Lean Aerospace Initiative
Plenary Workshop

Welcome and Theme Introduction

March 23, 1999

Presented By:
Earll M. Murman
MIT
Presentation Outline

- Introduction to LAI
- Impact of lean and the benefits of LAI
- A framework for the future
- Workshop overview
- Summary
LAI Sponsors and Participants

Avionics/Missiles
- Applied Materials Inc.
- Hewlett Packard
- Raytheon Systems Co. (Dallas and El Segundo)
- Lockheed Martin Electronics & Missiles
- Textron Systems Division
- Rockwell Collins, Inc.
- TRW Inc.

Airframe
- The Boeing Company (St. Louis, Seattle)
- Lockheed Martin Aeronautical Systems
- Northrop Grumman Corp.
- Raytheon Aircraft Co.

Propulsion
- Rolls Royce Allison
- General Electric Aircraft Engines
- Pratt & Whitney Gov’t Engines
- Sundstrand Corp.

Space
- Lockheed Martin Space & Strategic Missiles
- Boeing Space Transportation
- Pratt & Whitney Space Propulsion
- Hughes Space & Communications
- GenCorp Aerojet
- TRW Inc.

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)

Other Government
- DARPA
- DLA
- NASA
- NAVAIR
- AMCOM
- OUSD(A&T)
- NRO

Other Participants
- UAW
- AIA
- DSMC
- IDA
- Wharton (Univ of Penn)
- Univ of Chicago
- International Collaborations:
  - Univ of Linköping
  - UK LAI

MIT
- Lead Researchers
- Faculty, staff
- Students
- Neutral Catalyst

50/50 Cost Share between Government & Industry: Total $3.2M/yr.
Lean Aerospace Initiative History

1993 - 1996

- Consortium formed with industry/government/labor/MIT
- Focus on defense aircraft
- Research on benchmarking best practices
- Lean Enterprise Model (LEM) conceptualized
- Industrial base pilot projects started to accelerate improvement

1996 - 1999

- Government membership expanded and Space Sector added
- Research on improving practices
- Collaboration with international programs initiated
- Focus on products; e.g. LEM, policy recommendations
- Impact of lean and LAI on industry/government assessed

1999 - 2002  Planning for LAI Phase III in progress

- Focus on “Best Life Cycle Value” and five key themes
- Address barriers to implementation and transition to lean
- Enhance effectiveness of the national workforce
- Emphasize knowledge deployment
LAI’s Process Flow

Drivers: Economic Realities Leadership

Products → Research
Research → Data
Data → Awareness
Awareness → Experience
Experience → Imperative
Imperative → Research Priorities
Research Priorities → Implementation
Implementation → Industry, Labor, Government

LAI’s laboratory is the real world!
Current LAI Research and Products

(Detailed write ups for each research project in tab 15 of binders)

Product Development
- Req’ts gen/System eng
- Risk and variability
- Technology insertion
- PD value stream

Test and Space Ops
- Lean S/C testing
- Lean launch ops
- Lean on-orbit ops

Supplier Relations
- Info infrastructure
- Strategic outsourcing
- Supplier integration
- Benchmarking

Factory Ops
- Lean production system design
- Benchmarking assembly systems
- Transition to production

LAI Products
- Workshops
- Implementation Aids
- Lean Enterprise Model
- Policy Recommendations
- Reports/briefings/articles

Policy & External Environment
- Incentives for lean
- Lean user req’ts
- Subsystem commonality
- Lean overhead

Integrated Topics
Key LAI Events Since Last Plenary

- 13 Nov LAI Executive Board
  - Approved Prof. Widnall as Co-Chair representing MIT
  - Approved adding a MIT LAI stakeholder Co-Director
    - Cliff Harris was selected and joined LAI in Jan 1999
  - Approved making LEM architecture (practices, metrics, definitions, but not data sheets) publicly available 1Q 99
  - Approved preliminary plans for Phase III
- 19-20 Jan Product Development Workshop
  - Product Development Value Stream
- 3-4 Feb Implementation Workshop
  - System Barriers to Implementation
- 18 Feb Supplier Relations Symposium
  - Electronic Integration of the Lean Enterprise Supplier Value Stream
External Events
Since Last Plenary

- 8 Nov article in Dallas Morning News
- 10 Nov Presentation to SecAF Space Conference
- 1-4 Dec Defense Manufacturing Conference
- 15 Jan meeting with IAM representatives
- Feb Regional supplier workshop at the California Manufacturing Technology Center, Los Angeles
- 3 Mar Co-Chair briefing to Gen. Babbitt, AFMC/CC
  5 Mar Co-Chair briefing to Dr. Gansler, OUSD (A&T)
  - Briefed “Impact of lean and benefits of LAI”
- 9 Mar article in NY Times business section
- 11 Mar briefing to Business Executives for National Defense
Impact of Lean and Benefits of LAI

“What are the benefits which have been realized from implementation of lean practices in your organization, with an emphasis on specific and quantitative results”

“What are the contributions of the LAI to achieving these benefits”

- 28 Letters received from LAI Executive Board members (16 industry, 11 government, MIT)
- White paper on web page and in back pocket of binders
- Briefed to Gen. Babbitt and Dr. Gansler
Impact of Lean on Stakeholders

