

Lean Thinking

Module 1.1

Joel Cutcher-Gershenfeld

*Senior Research Scientist, MIT Sloan School of Management and
Executive Director, MIT Engineering Systems Learning Center*

Presentation for:

ESD.60 – Lean/Six Sigma Systems
MIT Leaders for Manufacturing Program (LFM)
Summer 2004

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

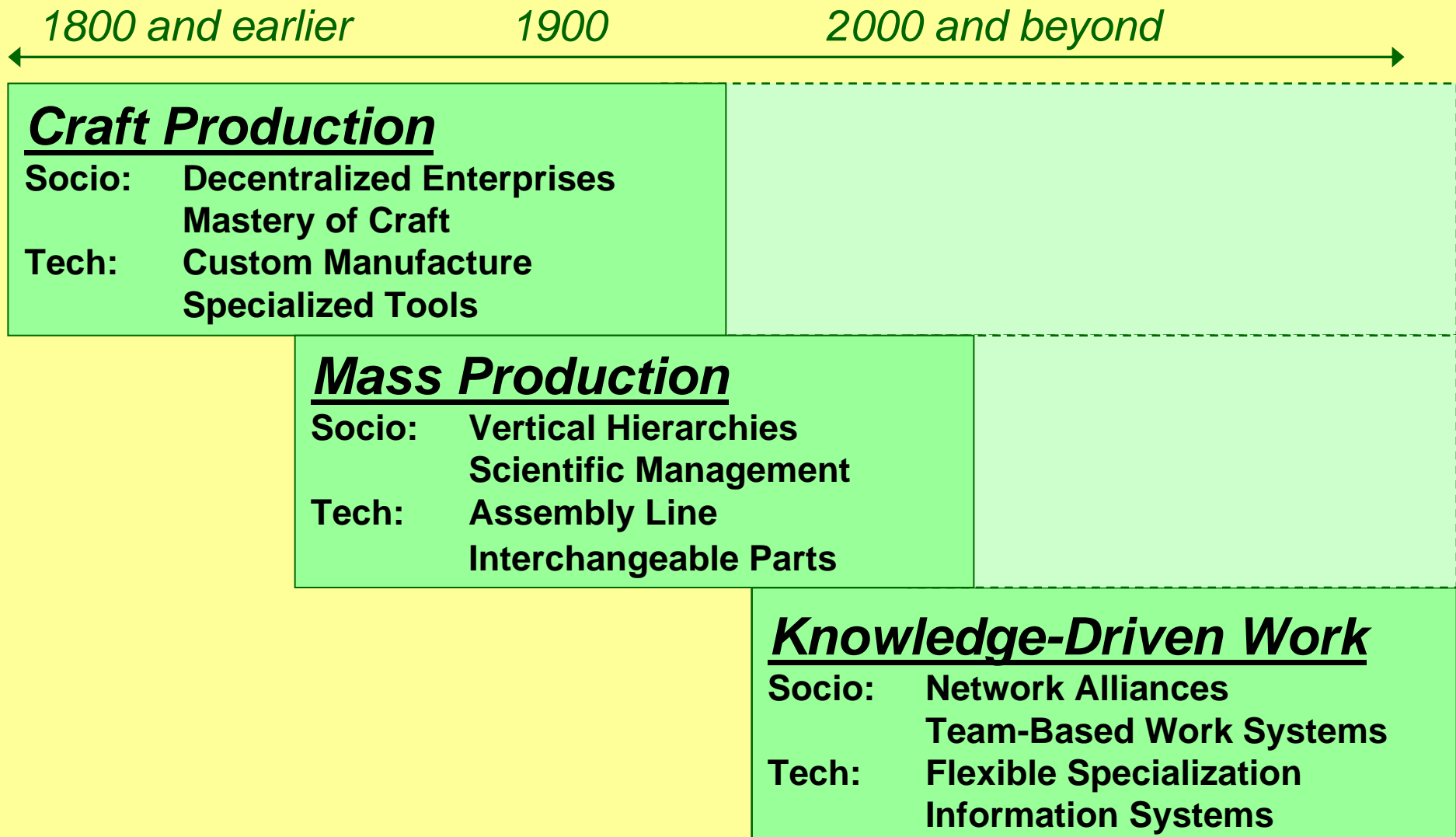
- Customer “pull”
- Flow of value
- Flexible response
- Prevention
- Knowledge-driven
- Integration
- Continuous improvement

