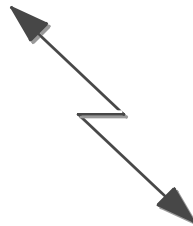
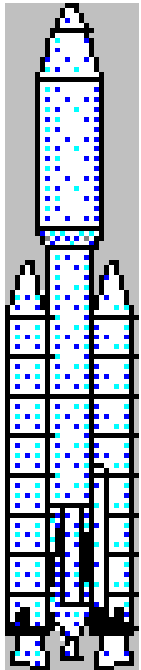
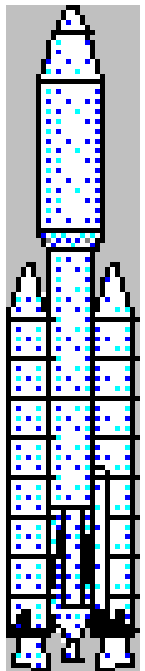
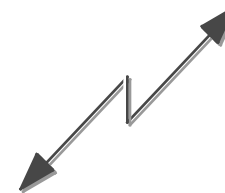
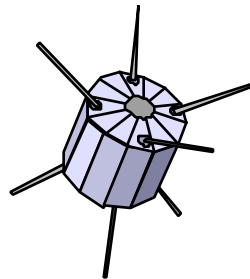
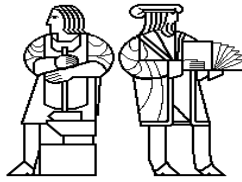


The Lean Space Quick Look Study: Results



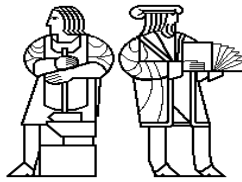
Daniel Hastings
MIT





Outline

- ◆ **Background of Lean Principles and Activities at MIT**
- ◆ **Lean Space Quick Look Study**
 - Goal/Objectives
- ◆ **Lean Aircraft Initiative**
- ◆ **Quick Look Study Process**
- ◆ **Stakeholders Input**
- ◆ **Research Opportunities**
- ◆ **Proposed Concept of Operations**
- ◆ **Next Steps**



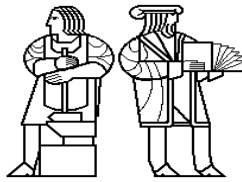
Background: Key Lean Principles

◆ Meta Principles

- Responsive to change - *basis of environment*
- Waste minimization - *basis of affordability*

◆ Enterprise Principles

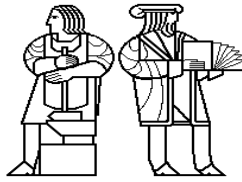
- Right thing, right place, right time, right quantity
- Effective relationships within the value stream
- Continuous improvement
- Striving for perfect first-time quality



Background: Lean Activities at MIT

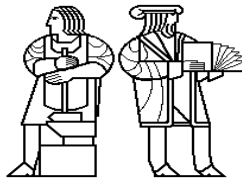
- ◆ **International Motor Vehicle Program (IMVP)**
- ◆ **Lean Aircraft Initiative (LAI)**
- ◆ **Fast and Flexible Manufacturing**
- ◆ **Lean Sustainment Initiative**
- ◆ **NSF Product Development Center**
- ◆ **Lean Ship**

HIGH LEVERAGE



Objectives of Lean Space - Quick Look

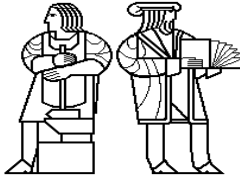
- ◆ **Is a Lean Space Initiative of value?**
- ◆ **What is the basis for buy-in by the stakeholders?**
- ◆ **What is an appropriate Concept of Operations for a Lean Space Initiative?**
- ◆ **What should be the linkages with LAI?**
- ◆ **Scope:**
 - **Spacecraft & Launchers**
 - **Spacecraft & Launch Operations**



Lean Aircraft Initiative

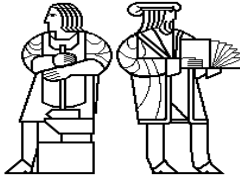
- ◆ **VISION:**
 - Significantly reduce cost and cycle time for military aircraft throughout the entire value chain while continuing to improve product performance**

- ◆ **LAI has:**
 - Established a forum for exchange of information, ideas and understanding
 - Created the Lean Enterprise Model (LEM)
 - Benchmarking data**
 - Case Studies**
 - Produced quantitative results leading to near real-time implementation



The Lean Aircraft Initiative Strategy

- ◆ **Partnership:** Industry, Air Force and MIT work jointly to define scope, emphasis, methodology
- ◆ **Inclusive:** All industry sectors and key stakeholders brought together
- ◆ **Systematic:** Focus on quantitative analyses; systems view
- ◆ **Objective:** MIT provides unbiased research; serves as neutral catalyst for change
- ◆ **Dynamic:** Working, learning , building together
- ◆ **Implementation:** Usable results on continuing basis; outreach, education and training



