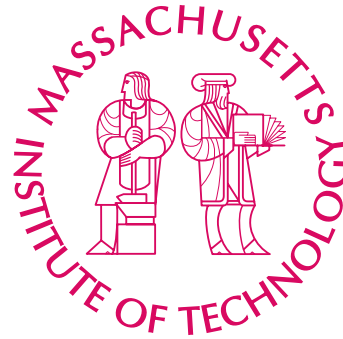


# Lean Aerospace Initiative Plenary Workshop

## Welcome and Theme Introduction



**March 23, 1999**

Presented By:  
Earll M. Murman  
MIT



# *Presentation Outline*

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- **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.

## Space

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

## Airframe

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

## MIT

- Lead Researchers  
Faculty, staff  
Students
- Neutral Catalyst

## Propulsion

Rolls Royce Allison  
General Electric Aircraft Engines  
Pratt & Whitney Gov't Engines  
Sundstrand Corp.

## Other Government

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

## 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 Participants

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

**50/50 Cost Share between Government & Industry: Total \$3.2M/yr.**



# Lean Aerospace Initiative History

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## 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

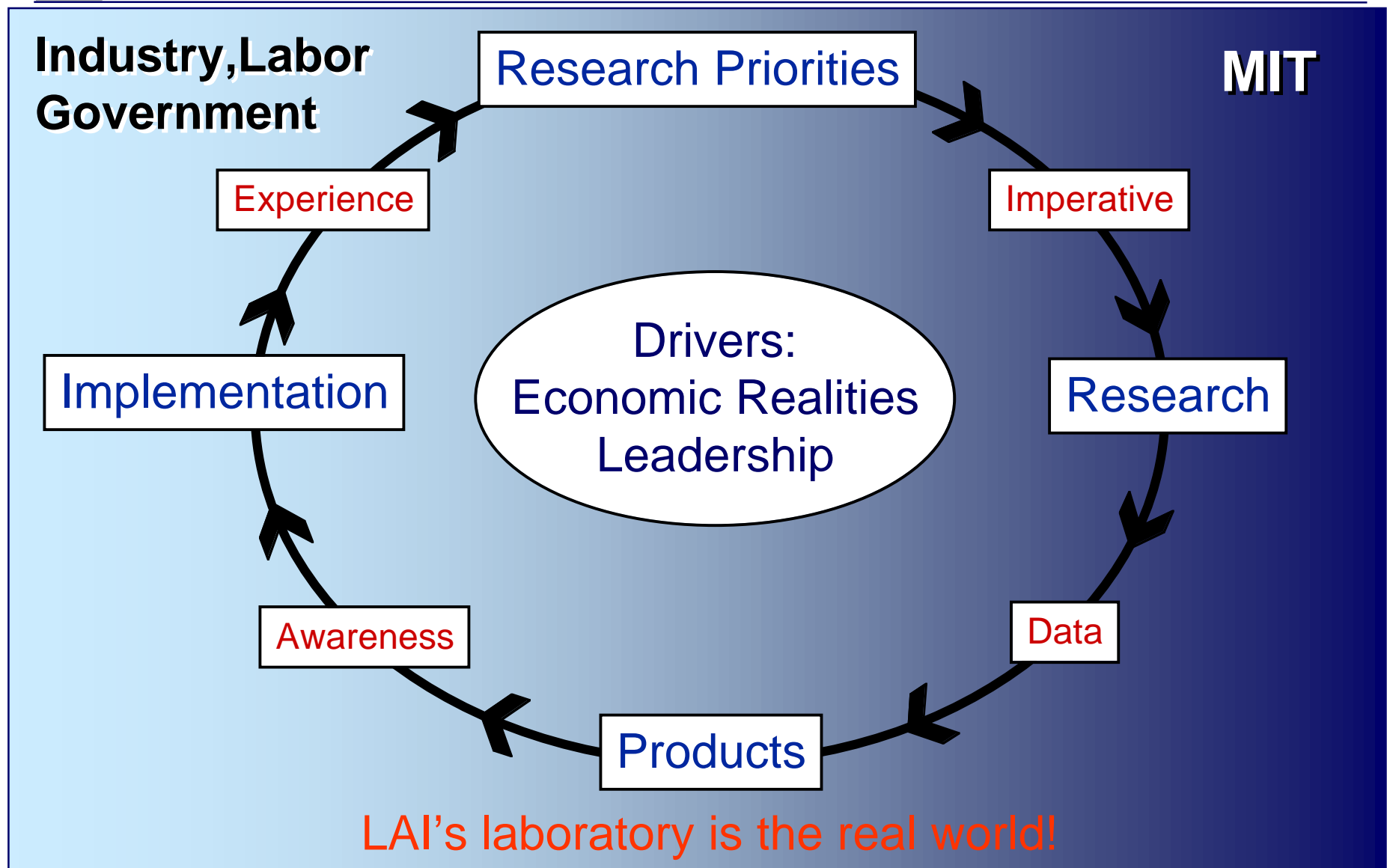
## 1996 - 1999

- 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

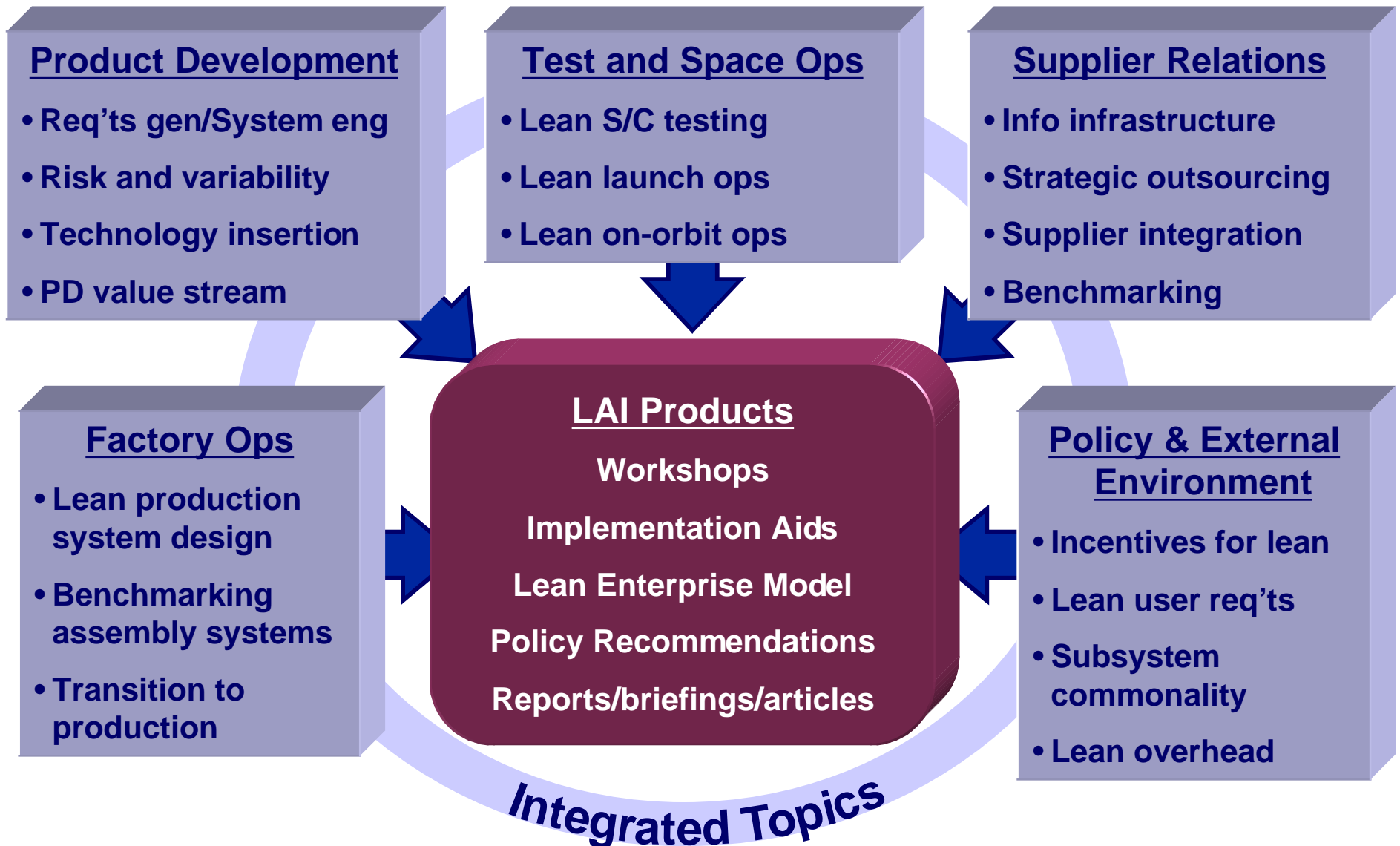
- Focus on “Best Life Cycle Value” and five key themes
- Address barriers to implementation and transition to lean
- Enhance effectiveness of the national workforce
- Emphasize knowledge deployment

# LAI's Process Flow



# Current LAI Research and Products

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





## ***Key LAI Events Since Last Plenary***

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- **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***