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



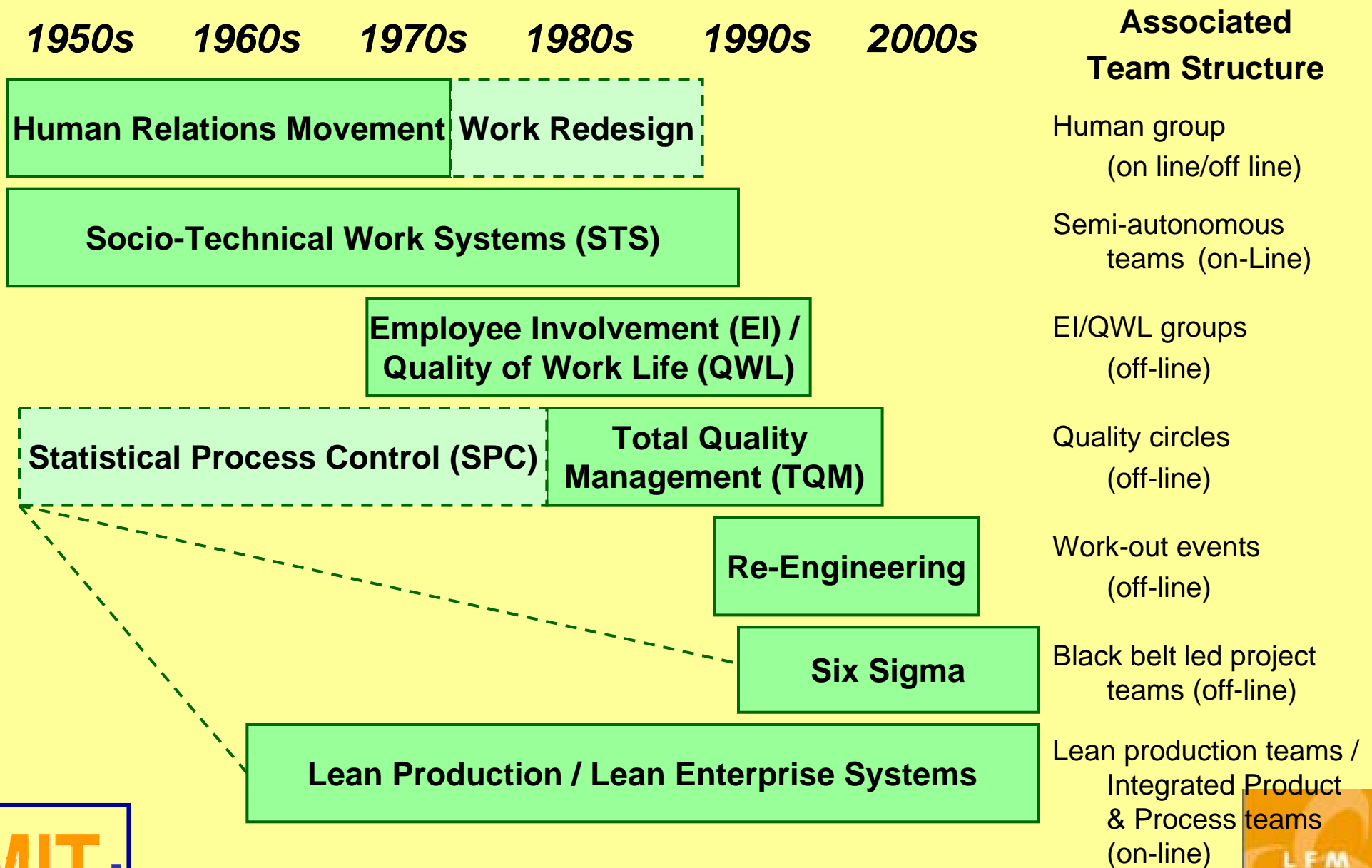
A Lesson From History

Image removed due to copyright considerations.

- 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?

Source: *Auburn & Cord* by Lee Beck and Josh B. Malks, Motor Books, Intl., 1996

Historical context: Transformation initiatives



Source: Auto Industry System Study by Joel Cutcher-Gershenfeld and Thomas Kochan, 2000
 © Joel Cutcher-Gershenfeld – ESD.60 Lean/Six Sigma Systems, LFM, MIT



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)

Case Example – Kanban:

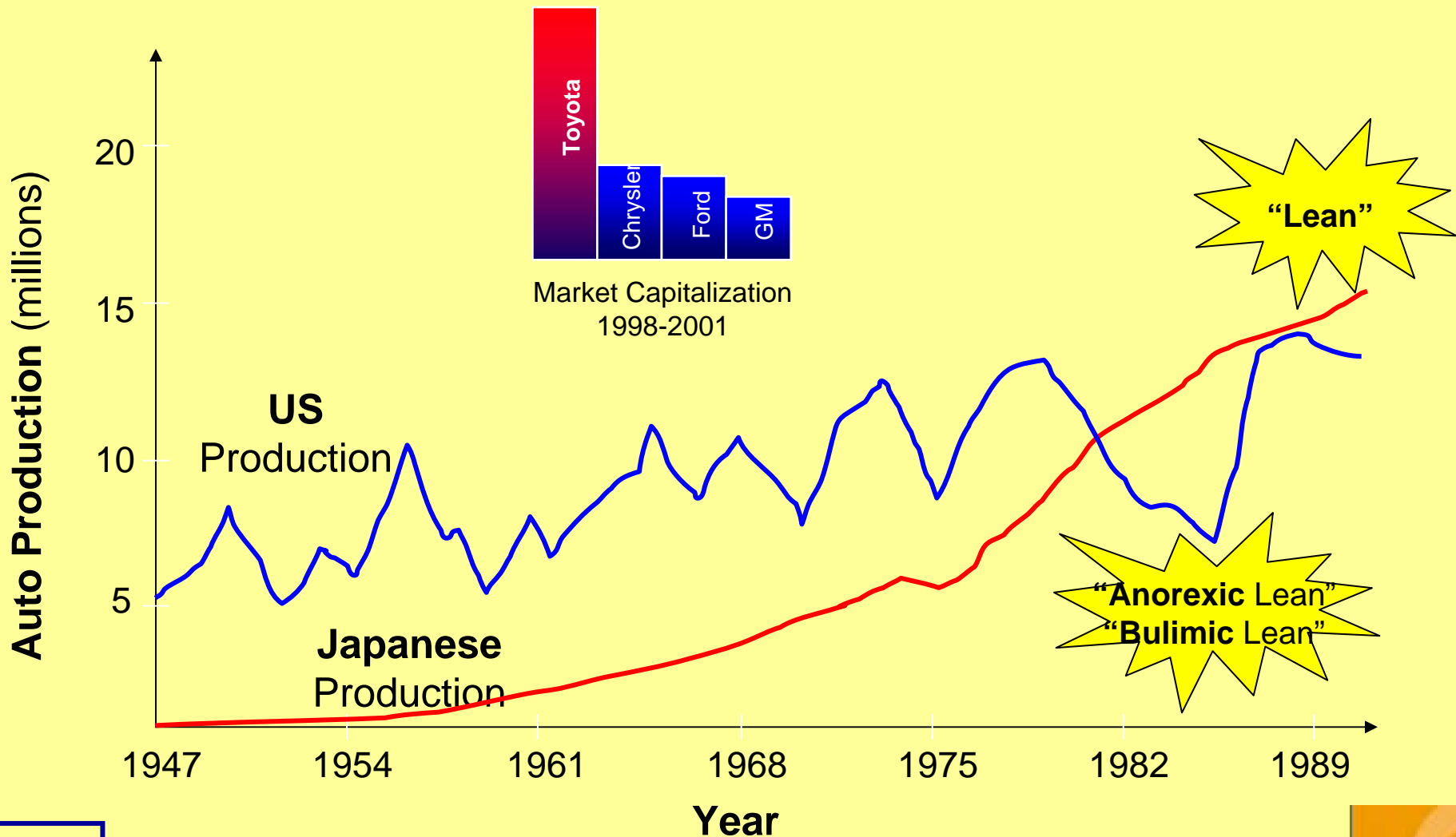
1950s	First kanban experiments
1960s	Kanban introduced company-wide
1970s	Kanban distributed across suppliers

