Introduction to LAI
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Earll M. Murman
LAI Co-Director
murman@mit.edu
617-253-3284
Agenda

➢ Why LAI?
➢ How does LAI work?
➢ What use is LAI to others?
➢ How far has LAI come and where will we go next?
Why LAI?
US Air Force asked:

Can the concepts, principles and practices of the Toyota Production System be applied to the military aircraft industry?

• Answer: Yes!
“Lean” is eliminating waste in order to create value.
Some Lean Lingo

- **Muda** - Japanese word for “waste” - 7 wastes
  - Overproduction, waiting time, transportation, inventory, processing, movement, rework
- **Value** - Something of worth to someone else
  - Function/cost or Function/(cost x time)
- **Kaizen** - continuous incremental improvement
- **Pull** - Downstream activities determining upstream activities
  - Implemented by Kanban
- **Single piece flow** - performing a complete series of actions on one part, rather than a single action on many parts
Lean Aerospace Initiative

Consortium

➢ Airframe, engine, avionics, missile and space companies
➢ Air Force agencies and System Program Offices (C-17, F-22, JSF, Training)
➢ NASA, Army, Navy representatives
➢ Pentagon—OSD, AF HQ
➢ United Auto Workers, International Association of Machinists

Purpose

To instigate, enable and support an industrial revolution in aerospace as significant as mass production

Phase III - $4M/yr - 50% Government • 33% Industry • 17% MIT
# The Lean Aerospace Initiative Community

## Avionics/Missiles
- BAE Systems North America
- Hewlett Packard
- Northrop Grumman ESSS
- Raytheon Systems Co.
- Raytheon Systems and Electronics Sector
- Rockwell Collins, Inc.
- Textron Systems Division

## Airframe
- Boeing Military Aircraft & Missiles
- Boeing Commercial Airplane Group
- Boeing Phantom Works
- Lockheed Martin Aeronautical Systems
- Northrop Grumman ISS
- Raytheon Aircraft Co.
- Sikorsky

## MIT
- Center for Technology, Policy, and Industrial Development
- School of Engineering:
  - Aerospace
  - Mechanical
- Sloan School of Management

## US Air Force
- Aeronautical Systems Center
- Air Force Research Laboratory (Materials and Manufacturing Directorate)
- Space and Missile Center
- SPOS: JSF, F-22, C-17, Training (JPATS)

## Space
- Boeing Space & Communications
- GenCorp Aerojet
- Lockheed Martin Space & Strategic Missiles
- Northrop Grumman ESSS Space Sector
- Spectrum Astro
- TRW Space and Electronics

## Other Participants
- UAW
- IAM
- AIA
- DSMC
- IDA
- International Collaborations:
  - Linköping University
  - Warwick, Bath, Cranfield
  - Nottingham Universities

## Other Government
- DCMA
- NASA
- NAVAIR
- AMCOM
- OUSD(AT&L)
- NRO

## Propulsion/Systems
- Curtis Wright Flight Systems
- Parker Aerospace
- Hamilton Sundstrand
- Pratt & Whitney
- Rolls Royce (N.A.)
“Delivering military aerospace products at significantly reduced costs and cycle time while meeting or exceeding performance expectations and enhancing the effectiveness of our national workforce”
“To enable fundamental change within industry and government operations that supports the continuing transformation of the US aerospace enterprise towards providing aerospace systems offering best life-cycle value”

A system offering best life-cycle value delivers best value in mission effectiveness, performance, affordability and sustainability at the right time and right price—advantages retained throughout product life.
How does LAI work?
Consortium Governance

Co-Chairs
Government (Lt Gen Reynolds)
MIT (Dr. Sheila Widnall)
Industry (Mr. James Pitts, NGC)

Executive Board
Senior executives from member organizations

Co-Directors
MIT Engineering (Dr. Earll Murman)
MIT Sloan School (Dr. Tom Allen)
Stakeholder (Mr. Fred Stahl)

LAI Operations
Joint teams from MIT, industry, government and organized labor.
LAI Team Structure

Team Compositions: MIT, Industry, Government, Labor
Team Sizes: 20 - 80 members per team
LAI Consortium Process Flow - Shared Roles and Responsibilities

Industry, Labor, Government

Research Priorities

Experience

Implementation

Awareness

Enablers: LAI Teams Leadership

Products

Research

Imperative

Data
What use is LAI to others?
Lean Aerospace Initiative

LAI Product Value Stream

- Tools: Lean Enterprise Model
  Transition to Lean Roadmaps
  Lean Enterprise Self Assessment Tool

- Publications
- Training Curriculum
- Web site Workshops
- Students

Stakeholder Defined Value
- Knowledge Base
- Implementation Framework
- Research Products
- Neutral Forum