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- **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**



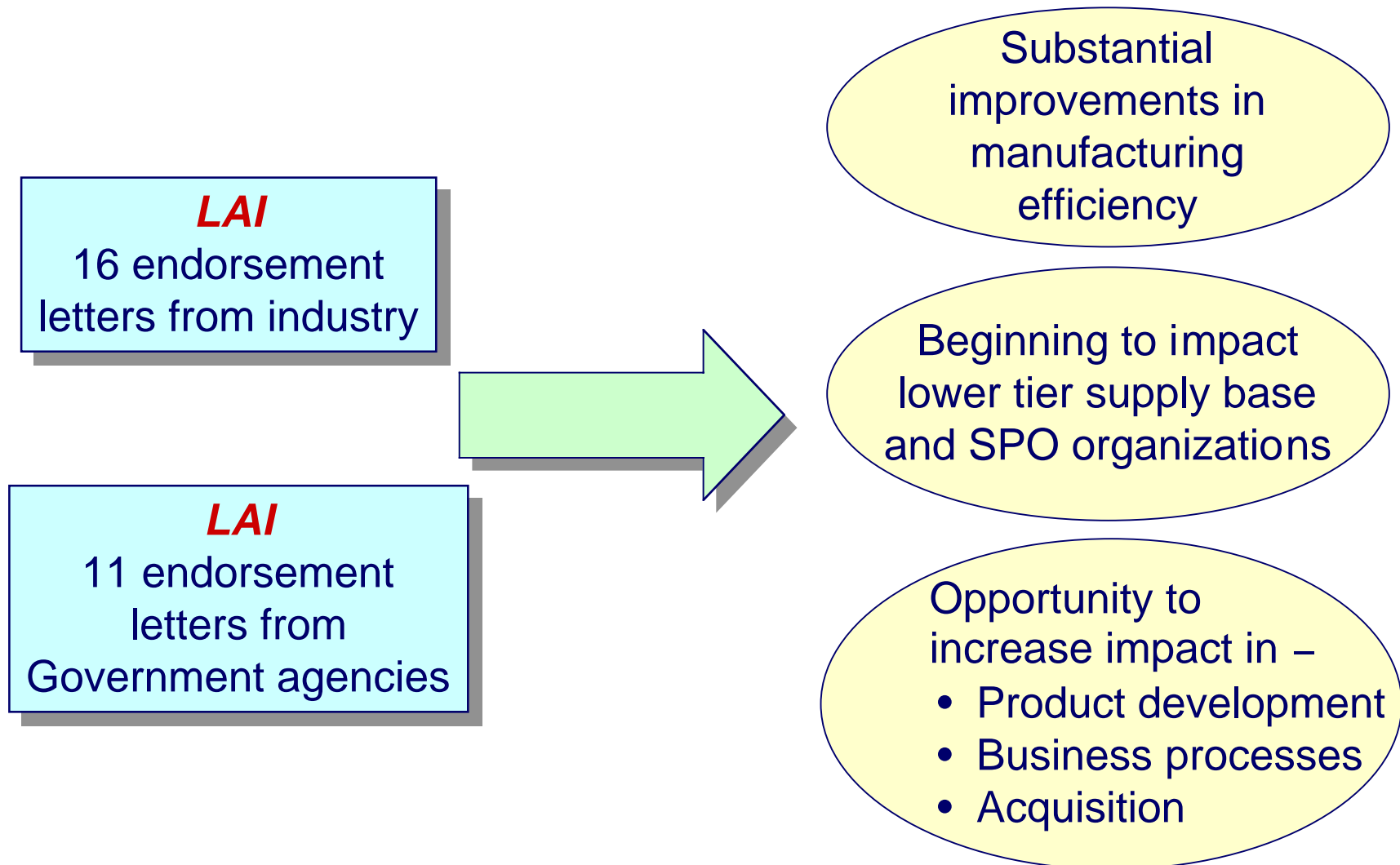
## *Impact of Lean and Benefits of LAI*

**“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**

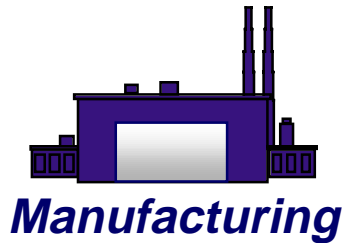
# Impact of Lean on Stakeholders



Source: "Benefits of Implementing Lean Practices and the Impact of the Lean Aerospace Initiative in the Defense Aerospace Industry and Government Agencies", LAI White Paper, January 31, 1999



