Lean Thinking
Module 1.1

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Presentation for:
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These materials were developed as part of MIT’s ESD.60 course on “Lean/Six Sigma Systems.” In some cases, the materials were produced by the lead instructor, Joel Cutcher-Gershenfeld, and in some cases by student teams working with LFM alumni/ae. Where the materials were developed by student teams, additional inputs from the faculty and from the technical instructor, Chris Musso, are reflected in some of the text or in an appendix.
Overview

Learning Objectives

- Awareness of the contrast between “mass” and “lean” mindsets
- Appreciation of the historical context for lean thinking
- Ability to engage in lean thinking with respect to application examples (5S’s, 7 Wastes, and others)
- Increased ability to teach others about lean thinking

Session Design (60-90 min.)

- Part I: Introduction and Learning Objectives (1-2 min.)
- Part II: Key Concept or Principle Defined and Explained (5-7 min.)
- Part III: Exercises and Activities Based on Field Data and Scenarios that Illustrates the Concepts or Principles (45-60 min.)
- Part IV: Common “Disconnects,” Relevant Measures of Success, and Potential Action Assignment(s) to Apply Lessons Learned (15-20 min.)
- Part V: Evaluation and Concluding Comments (2-3 min.)
Redefining “lean”

Definition:

“Becoming ‘lean’ is a process of eliminating waste with the goal of creating value.”

Note: This stands in contrast to definitions of lean that only focus on eliminating waste, which is too often interpreted as cost cutting – independent of its impact on value delivery.
Two mindsets

“Mass Production” Mindset
- Producer “push”
- Movement of materials
- High volume
- Inspection
- Expert-driven
- Decomposition
- Periodic adjustment

“Lean Enterprise” Mindset
- Customer “pull”
- Flow of value
- Flexible response
- Prevention
- Knowledge-driven
- Integration
- Continuous improvement
Where to begin?

- An Exercise in Lean Thinking:
  - Small groups of 4-5 people
  - Half of the groups:
    - Draw a picture of a home workbench or kitchen used by someone engaged in “mass” thinking
  - The other half of the groups:
    - Draw a picture of a home workbench or kitchen used by someone engaged in “lean” thinking

Note: An option for this exercise would be to draw a picture on a transparency to illustrate your description
Historical context: The changing nature of work

1800 and earlier  |  1900  |  2000 and beyond

**Craft Production**
- Socio: Decentralized Enterprises, Mastery of Craft
- Tech: Custom Manufacture, Specialized Tools

**Mass Production**
- Socio: Vertical Hierarchies, Scientific Management
- Tech: Assembly Line, Interchangeable Parts

**Knowledge-Driven Work**
- Socio: Network Alliances, Team-Based Work Systems
- Tech: Flexible Specialization, Information Systems


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A Lesson From History

- 150 car makers in Indiana since the turn of the century -- only 3 doing final assembly of cars in Indiana today (Honda, Subaru, and Toyota)
- Leading manufacturer -- Auburn Motors -- established an assembly line, but it was fixed for chassis -- moving manually from one set of saw horses to another -- and they resisted abandoning wood for steel in body frames
- What will people in the future say about a plant that had some group meetings, some new measurables, some preventative maintenance, some in-station process control, some reduced in-process inventory, and some coordination among production, maintenance and engineering?

Historical context: Transformation initiatives

1950s  1960s  1970s  1980s  1990s  2000s

- Human Relations Movement
- Work Redesign
- Socio-Technical Work Systems (STS)
- Employee Involvement (EI) / Quality of Work Life (QWL)
- Statistical Process Control (SPC)
- Total Quality Management (TQM)
- Re-Engineering
- Six Sigma
- Lean Production / Lean Enterprise Systems

Associated Team Structure
- Human group
  (on line/off line)
- Semi-autonomous teams (on-Line)
- EI/QWL groups
  (off-line)
- Quality circles
  (off-line)
- Work-out events
  (off-line)
- Black belt led project teams (off-line)
- Lean production teams / Integrated Product & Process teams (on-line)

Source: Auto Industry System Study by Joel Cutcher-Gershenfeld and Thomas Kochan, 2000
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Historical context: Emergence of lean

Selected Elements of Toyota Production System Implemented over Three Decades:

- “Pull” vision
- Kanban (card) system
- Production leveling
- Reduced set-up time (Shingo)
- Jidoka (people giving wisdom to machines)
- Statistical Process Control (SPC)
- Quality Circles
- Kaizen (continuous improvement based on knowledge)
- Poka-yoke (error proofing)
- Adnon (visual display)

Discussion Question:

- It took close to 30 years for Toyota to develop all of the aspects of the Toyota Production System, including the lean thinking that goes with that system. How long do you think it might take a large aerospace company such as Boeing or Lockheed Martin or Pratt and Whitney to build the same capability -- 30 years, 20 years, 10 years, 5 years?