Research
Real time Implementation
Policy Recommendations

web.mit.edu/lean
Lean Aerospace Journey And LAI Products

Lean Enterprise

Lean Factory

Lean Auto Factory


LAI Phase I  LAI Phase II  LAI Phase III

Executive Lean Enterprise Self-Assessment Tool (LESAT)

Transition to Lean Roadmaps

Picture of airliner

Lean Enterprise Model

Toyota Production System
Lean Enterprise Model
Practices and Benchmark Data

Meta-Principles/Enterprise Principles

Enterprise Level Metrics

Overarching Practices

- Identify & Optimize Enterprise Flow
- Implement Integrated Product & Process Development
- Maintain Challenge of Existing Processes
- Assure Seamless Information Flow
- Develop Relationships Based on Mutual Trust & Commitment
- Nurture a Learning Environment
- Optimize Capability & Utilization of People
- Continuously Focus on the Customer
- Ensure Process Capability and Maturation
- Make Decisions at Lowest Possible Level
- Promote Lean Leadership at all Levels
- Maximize Stability in a Changing Environment

Metrics - Barriers - Interactions

Supporting Practices (~300)

Enabling Practices (~60)

Data Sheets (~225)

Internet Links (~600)
Enterprise Transition To Lean (TTL) Roadmap

Entry/Re-entry Cycle

- Adopt Lean Paradigm
- Decision to Pursue Enterprise Transformation
- Enterprise Strategic Planning

Long Term Cycle

- Focus on the Value Stream
- Develop Lean Structure & Behavior

Short Term Cycle

- Focus on Continuous Improvement
- Detailed Lean Vision
- Environmental Corrective Action Indicators

Outcomes on Enterprise Metrics

Create & Refine Implementation Plan

- Implement Lean Initiatives
- Lean Implementation Framework

Detailed Corrective Action Indicators

Enterprise Level Implementation Plan
Lean Enterprise Self Assessment Tool

Tool for executive self-assessment of the present state of “leanness” of an enterprise and its readiness to change

Capability maturity model

Supporting materials

World Class
Lean Enterprise Value:
Insights from MIT’s Lean Aerospace Initiative

Preface
Foreword
Acknowledgements

Part I Higher, Faster, Farther!
Chapter 1 The 21st Century Challenge
Chapter 2 The Cold War Legacy
Chapter 3 Monuments and Misalignments

Part II Better, Faster, Cheaper?
Chapter 4 Lean Thinking
Chapter 5 Islands of Success
Chapter 6 Lean Enterprises

Part III Creating Enterprise Value
Chapter 7 A Value Creation Framework
Chapter 8 Program Value
Chapter 9 Corporate and Government Value
Chapter 10 National and International Value
Chapter 11 Future Value

Manuscript
To be delivered to publisher
October 2001
16 current MS & PhD students
- 8 Aeronautics-Astronautics
- 4 Technology & Policy
- 2 Technology & Management
- 1 Mechanical Engineering
- 1 Sloan School
- 1 USAF Fellow

57 graduated MS & PhD students
- 12 entered government service
- 10 entered aerospace industry
- 15 entered consulting industry
- 18 entered other professions
- 2 continuing studies at MIT

25 affiliated MS & PhD students
How far has LAI come and where will we go next?
**Strategic Impact of LAI**

### Journey of the Aerospace Industry

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<tr>
<th>Pre-1990</th>
<th>The ‘90’s</th>
<th>The Future</th>
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<tbody>
<tr>
<td>Craft</td>
<td>Mass Production</td>
<td>Lean Production</td>
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<td>Lean Enterprise</td>
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<td>Lean Extended Enterprise</td>
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- **LAI is extending “lean” knowledge and know-how**
  - Complex products with low rate production
  - Whole enterprise
  - Extended enterprise including the government customer

- **LAI helps an important national industry accelerate a fundamental, systemic transition from craft/mass to Lean**

- **LAI educates**

- **LAI is a new model for industry-government-academic-labor collaboration**
What’s New in 2001

➢ Renewed top level Air Force support
  ➢ Gen Lester Lyles: Get the message out!
  ➢ Mrs. Darleen Druyun—Endorsement
  ➢ Lt Gen Raggio—“LAI is delivering value”

➢ Phase III emphasis
  ➢ Lean Enterprise Self-Assessment Tool
  ➢ Curriculum, with other universities
  ➢ Graduates with “lean experience”

➢ LAI Follow-On (Beginning Sept 2002)
  ➢ Executive Board planning underway
  ➢ “Concept of Operations” — to be signed by Co-Chairs at Executive Roundtable (December 13)
Why Do We Need an LAI Follow-On?

From LAI Executive Subcommittee ("G9")

➢ **Do for the rest of the enterprise what we did for manufacturing**

➢ **Educate “everybody” about lean**

➢ **Sustain lean knowledge and tools and help members use them**