# Selected Examples of Impact of Lean in the Product Value Stream



Up to 60% Reduction in Floor Space with Same Capacity

> 60% Manufacturing Productivity Improvements

35% Overall Production Operations Productivity Improvements



**Supplier Integration**

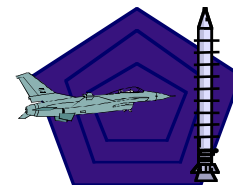
40% Supplier Lead-time Reduction



**Product Development**

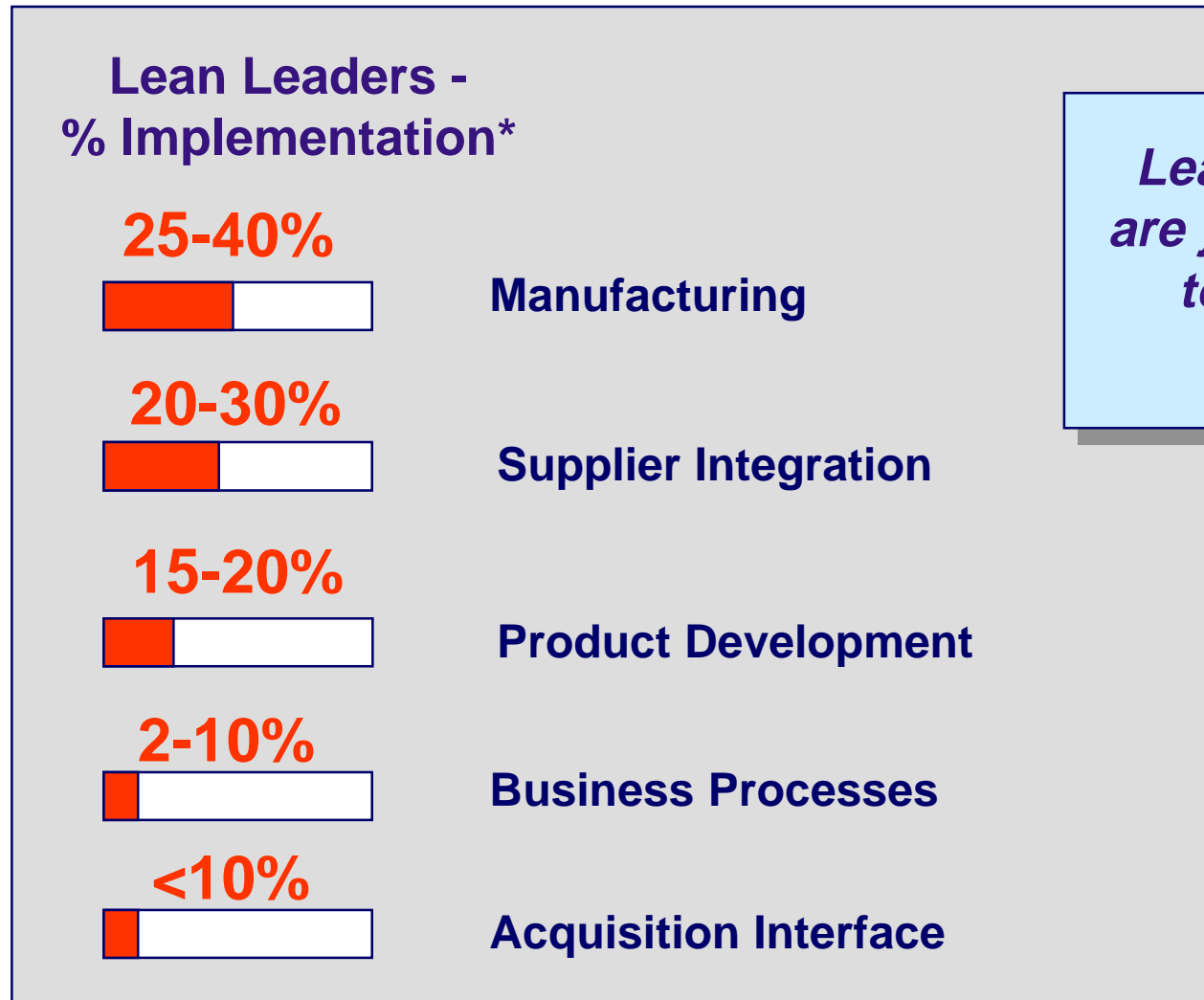
30% Reductions in Product Development costs demonstrated in pilot projects