LEM Architecture: Applies to Space

Principles

- WASTE MINIMIZATION •RESPONSIVENESS TO CHANGE
- Right Thing at Right Place, Right Time and in Right Quantity
- Optimal First Unit Delivered Quality • Continuous Improvement
- Effective Relationships within the Value Stream

Enterprise Level Metrics

- Flow Time •Resource Utilization • Quality Yield
- Stakeholder Satisfaction

12 Overarching Practices

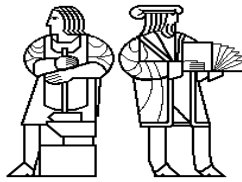
Metrics -Data - Barriers - Interactions

64 Enabling Practices

Metrics -Data - Barriers - Interactions

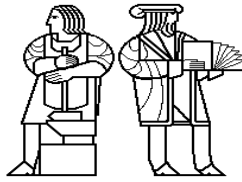
Supporting Practices

**Small Differences
for space**



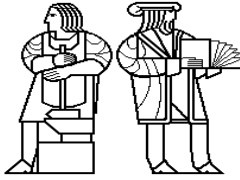
Quick Look Study Process

- ◆ **Form IPT**
 - AF/Aerospace/Industry/MIT participation
- ◆ **Map LEM into space enterprise**
- ◆ **Survey stakeholders (written & visits)**
 - Research Issues
 - Willingness to participate
- ◆ **Develop Concept of Operations with the Lean Aircraft Initiative**



Stakeholder Survey & Visits

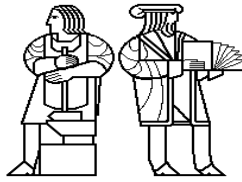
- ◆ **Would a Lean Space Initiative similar to the Lean Aircraft Initiative be of benefit to you?**
 - **If so, how should it be structured?**
 - **Will you be willing to participate?**
 - **What are your research issues?**



Stakeholder Presentation: Mission

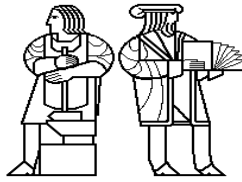
- ◆ **Core Lean Space Initiative Mission**
 - Significantly reduce cost and cycle time for space assets while improving product performance

- ◆ **Means to accomplish mission**
 - Joint Government/Industry/MIT participation
 - Integrative research on cross cutting topics using stakeholder data
 - Application & extension of the LEM
 - Facilitate enterprise-wide change



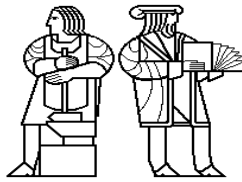
Stakeholder Presentation: Benefits

- **Partnership driven forum to define & resolve key industry/government issues**
- **Joint benchmarking of best practices backed by data**
- **Leveraging of experience from LAI & other lean studies**
- **Emphasis on short & long term issues**
- **Generation of new lean practices for lean operation**



Stakeholder Presentation: Concept of Operations

- ◆ **Form an Industry/Government/MIT Consortium**
- ◆ **Funding**
 - LAI members interested in space sector contribute \$25K additional
 - Non-LAI members contribute \$75K
 - Government to match Industry investment

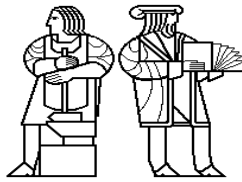


Stakeholder Responses: Visits & Surveys

(V) ♦	Boeing Defense & Space Group	YES	(V) ♦	Lockheed-Martin Sunnyvale	MAYBE*
(V) ♦	Hughes Space & Communications Co.	YES	♦	Motorola	MAYBE
(V) ♦	Lockheed Martin Astronautics	YES	(V) ♦	Space Systems/Loral	MAYBE
(V) ♦	McDonnell-Douglas	YES	♦	TRW	MAYBE*
♦	Pratt & Whitney	YES	(V) ♦	Computer Sciences	NO
♦	Textron Systems Division	YES	♦	DynCorp	NO
♦	Space Applications Corp.	YES	♦	GTE	YES
♦	Thiokol	YES	♦	Globalstar	NO
			♦	Honeywell	MAYBE
			♦	Litton Industries Inc.	NO
			♦	Raytheon Company	NO
			♦	Texas Instruments	NO

