The Lean Advancement Initiative (LAI) at MIT and Principles of Enterprise Systems

Prof. Debbie Nightingale
Co-Director
Lean Advancement Initiative
Lean+ Conference – Spring 2009
Outline

- LAI Overview
- New Products, Partnerships and Events
- Boeing Involvement with LAI
- Future Direction
LAI: A Consortium Dedicated To
Enterprise Performance

- Enable Enterprises to effectively, efficiently and reliably create value in a complex and rapidly changing environment
- Enable focused and accelerated transformation of complex enterprises
- Collaborative engagement of all stakeholders in Industry, Government and Academia
- Understand, develop, and institutionalize principles, processes, behaviors and tools
Boeing Involvement with EdNet

- Boeing has sponsored 10 Lean Academy weeklong workshops in last 4 years
  - Lean education for entry level Boeing employees
  - Involvement of local universities
  - Exposure to local leaders and lean activities

- Boeing “alums” are active participants in developing and delivering material
  - Al Haggerty
  - Thad Sandford
Increasing Total Enterprise Effectiveness

Successes through interaction between functions
- Lean applied to enabling processes
  - HR
  - IT, etc.

Success through enterprise integration & application to Product Dev
- Transition from waste minimization to value creation

Success through total enterprise integration of all stakeholders
- Industry
- Government
- Suppliers
- Employees

Expanding the lean boundaries
- Suppliers
- Customers
- Partners

1993

NOW

LAI - Expanding Enterprise Focus

Success through networked enterprises

EVOLUTION OF LEAN ENTERPRISE THINKING
LAI Operating Model

- **Deploy Knowledge**
  - Enable Transformation
  - Exchange Knowledge
  - Measure Value

- **Enable Enterprise Excellence**
  - Conduct Enterprise Research
  - Develop Transformation Products

- **Collaborate**
  - Accelerate Deployment
  - Engage all Stakeholders
  - Collaborate To Transform

- **Create Knowledge**
Creating a Holistic Approach to Enterprise Transformation

<table>
<thead>
<tr>
<th>Transformation Issue</th>
<th>Enterprise Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>How do I motivate and sustain enterprise transformation?</td>
<td>7 Principles of Lean Enterprise Thinking</td>
</tr>
<tr>
<td>How do I transform my enterprise to lean?</td>
<td>Enterprise Transformation Roadmap</td>
</tr>
<tr>
<td>What analytical tools can I use to support my decision making?</td>
<td>Enterprise Architecting Framework</td>
</tr>
<tr>
<td></td>
<td>Enterprise Strategic Analysis and Transformation (ESAT)</td>
</tr>
</tbody>
</table>
7 Principles of Lean Enterprise Thinking

1. Adopt a holistic approach to enterprise transformation.
2. Identify relevant stakeholders and determine their value propositions.
3. Focus on enterprise effectiveness before efficiency.
4. Address internal and external enterprise interdependencies.
5. Ensure stability and flow within and across the enterprise.
6. Cultivate leadership to support and drive enterprise behaviors.

**Understand Current State**

• Perform Stakeholders Analysis
• Define As-Is Value Stream
• Perform Enterprise Assessment

**PLANNING CYCLE**

**Engage Leadership in Transformation**

• Convey Urgency
• Foster Executive Lean Learning
• Obtain Executive Buy-In
• Establish Executive Lean Transformation Council

**Strategic Implications of Transformation…**

• Monitor & Measure the Outcomes
• Nurture Process, & Imbed Lean Culture
• Capture & Diffuse Lessons Learned
• Synchronize Strategic Long-Term & Short-Term Cycles

**Nurture, Process & Imbed Lean Enterprise Thinking**

**Implement & Coordinate Transformation Plan**

• Develop Detailed Project Implementation Plans
• Synchronize Detailed Plans
• Implement Projects and Track Progress
• Commit Resources
• Provide Education & Training

**Execution Cycle**

**Creating Transformation Plan**

• Identify Key Enterprise Improvement Project Areas
• Determine Impact Upon Enterprise Performance
• Prioritize, Select and Sequence Project Areas
• Publish Communication Plan

**Align Enterprise Infrastructure**

• Align Organization
• Align Incentives
• Empower Change Agents
• Rationalize Systems & Policies
• Align Metrics

**Envision & Design Future Enterprise**

• Create Vision of Future State
• Define “To-Be” Enterprise Value Stream
• Perform Gap Analysis

**A Committed Leadership Team**

**Source:** Nightingale, Srinivasan and Mize

http://lean.mit.edu
Enterprise Strategic Analysis for Transformation (ESAT)

ESAT
An integrated, analytical framework for diagnosing and improving overall Enterprise performance.