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?*

Auto industry data: A lean story?

(data from *The Machine That Changed the World*)



1. Data from Womack, Jones and Roos, *The Machine that Changed the World*, The Free Press, 1990.

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

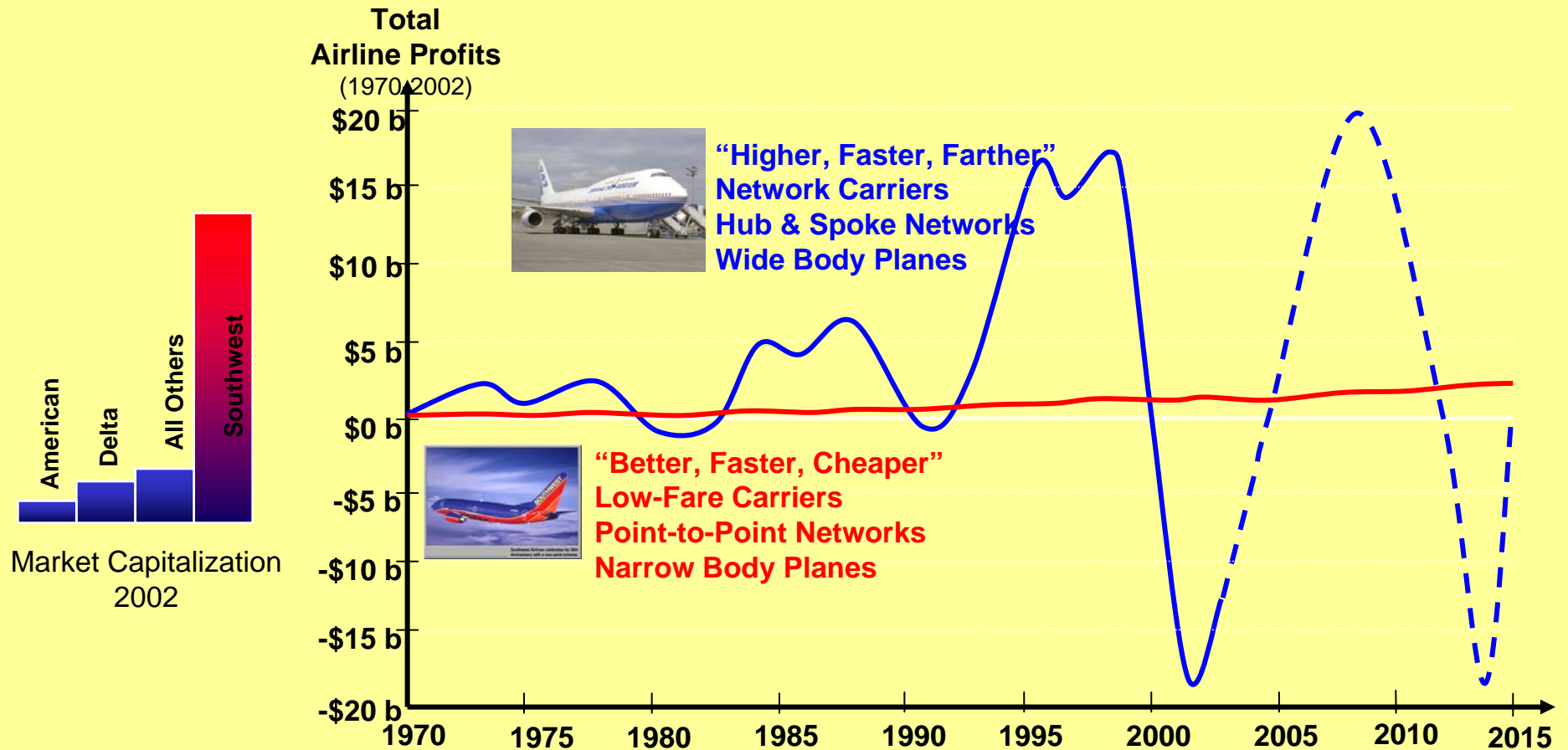
© Joel Cutcher-Gershenfeld – ESD.60 Lean/Six Sigma Systems, LFM, MIT

6/9/04 -- 10



Airline industry data: A lean story?