(V) Visited

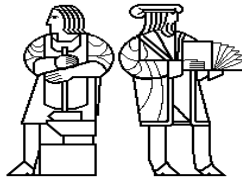
* Yes, if Gen. DeKok approves



Government Stakeholders Response

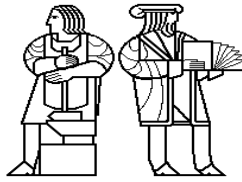
- ◆ **Government**
 - **Air Force**
 - ◆ **AFRL** YES
 - ◆ **Space Command (V)** YES
 - ◆ **ESC** YES
 - ◆ **ASC** YES
 - ◆ **AFMC** YES
 - **NASA** YES
 - **NRO (V)** CONDITIONAL
 - **BMDO (V)** YES
 - **Space Architect** YES
 - **DUSD(Space)** No Response

◆(V)= Visit



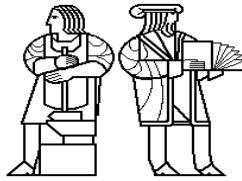
Stakeholder Comments (Visits)

- ◆ **Most common reason for participation**
 - Desire to engage the government in a neutral forum so as to jointly push for leanness
- ◆ **Most common reason for lack of participation**
 - Not clear what would be the value added at this time to the company in its ongoing push for leanness
 - Concern about giving away a competitive edge
 - **Both concerns were there at LAI initiation & are not concerns any more**



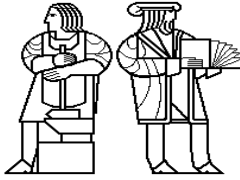
Survey Results: 23 Surveys & Visits

- ◆ **The end-to-end process, from acquisition of space and launch assets to operation of those assets, can be streamlined**
- ◆ **All have initiated major improvements in their productivity**
- ◆ **Many believed a Lean Space Initiative would offer a modest-to-great benefit to their organization**
- ◆ **Most were interested in participating**
- ◆ **A minority believed the Lean Space Initiative should be separate from LAI**



Survey Results (Continued)

- ◆ **Biggest factors that discourage leanness:**
 - “inconsistent and changing requirements from customers, government and prime contractors”
 - “technical limitations in processes and technologies”
- ◆ **Biggest factors that encourage leanness:**
 - “customer-induced”
 - “organizational, managerial or cultural changes”



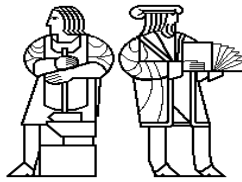
Potential Research Issues Identified by Stakeholders

◆ LAI Current Research Issues

- Risk Assessment and Management in a Lean Environment
- Impact of Acquisition Policy on Leanness
- Impact of Constantly Changing Requirements & Funding
- Lean Supply Chain Management
- Lean Development Practices

◆ Additional Space Research Issues

- New Technology Insertion in a Lean Environment
- Translation and Impact of the Commercialization of Space
- Lean Space & Launch Operations
- How to Create Open Architectures for Multiple Space Systems
- How to Build Specialized Satellites in a Lean Environment
- The Lean Enterprise in Tomorrow's Environment



Stakeholder Concerns: Our Responses

◆ **Sharing of competitive data**

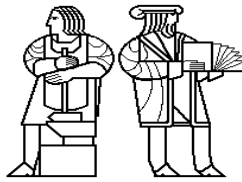
- MIT is the honest broker
- Data will be disguised
- Proprietary data completely protected
- Addressed satisfactorily in LAI through MIT normalizing of data and 30 day review of data

– **Foreign Involvement**

- Generic Data only
- Bounded by ITAR

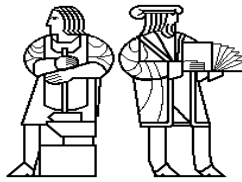
◆ **Classified information: NRO concern**

– **Work through Lincoln Lab**



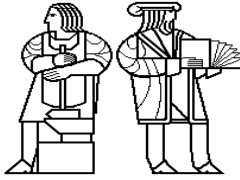
Summary

- ◆ **There is strong support for a Lean Space Initiative for contractors**
- ◆ **Good support from government**
- ◆ **There are significant unique research opportunities**
- ◆ **LAI-created LEM maps to space**
- ◆ **Recommendation**
 - **Create a space sector of LAI**



Concept of Operations: Space Sector of LAI

-
- ◆ **Intellectual leadership flows from LAI director & sector lead**
 - Earll Murman & Joyce Warmkessel
 - ◆ **Viable Sector size**
 - \$600,000 + per year for two years
 - Half from government, half from industry
 - ◆ **LAI focus teams expand to space on related issues**
 - e.g., government policy, risk
 - ◆ **Sector team tackles space unique issues**



NEXT STEPS

- ◆ **Quick Look Study wraps up July 20th**
- ◆ **If SMC, ASC & LAI approve:**
 - MIT proposes a space sector of LAI
 - Nominal start 1 September 1997
 - Decision by SMC needed by 1 August*

*** SMC Commander Approved on July 18**