- Focuses on Enterprise-wide processes
- Provides a cohesive method for diagnosing an Enterprise to expose sources of waste and barriers to value delivery
- Considers the needs and values of all Enterprise stakeholders
- Identifies process interfaces, disconnects, and delays
- Establishes an Enterprise vision for the future
- Identifies improvement opportunities that will lead the Enterprise to its future state
LAI Enterprise Self-Assessment Tool (LESAT)

LAI Research
EVSMA
ESAT
Theses

LAI Consortium
Usage Experience

Downloaded more than 3,400 times since 2003

v1.0* (2001)
v1.5 (2009)
V2.0 (2010)
Version 2.0 development team includes 20+ participants from US, UK, and Australia

Schedule aligned with DoD effort on systems engineering effectiveness

- Six new leading indicators to be added to current 13
- New information and real-world examples will be included

Incorporated in IBM Rationale Product Suite

NAVAIR’s Systems Engineering Development & Implementation Center (SEDIC) using SE leading indicators to develop advanced analysis techniques and toolkit for Navy programs

“The leading indicators project is an excellent example of how academic, government and industry experts can work together to perform collaborative research that has real impact on engineering practice”

Magazine
March 2007

http://lean.mit.edu
Cost Modeling

Proprietary Implementations
- SEEMap
- COSYSMO-R
- SECOST
- Systems Eng. Cost Tool

COSYSMO Model

\[ PM_{CM} = A \cdot \left( \sum_{i} \left( w_i \Phi_{E_{ij}} + w_{ijk} \Phi_{E_{ik}} \right) \right)^{E} \cdot \prod_{j=1}^{E} EM_{ij} \]

Commercial Implementations
- SystemStar™
- SEER®
- PRICE

Academic Curricula
- SMU
- MIT
- George Mason University
- UC San Diego

Policy & Contracts
- NASA
- U.S. Air Force
- U.S. Army

10 Academic Theses

Deploy
Enable
Create
Collaborate
Knowledge Exchange Events

**CHANGE MANAGEMENT**

Knowledge Exchange Event

*October 2008*

- Taught and applied the five Enterprise Change Capabilities
- 16 participants
- Visited P&W EHRO facility to apply and present findings
- EHRO Facility reviewed and implemented suggestions

---

**ESAT**

Knowledge Exchange Event

*Sept. 2008*

Event was hosted by:

*U.S. Army*

---

**METRICS**

Knowledge Exchange Event

*November 2008*

Event was hosted by:

*Raytheon*
Communities of Practice

Community of Practice
A knowledge creating community that collaboratively solves hard, real-world problems
- Active participation
- Open and honest sharing

Product Development Community of Practice
- LAI’s third PD benchmarking event hosted by Raytheon in June 2008 at the University of Arizona.
- Collaboration with Technical University of Braunschweig for global benchmarking of implementation of Lean practices in PD.

Metrics Community of Practice
- Group’s second KEE was hosted by at Raytheon in Andover, MA, in November 2008
- LAI continues to contribute to measurement initiatives at Raytheon and Lockheed Martin
- Joint measurement workshop planned for May 2009
New Community of Practice Formed

Community of Practice

A knowledge creating community that collaboratively solves hard, real-world problems

- Active participation
- Open and honest sharing

Assessment/Diagnostic Community of Practice

- Recent interest in common methodologies and instruments for assessment or diagnostic sparked discussion session at Annual Meeting
- Meeting defined key interest areas for members
- Consensus to form a community of practice at April 2009 LAI Annual Meeting
- Future involvement in revisions to LAI LESAT tool
Expanding Lean Into Software

Boeing Phantom Works
- LAI developed a roadmap for enabling rapid certification of aerospace embedded software systems

- Literature Review (Standards, Academic Literature)
- Expert Interviews (Industry, Government, Academia)
- Roadmap for Future Research (Technology, Process)
**Journal of Enterprise Transformation (JET)**

**Unique New International Journal**

- Forum for articles on trends, new findings, and ongoing research on Enterprise Transformation
- Interdisciplinary research in management, industrial & systems engineering, information systems, organizational behavior, political science, and economics

- Partnership with the Institute of Industrial Engineers (IIE) and the International Council on Systems Engineering (INCOSE)
- Professor Nightingale and Dr. Ricardo Valerdi will serve as inaugural editors
- Associate editors from Europe, Asia, and the United States

- First Issue in early 2010

© 2009 Massachusetts Institute of Technology – Deborah Nightingale  April 2009 - 21
2009 LAI
Enterprise Transformation Research Summit
A Day-Long Overview of LAI's Enterprise Research, Insights, Findings, and Applications

Focused on LAI modes of doing Enterprise research:

- Developing and Deploying Enterprise models into practice and engagement
- Creating powerful partnerships for research and engagement
- Strengthening Enterprise performance with competency and collaboration models
- Learning from case studies
- Addressing Enterprise processes

Provided a mechanism to:

- Rapidly disseminate learning
- Highlight key areas from members that need further work

Videos
Thirteen presentations from this Research Summit are on video and can be viewed on our website (http://lean.mit.edu) and on MIT TechTV (http://techtv.mit.edu)
Highlights of Emerging Research

Chris Glazner
MIT Degree Candidate: Ph.D., Engineering Systems, 2009

- Strategic-level modeling and simulation of Enterprise Architecture to address key question directly affecting bottom-line results
  - Analyzes investment tradeoffs across multiple business units
  - Provides guidance on how to most effectively incentivize a company’s business units and allocate R&D discretionary budget