(source: IATA & Southwest Airlines)



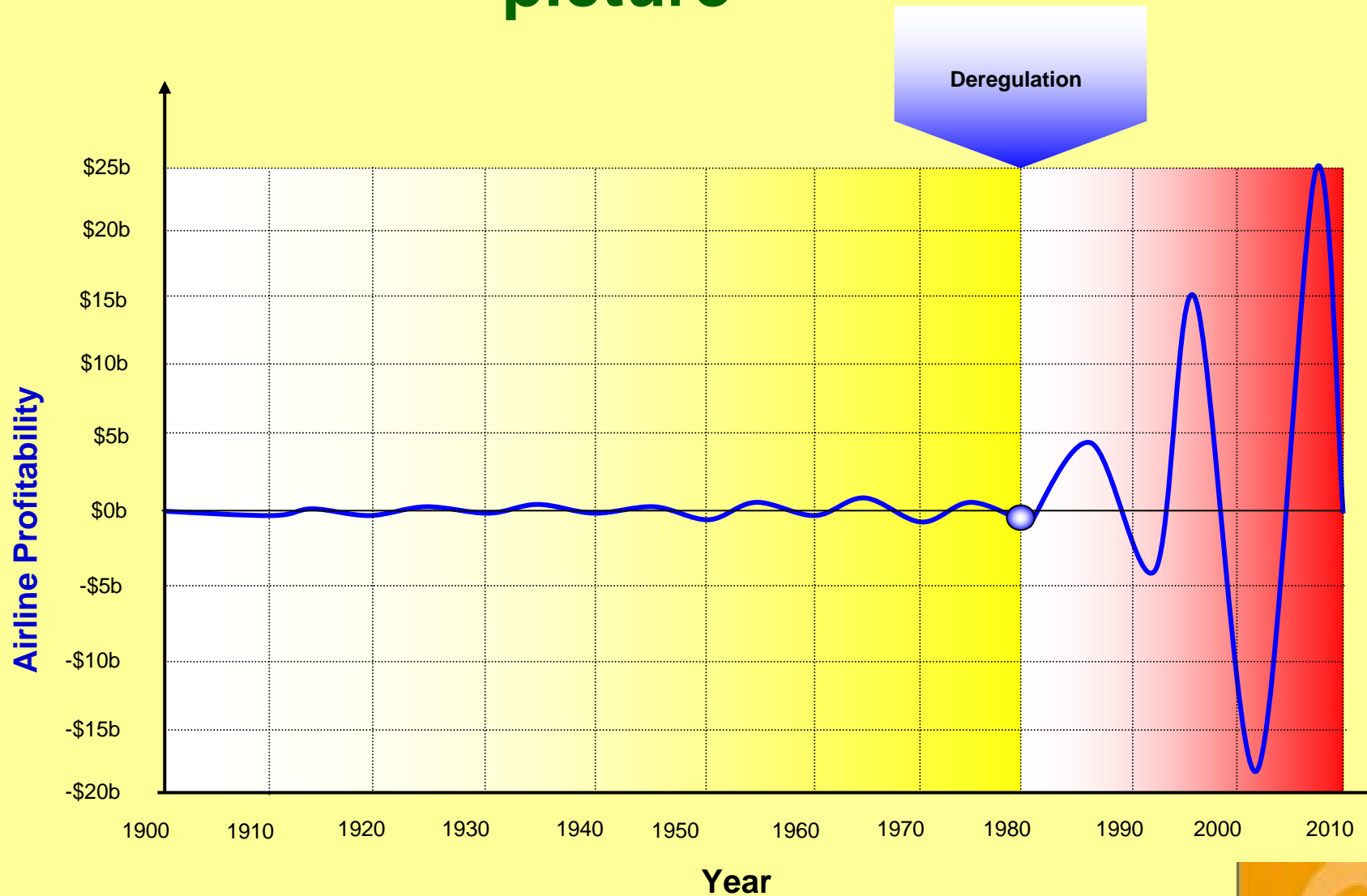
1. Data from the IATA.

Source: Ted Piepenbrock 2003, Engineering Systems Division Doctoral Seminar, Massachusetts Institute of Technology
 © Joel Cutcher-Gershenfeld – ESD.60 Lean/Six Sigma Systems, LFM, MIT

6/9/04 -- 11



Airline industry data: Another look at the picture



Source: Presentation on "Enterprise Design for Dynamic Complexity: Enterprise Product Strategy" by Ted Piepenbrock at the Lean Aerospace Initiative Product Development Community Meeting, (October, 2003)

