint(s) - any resource whose capacity is less than customer demand

Source: M. Rother and J. Shook, Learning to See, Lean Enterprise Institute, 1999
Basic Steps to VSM

1. Define the boundaries
2. Define the value
3. “Walk” the process
   - Identify tasks and flows of material and information between them
4. Gather data
   - Identify resources for each task and flow
5. Create the “Current State” map
6. Analyze current conditions
   - Identify value added and waste
   - Reconfigure process to eliminate waste and maximize value
7. Visualize “Ideal State”
8. Create the “Future State” map
9. Develop action plans and tracking

Tips for Creating a VSM

- Involve entire team
- Actually walk the process - follow the material and information through the process, starting at the beginning
- Use post-it notes and butcher paper
- Use symbols or icons that are meaningful to the process but common enough to be understood by all involved
Administrative Process Value Stream Map - Current State

- Process Steps: 56
- Handoffs: 52
- Cycle Time: 60 days
- 1st Pass Yield: 50%

Source: Raytheon

Administrative Process Value Stream Map - Future State

- Process Steps: 21 (62% reduction)
- Handoffs: 5 (90% reduction)
- Cycle Time: 30 days (50% reduction)
- 1st Pass Yield: 100% (100% improvement)

Source: Raytheon
**Keys for Success with VSM**

**Follow the Process**
- Remember that value stream mapping & analysis is a process
- Avoid short-cuts...the steps are important!
- Remind yourself and your team to be disciplined

"We can skip this step"
"We already know how we want to make this"
"Let's not worry about that for now"

**Learn by Doing!**
- This
- Process
- Works!!

---

**Analyze the Current Condition**

**Complete Red-Yellow-Green Dot Analysis**

**Value-Added Activities**
- An activity that transforms or shapes material or information
- And the customer wants it
- And it’s done right the first time

**Non Value-Added – Needed Activities**
- Activities causing no value to be created but which cannot be eliminated based on current state of technology or thinking
- Required (regulatory, customer mandate, legal)
- Necessary (due to non-robustness of process, currently required; current risk tolerance)

**Non Value-Added Activities**
- Activities that consume resources but create no value in the eyes of the customer
- Pure waste
- If you can’t get rid of the activity, it turns to yellow
The Goal is to Eliminate Waste

Types of Waste

- Defects
- Over Production
- Transportation
- Movement
- Waiting
- Inventory
- Over Processing

The Seven Types of Waste In Business Processes

<table>
<thead>
<tr>
<th>Types</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defects</td>
<td>incorrect data entry</td>
</tr>
<tr>
<td>Over Production</td>
<td>preparing extra reports, reports not acted upon, multiple copies in data storage</td>
</tr>
<tr>
<td>Transportation</td>
<td>extra steps in the process, distance traveled</td>
</tr>
<tr>
<td>Movement</td>
<td>extra steps, extra data entry</td>
</tr>
<tr>
<td>Waiting</td>
<td>processing monthly, not as the work comes in (i.e. closings)</td>
</tr>
<tr>
<td>Inventory</td>
<td>transactions not processed</td>
</tr>
<tr>
<td>Over Processing</td>
<td>sign-offs</td>
</tr>
</tbody>
</table>
Some General Product Definition Wastes

- Task to Be Accomplished
  (New, In-work, etc.)
- Undocumented Information
- Prioritization
- Too Much Information
- Required to Stop a Given Task Due to Unavailable, Inaccurate, And/or Late Information
- Jobs in Queue Waiting for Resources
- Setup Time
  (Computer Logon, Printers, Xerox, etc.)
- Access to Data Storage
- People Are Not Co-located
- Walk to Tools
  (Printer, Copier, CADAM, etc.)
- Hand Carry Product for Signatures
- Travel to Meetings

- Inaccurate / Incomplete Information
- Inadequate Analysis
- Requirements Creep
- Change / Multiple Tools
- Inadequate Testing

- Generating More Info Than Required
- Excessive Iterations, Don't Stop at Good Enough
- Fine Tuning Beyond Required
- Over Designing
- Unnecessary Interim Drawings for Build
- Over Analysis
- Excessive Test Points
- Duplicate Tasking

Seven Types of Waste

- Inventories
  More WIP Than the Absolute Minimum
- Waiting
  Delay From Previous Processing Steps
- Movement
  Unnecessary Movement of People During the Course of Their Work
- Transportation
  Unnecessary Transport of Materials
- Making Defective Products (Rework)
  Products Do Not Meet Customer Requirements
- Over Processing
  Doing More Than Is Necessary
- Over Production
  Making Ahead of Demand

Exercise – Specific Examples You Encounter

- Making Defective Products (Rework)
  Products Do Not Meet Customer Requirements
- Over Processing
  Doing More Than Is Necessary
- Over Production
  Making Ahead of Demand

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