“Modeling and Understanding Enterprise Behavior Using a Hybrid Simulation Approach”

Presented by Chris Glazner at the LAI 2009 Enterprise Transformation Research Summit

See this presentation on Video at the LAI website (http://lean.mit.edu) and at MIT Tech TV (http://techtv.mit.edu)
Highlights of Emerging Research

- Developed and empirically validated integrated model of the USAF requirements, planning, budgeting, and acquisition systems
- Anomalous behaviors of acquisition are in fact emergent behaviors of a much larger, complex system
- Prior studies suggest many of the ‘pathologies’ outside of the control of the acquisition managers

<table>
<thead>
<tr>
<th>Swim Lane</th>
<th>Pre-MS “A” (Concept Refinement)</th>
<th>Pre-MS “B” (Technology Development)</th>
<th>Pre-MS “C” (System Development &amp; Demonstration)</th>
<th>Pre-Full Rate Production (Production &amp; Deployment)</th>
<th>Operations and Sustainment</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Money</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acquisition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contractor</td>
<td>Scoping of Model</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

“Identifying Leverage Points in Defense Acquisition Program Performance”

Presented by Major Robb Wirthlin at the LAI 2009 Enterprise Transformation Research Summit

See this presentation on Video at the LAI website (http://lean.mit.edu) and at MIT Tech TV (http://techtv.mit.edu)
Welcome

The Lean Advancement Initiative (LAI) offers organizational members from across the enterprise - thinking, products, and tools related to Lean - a unique research consortium that provides best practices, learned, and best practices.

LAI offers:

- unique opportunities to engage, learn, and share organizational transformation strategies
- a portfolio of thought-provoking and innovative enterprise-level research

Vision

LAI’s work is designed to enable enterprises to effectively, efficiently, and reliably create value in complex and rapidly changing environments.

Mission

LAI enables the focused and accelerated transformation of complex enterprises through the collaborative stakeholder engagement in developing and institutionalizing principles, processes, behaviors, and tools for enterprise excellence.
Adoption of Measurement Tools at BAE Systems and Raytheon

LAI Researcher Dr. Ricardo Valerdi | 00:13:00

What Makes measurement systems Adoptable? (survey on)
- Well documented
- Tailorable
- Tryability
- Information freshness
- Low barrier of entry
- Relative advantage
- Demonstrates value
- Compatibility
- On-going peer support
- Variety of incentives
- Agility
- Flexibility
- Credibility
- Data validity/integrity
LAI Synergies

LAI Communities of Practice

MIT School of Engineering

SEA - MIT Leaders for Manufacturing

MIT Sloan Management

9 MIT ILP

MIT EdNet

System design and management

Educate. Motivate. Innovate.
Boeing Involvement with LAI

- Active involvement in LAI’s Executive Board
- Participant in Case Studies and Knowledge Exchange Events
- Boeing has been active in all of LAI’s Lean PD benchmarking events
  - Rockwell Collins, 2007; Raytheon Missile Systems, 2008; Boeing hosted a second 2008 meeting in El Segundo
- In 2003 Boeing adopted LAI’s lean product development simulation as part of their basic training for engineers
  - Trained several thousand engineers and managers.
  - LAI workshop for train-the-trainer
Boeing Involvement with LAI

- Boeing incorporated parts of LAI’s supplier networks transformation toolset into their executive education programs.

- Boeing was a member of the LAI-collaboration that produced the Leading Indicators Guide Version 1.0 and LESAT 1.0.

- Supervision of Boeing Students

- Other SDM/LFM/Advanced Degree students in the areas of Supply Chain Management, Enterprise Transformation, Lean Engineering
Upcoming Knowledge Exchange Events

Knowledge Exchange Events

May 14, 2009
Using LESAT for Transformation
Host: MIT, Cambridge, MA

Knowledge Exchange Events

August 4-5, 2009
Sustaining Lean Practices Through Industry Education
Host: Boeing, Seal Beach, CA

Knowledge Exchange Events

October 28-30, 2009
Sharing Lean Change Success Stories
Host: TBD

Knowledge Exchange Events

November 4, 2009
Systems Engineering and Project Management Strategies for Cost Estimation
Location: TBD
This Summer at MIT

Architecting the Future Enterprise
June 8-9, 2009
(25% discount for LAI members)

LAI Lean Academy Course
July 13-15, 2009
(10% discount for LAI members)

LAI Lean Engineering Seminar
July 16-17, 2009
(10% discount for LAI members)

LAI Lean Healthcare Academy
July 16-18, 2009
(10% discount for LAI members)

web.mit.edu/professional/short-programs/
The Road Ahead

LAI will continue unique focus on large-scale Enterprise architecting and transformation

“Pull” from other sectors for Lean Enterprise thinking

Increase National and International impact
Enabling Enterprise Excellence

Discovery - Deployment - Renewal

Research Shapes Deployment

Enterprise Research
We study Enterprises to identify best practices, transformation strategies and future Enterprise architectures

Transformation Knowledge Deployment
We transform research-based knowledge into education, products, knowledge exchange events, and transformation events

Deployment Shapes Research

Stakeholder-Centric Value Creation