© Joel Cutcher-Gershenfeld – ESD.60 Lean/Six Sigma Systems, LFM, MIT

6/9/04 -- 12



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

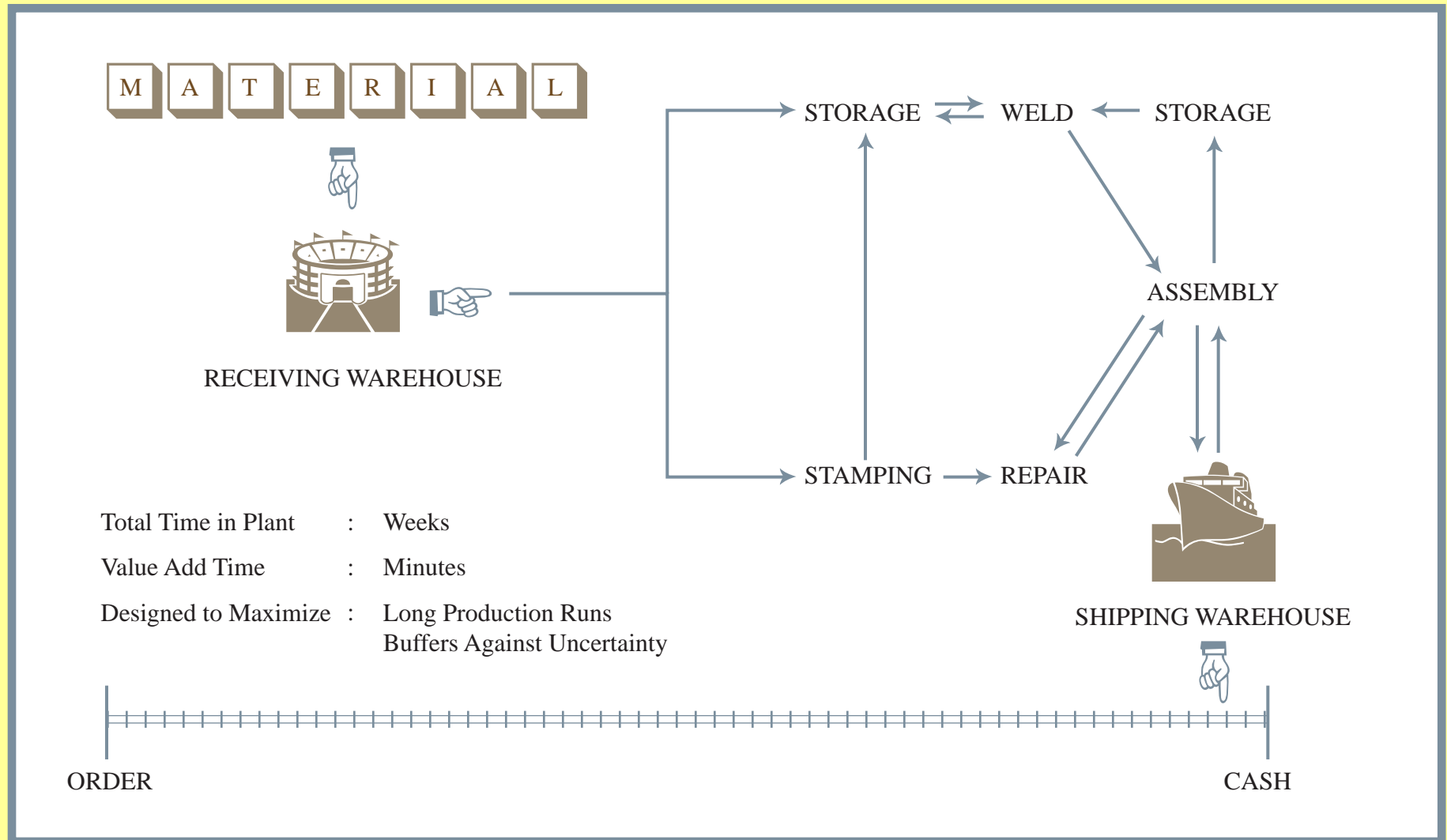
- Simplify or Sort (seiri)
- Straighten or Set (seiton)
- Scrub or Shine (seiso)
- Stabilize or Standardize (seiketsu)
- Sustain or Self-Discipline (shitsuke)