**Opportunity**



**Acquisition System & Policy**

# Lean Implementation and Opportunities in Product Value Stream



*Lean “converts” are just beginning to realize the benefits*

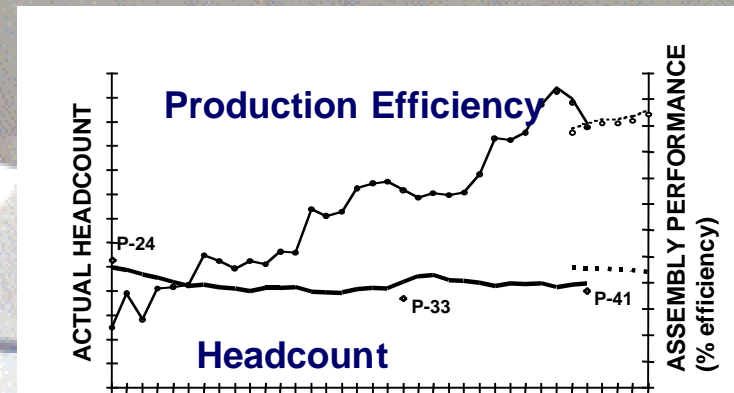
\*LAI Integration Team Assessment

# Customer Practices & Policies

## Incentives for Lean Behavior on C-17

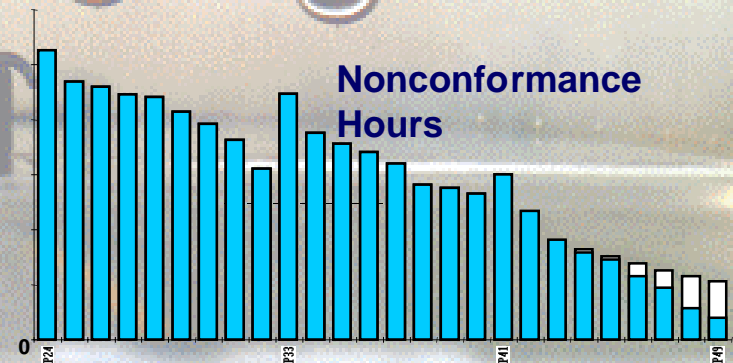
### Lean Business Practices

- 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%**



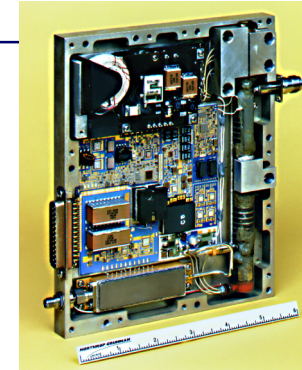
# Pilot & Demonstration Projects

## 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

**MODULAR FACTORY FOR ELECTRONIC WARFARE COMPONENT MFG (CEC Program, ALQ-135)**  
50% reduction in microwave power module (MPM) costs



## ADVANCED MODULAR MISSILE FACTORY

40% reduction in AMRAAM cycle time, 25% plant-wide inventory reduction



## C-17 LEAN FACTORY

\$18M Price Reduction on Main Landing Gear Pod and Cargo Door



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

Source: “Benefits of Implementing Lean Practices and the Impact of the Lean Aerospace Initiative in the Defense Aerospace Industry and Government Agencies”, LAI White Paper, January 31, 1999



## ***LAI Impact on Education***

### **Scholarship and Enhanced Educational Programs:**



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

- **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**

Source: “Benefits of Implementing Lean Practices and the Impact of the Lean Aerospace Initiative in the Defense Aerospace Industry and Government Agencies”, LAI White Paper, January 31, 1999





## 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”***

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- **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

P.M.

Focus Team Meetings

Reception

## 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

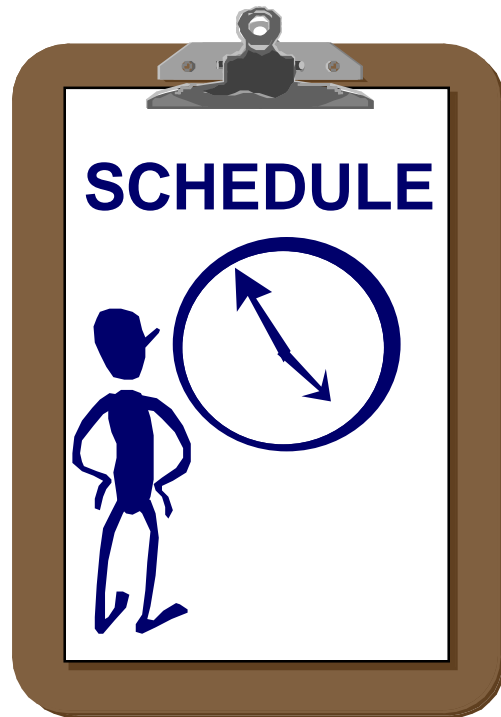
7 different topical areas

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

**LAI IS YOUR INITIATIVE!**