**LAI**
- 16 endorsement letters from industry

**LAI**
- 11 endorsement letters from Government agencies

Substantial improvements in manufacturing efficiency

Beginning to impact lower tier supply base and SPO organizations

Opportunity to increase impact in –
- Product development
- Business processes
- Acquisition

Selected Examples of Impact of Lean in the Product Value Stream

- **Manufacturing**
  - Up to 60% Reduction in Floor Space with Same Capacity
  - > 60% Manufacturing Productivity Improvements
  - 35% Overall Production Operations Productivity Improvements

- **Supplier Integration**
  - 40% Supplier Lead-time Reduction

- **Product Development**
  - 30% Reductions in Product Development costs demonstrated in pilot projects

Lean Implementation and Opportunities in Product Value Stream

Lean Leaders - % Implementation*

25-40% Manufacturing

20-30% Supplier Integration

15-20% Product Development

2-10% Business Processes

<10% Acquisition Interface

Lean “converts” are just beginning to realize the benefits

*LAI Integration Team Assessment
Lean Business Practices

- Strong Integrated Product Teams proponent
- Shared metrics and data
- Creative Incentives
  - Separate contracts to provide insight (delivery, affordability, support)
  - Award fee for each contract tied to complementary goals and measures
  - Unique incentives in multi-year contract (e.g. sell place in line if FMS opportunities arise)

Results
Deliveries ahead of schedule
Production efficiency up 50%
Nonconformance hours down 70%

Source: C-17 SPO
**Pilot & Demonstration Projects**

<table>
<thead>
<tr>
<th>MODULAR FACTORY FOR ELECTRONIC WARFARE COMPONENT MFG (CEC Program, ALQ-135)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% reduction in microwave power module (MPM) costs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ADVANCED MODULAR MISSILE FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>40% reduction in AMRAAM cycle time, 25% plant-wide inventory reduction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C-17 LEAN FACTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>$18M Price Reduction on Main Landing Gear Pod and Cargo Door</td>
</tr>
</tbody>
</table>

---

**To Date:**
- 16 Lean Forum projects initiated
- Linked to LAI research findings
- $96M invested, ManTech & SPO
- 2:1 return documented
- All projects tied to a weapon system sponsor (JSF, F-22, C-17, AIM-120) to insure implementation

**Examples**

Source: ManTech
Major Reported LAI Benefits

- Consortium-guided, university led research program evolving a knowledge base to support transitioning to lean
- Research products, e.g. the Lean Enterprise Model (LEM), provide reference tools for common awareness, language and understanding of lean principles
- Focus and framework for implementation
- Neutral forum for exchange of information, ideas, and understanding

“Everyone in the defense establishment shares the benefits of LAI. Through mutual commitment to improvement, shared knowledge, and leveraged implementation, we have raised the level of competency in the US defense industry and fueled the acquisition reform process.” - Industry letter

LAI Impact on Education

Scholarship and Enhanced Educational Programs:

- Faculty & graduate students in LAI engaged in real world problems addressing a national need
- Graduating students placed in U.S. aerospace organizations
- Collaboration between Engineering & Management Schools and faculty
- Impact on degree programs and curriculum
- A new academic model for collaboration with industry and government

“LAI aligns MIT closer to industry and government concerns.”

Best Life Cycle Value

A system offering best life-cycle value is defined as a system introduced at the right time and right price which delivers best value in mission effectiveness, performance, affordability and sustainability and retains these advantages throughout its life.
Five Enterprise Themes For “Best Life Cycle Value”

- Time as measured by cycle time and clock speeds
  - Shift to “economies of time” from “economies of scale”
- Organization and people as essential to success
  - Related to largest number of LEM Overarching Practices
- Knowledge & information infrastructures as enablers
  - Linkages for the lean enterprise value streams
- Government as a lean customer and operator
  - Central driver in the pace of change to lean
- Measuring the added value to the enterprise
  - Workforce, customers, shareholders, the public

Themes for this morning’s plenary speakers
**Plenary Workshop Format**

**Day One - Mar. 23**
- A.M. - General Session
  - LAI Perspective: Tom Ferguson
  - Keynote: Doug Engelbart
  - Speaker: Tom Kochan
  - Panel Discussion

**Day Two - Mar. 24**
- A.M. - General Session
  - Implementation Activities
  - Lean Debate
  - Coordination Strategies with Speakers: Marc Knez, Jan Summers, Sandy Jap

- P.M.
  - Breakout Sessions
    - 7 different topical areas
  - Reception
  - Dinner
Workshop Notes

- Presentations are in your binders; also on our web site on or about April 4, 1999
- A Workshop Evaluation is also included
- On-site business services 4th floor or limited assistance at LAI registration desk
- Two scheduled breaks - please keep program running smoothly by adhering to times
- Refer to Tab 1 for complete list of scheduled meetings and room assignments
- Videotaping in progress to help extend learning and outreach
- Reception with cash bar starting at 5:30
Summary

- LAI has evolved since 1993 to provide the knowledge base and implementation focus for transitioning the national defense aerospace enterprise to lean
- Lean has demonstrated reduced cycle times and costs for military aerospace products, with improved performance
- A focus for the future is “Best Life Cycle Value” with accompanying key enterprise themes
- Welcome to the Spring 99 LAI Plenary Workshop