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

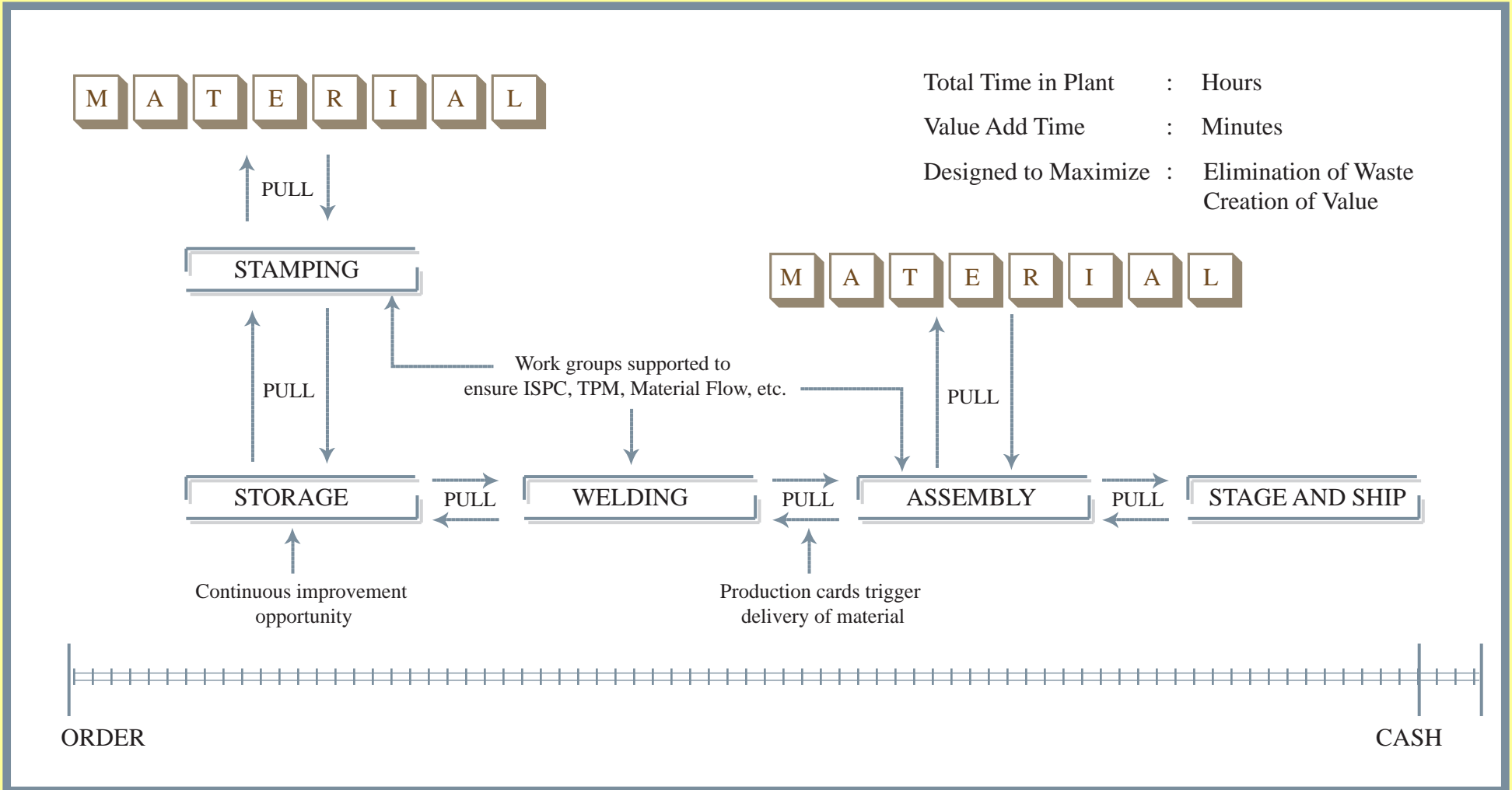
What changes are needed in social systems – including what new ways of thinking?

Do the same analysis with respect to the Five S's

Mass Production (“push”): Auto Assembly Plant



Lean Manufacturing (“pull”): Auto Assembly Plant



Value Streams

Enterprise and Extended Enterprise



Multi-plant/Program

Plant

Design and Development

Components & Materials → Finished Goods

Delivery & Sustainment

Support Functions and Infrastructure (Physical & Social)



Courtesy of Matthias Holweg. Used with permission.

Source: Adapted from presentation by Matthias Holweg on "Latest Developments in Lean Thinking," CMI