Case Example – Kanban:

1950s First kanban experiments
1960s Kanban introduced company-wide
1970s Kanban distributed across suppliers
Auto industry data: A lean story?
(data from *The Machine That Changed the World*)


**Source:** Ted Piepenbrock 2003, Engineering Systems Division Doctoral Seminar, Massachusetts Institute of Technology

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**Part I: Introduction**

**Part II: Concepts**

**Part III: Application**

**Part IV: Disconnects**

**Part V: Conclusion**
Airline industry data: A lean story?
(source: IATA & Southwest Airlines)

1. Data from the IATA.

Source: Ted Piepenbrock 2003, Engineering Systems Division Doctoral Seminar, Massachusetts Institute of Technology © Joel Cutcher-Gershenfeld – ESD.60 Lean/Six Sigma Systems, LFM, MIT
Airline industry data: Another look at the picture


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Lean thinking: A mental model

Womak and Jones:

- Specify value
- Identify the value stream
- Make value flow continuously
- Let customers pull value
- Pursue perfection

Exercise: The Seven Wastes and the Five S’s

The Seven Wastes
- Over Production
- Waiting
- Transportation
- Inventory
- Processing
- Motion
- Defects

The Five S’s
- Simplify or Sort (seiri)
- Straighten or Set (seiton)
- Scrub or Shine (seiso)
- Stabilize or Standardize (seiketsu)
- Sustain or Self-Discipline (shitsuke)

What changes are needed in technical/physical systems to address the Seven Wastes?

What changes are needed in social systems – including what new ways of thinking?

Do the same analysis with respect to the Five S’s.
Mass Production ("push"): Auto Assembly Plant

- **Material**
  - RECEIVING WAREHOUSE

- **Production Process**:
  - STAMPING → REPAIR → STORAGE
  - WELD → STORAGE

- **Time Information**:
  - Total Time in Plant: Weeks
  - Value Add Time: Minutes
  - Designed to Maximize: Long Production Runs
  - Buffers Against Uncertainty

Adapted from: Ford Motor Company -- FPS
Lean Manufacturing ("pull"): Auto Assembly Plant

Total Time in Plant: Hours
Value Add Time: Minutes
Designed to Maximize: Elimination of Waste
Creation of Value

Adapted from: Ford Motor Company -- FPS

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Value Streams

Enterprise and Extended Enterprise

Order ............................................ Delivery
Concept ...................................... Launch
Raw-materials .................................. Customer

Multi-plant/Program

Plant

Design and Development
Components & Materials → Finished Goods
Delivery & Sustainment

Support Functions and Infrastructure (Physical & Social)

Source: Adapted from presentation by Matthias Holweg on “Latest Developments in Lean Thinking,” CMI
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Sample Value Stream Map


Source: Presentation by Matthias Holweg on “Latest Developments in Lean Thinking,” CMI

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The Deming Cycle

Plan (what to do; for improvement)

Do (..it, on a trial basis; experiment)

Check (if it works; the risks; the variation, LEARN!)

Act (implement more widely; standardise)

“Hold the gains”

The Deming Cycle

Courtesy of Matthias Holweg. Used with permission.

Source: Presentation by Matthias Holweg on “Latest Developments in Lean Thinking,” CMI
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Lean “Disconnects”

- **Small Groups**
  - Discuss disconnects that you have observed in lean implementation initiatives
  - or
  - Discuss potential disconnects that might arise in the implementation of the new work cells in the previous exercise

- **Full Group**
  - Identify patterns in the data and overall implications
What is the Relationship of the “Disconnects” with this Model?

Adapted from: Materials Developed by WorkMatters, LLC in Collaboration with the Ford Motor Company

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Conclusion

Return to the Definition:

“Becoming ‘lean’ is a process of eliminating waste with the goal of creating value.”

Why Might These Be Considered First Principles:

- Fairness and respect
- Customer as “True North”
- Eliminate waste to add value
- Knowledge-driven continuous improvement (PDCA)
Selected Sources – Chronological Order