© Joel Cutcher-Gershenfeld – ESD.60 Lean/Six Sigma Systems, LFM, MIT

6/9/04 -- 17



Sample Value Stream Map

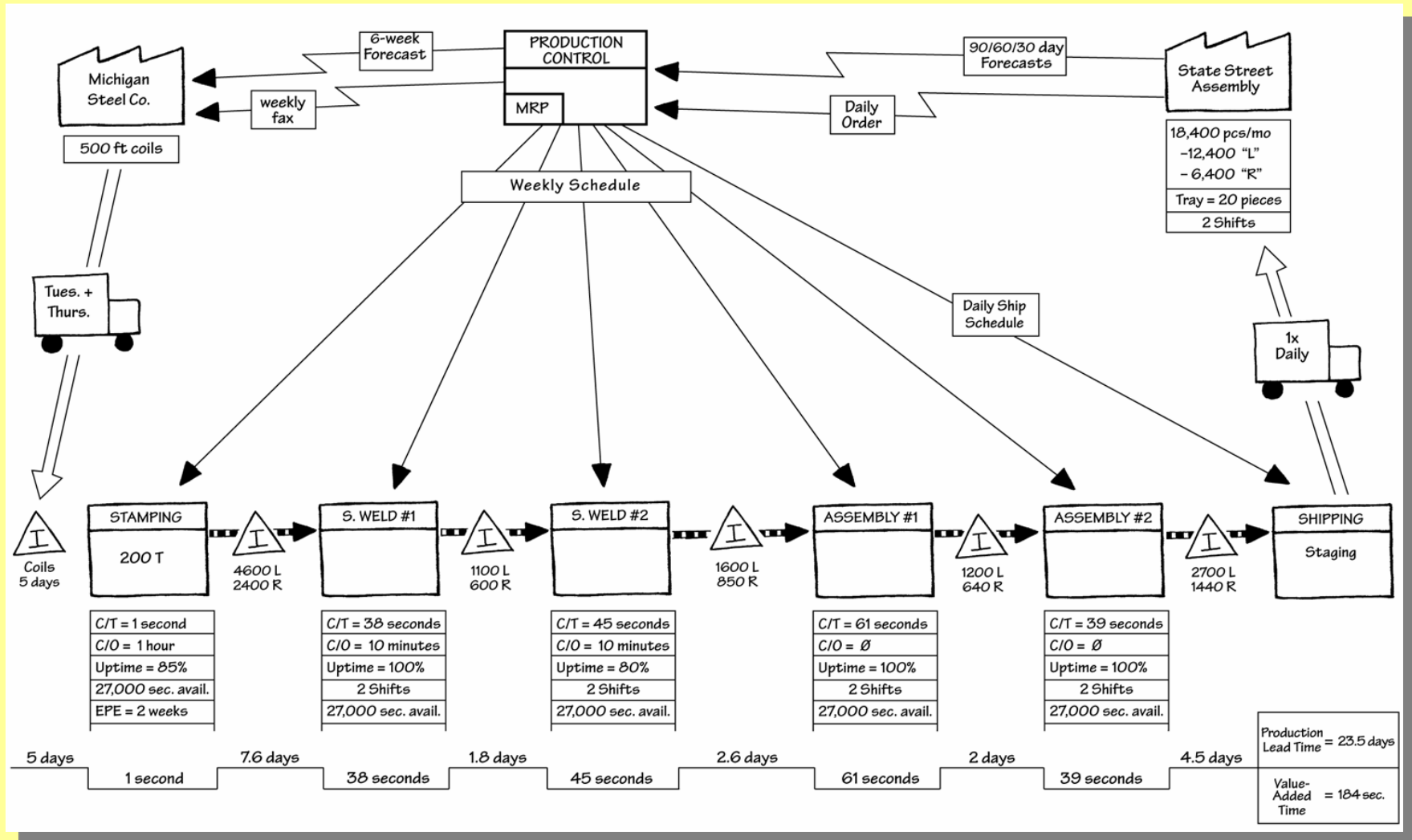


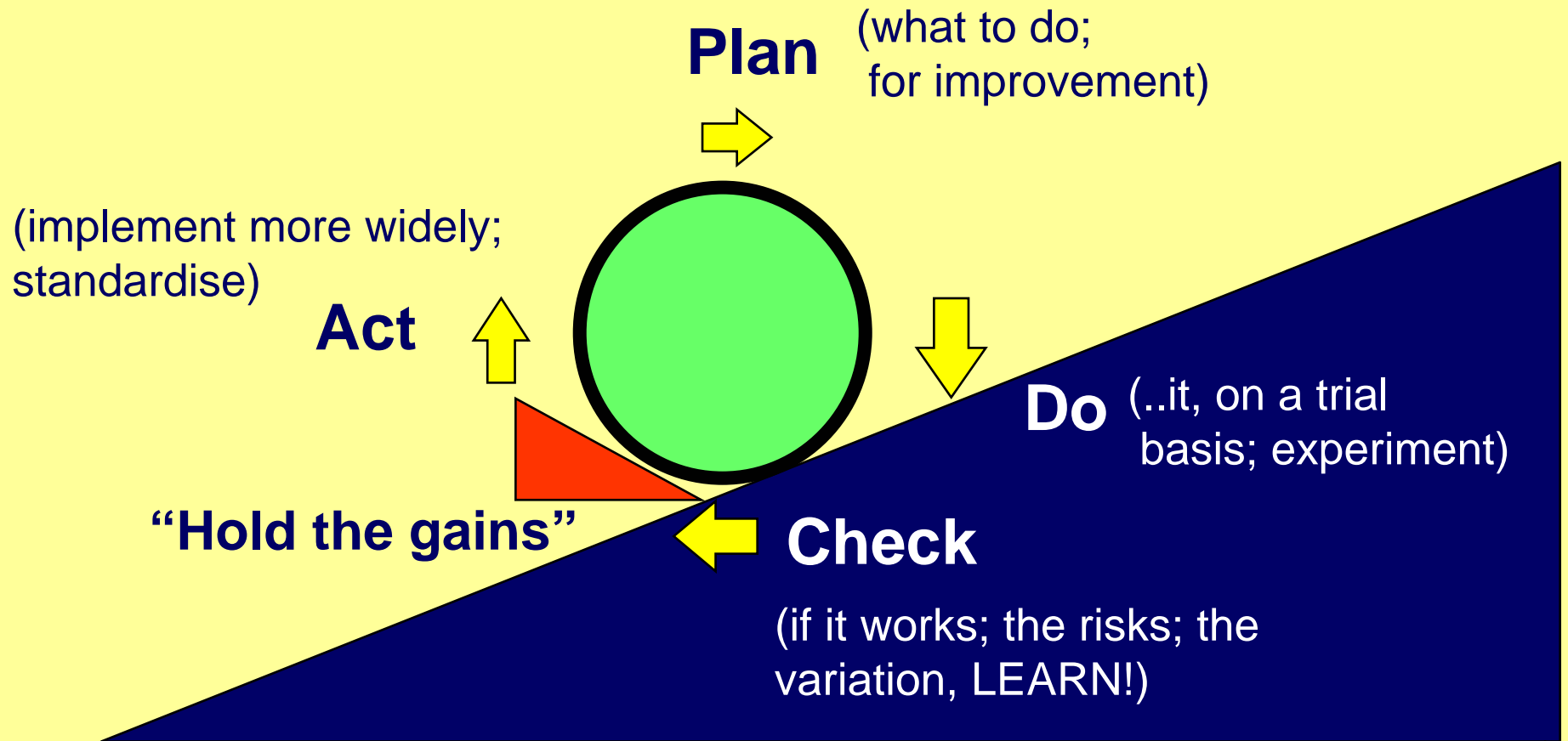
Diagram from Mike Rother and John Shook (1998). Learning To See: Value Stream Mapping to Add Value and Eliminate Muda. The Lean Enterprise Institute. ISBN: 0-9667843-0-8. Courtesy of Lean Enterprise Institute, Inc. Used with permission.

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

© Joel Cutcher-Gershenfeld – ESD.60 Lean/Six Sigma Systems, LFM, MIT



The Deming Cycle



Lean “Disconnects”

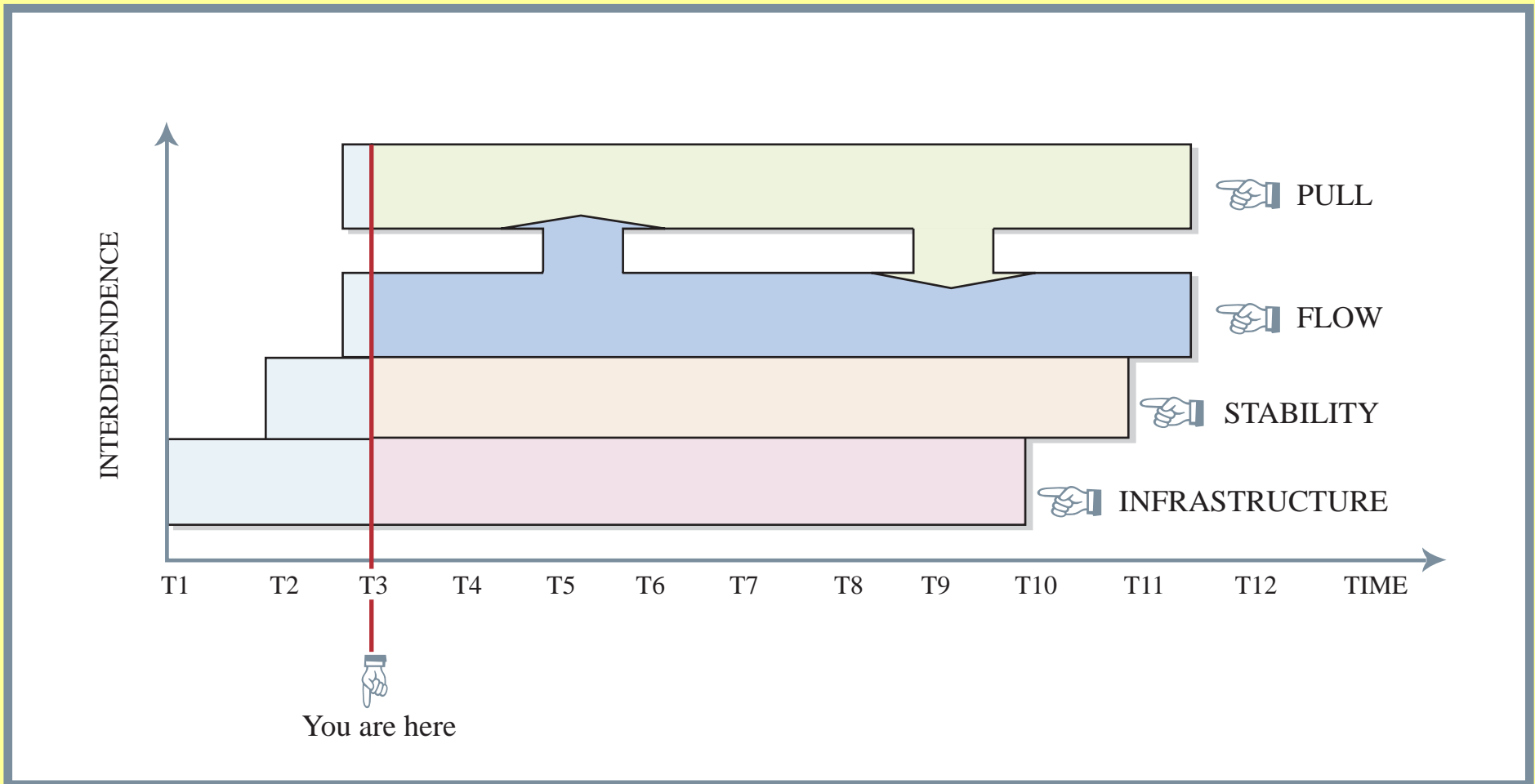
➤ Small Groups

- 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?



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

- Womack, James P., Daniel T. Jones and Daniel Roos, *The Machine that Changed the World*, The Free Press (1990).
- Womack, James P. and Daniel T. Jones, *Lean Thinking: Banish Waste and Create Wealth in Your Corporation*, Simon & Schuster (1996).
- Cutcher-Gershenfeld, Joel, Michio Nitta, Betty Barrett, Nejib Belhedi, Simon Chow, Takashi Inaba, Iwao Ishino, Wen-Jeng Lin, Michael Moore, William Mothersell, Jennifer Palthe, Shobha Ramanand, Mark Strolle, and Arthur Wheaton, *Knowledge-Driven Work: Lessons from Japanese and U.S. Work Practices*. New York: Oxford University Press (1998).
- Fujimoto, Takahiro, *The Evolution of a Manufacturing System at Toyota*, Oxford University Press (1999).
- Ohno, Taiichi, *Toyota Production System: Beyond Large-Scale Production*, Productivity Press, (1978; English translation, 1988).
- Murman, Earll, Allen, Thomas, Bozdogan, Kirkor, Cutcher-Gershenfeld, Joel, McManus, Hugh, Nightingale, Deborah, Rebentisch, Eric, Shields, Tom, Stahl, Fred, Walton, Myles, Warmkessel, Joyce, Weiss, Stanley, Widnall, Sheila; *Lean Enterprise Value: Insights from MIT's Lean Aerospace Initiative*, London, Palgrave (2002).
- Gittel, Jody Hoffer, *The Southwest Airlines Way: Using the Power of Relationships to Achieve High Performance*, McGraw-Hill (2003).
- Charts and Graphs from Presentations by Ted Piepenbrock in ESD Doctoral Seminar and other forums (2003).
- Charts and Graphs from Presentation by Matthias Holweg on “Latest Developments in Lean Thinking,” CMI (2004).