Outline

• LAI Overview

• Lean Enterprise Principles

• Transformation Strategies

• New Products, Partnerships and Events

• Findings, Insights and Road Ahead
1989
Identified sources of major weaknesses in US productivity, including commercial aircraft & education.

1990
Identified Lean, based upon Toyota Production System as a successor to mass production.

2002
Translated Lean principles to aerospace and enterprise context.
The Challenges of Complex Enterprises Requires a Systems Approach

- New strategic systems perspective
- Viewing enterprises as *holistic* and *highly networked* systems
- Integrating leadership processes, lifecycle processes and enabling infrastructure systems
- Balancing needs of multiple stakeholders working across boundaries

MOVING FROM THE PAST
(hierarchical) enterprise

TOWARDS THE FUTURE
(networked) enterprise
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
LAI Operating Model

- Enable Transformation
- Exchange Knowledge
- Measure Value

- Accelerate Deployment
- Engage all Stakeholders
- Collaborate To Transform

- Conduct Enterprise Research
- Develop Transformation Products

- Create Knowledge
- Enable Enterprise Excellence

- Collaborate

- Deploy Knowledge
What is a Lean Enterprise?

“A lean enterprise is an integrated entity that effectively and efficiently creates value for its multiple stakeholders by employing lean principles and practices.”

Murman et al., *Lean Enterprise Value*, Palgrave, 2002
Who Are Enterprise Stakeholders?

Any group or individual who can affect or is affected by the achievements of the organization’s objective

Source: Freeman, Strategic Management: A Stakeholder Perspective, Pittman, 1984
Value Creation Framework

Find stakeholder value

Agree to and develop the approach

Deliver on the promise

Dynamic and Iterative

Value Identification

Value Proposition

Value Delivery

Do the RIGHT job – Do the job RIGHT

The Evolution of Business Ecosystems: Enterprise Architecture Drives Performance

Ted Piepenbrock

Enterprise Architectures

Modular Enterprises

Integral Enterprises

Competitive Dynamics

Firm Performance

Industrial Evolution

Market Capitalization

Top-line Revenue focus

Bottom-line Cost focus

Growing Markets (Economies of Scale)

Stable Markets (Economies of Scope)

Carrying Capacity (e.g., Global GDP)

Firm Output

Long-term Speed & Stability

Short-term Speed & Flexibility


1900 1925 1950 1975 2000

http://lean.mit.edu
LAI - Expanding Enterprise Focus

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 vs NOW**
Creating a Holistic Approach to Enterprise Transformation

**Transformation Issue**

- How do I motivate and sustain enterprise transformation?
- How do I transform my enterprise to lean?
- What analytical tools can I use to support my decision making?

**Enterprise Tool**

- 7 Principles of Lean Enterprise Thinking
- Enterprise Transformation Roadmap
- Enterprise Architecting Framework
- Enterprise Strategic Analysis and Transformation (ESAT)
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.

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.

1. Adopt a holistic approach to enterprise transformation.

“From 1998 through 2005, we made dramatic market share gains, going from ... the mentality of an OEM to a very service oriented company.”

- Kent Stattler
  EVP of Services, Rockwell Collins
  Overhaul & Maintenance, Sept.1, 2007

Rockwell Collins Case Study

- 1998
  Lean electronics begins
- 1999
  Core Process Optimization Begins
- 2000
  Shared services organizations put into place
- 2001
  Rockwell Collins Spun off
- 2002
  Enterprise Scorecard
- 2003
  Refined Vision and Values Roadmap
- 2004
  Lifecycle Value Stream Management
- 2006
  Engineering Cycle Time Improvement

Source: George Roth, Lean Enterprise Change Case Study, 2006

http://lean.mit.edu
2. Identify relevant stakeholders and determine their value propositions.

“Rockwell Collins places first in this year’s Top-Performing Companies (TPC) ranking of aerospace and defense (A&D) companies with annual revenues of $1-5 billion.”

Source: Aviation Week and Space Technology, 2007
Rockwell Collins Case Study

Lean Electronics allows us to achieve improvements in quality, on-time delivery and other key performance measures.

Life Cycle Value Stream Management helps us achieve the best possible business decisions across the entire spectrum of our product and service offering.

Design and Development Cycle Time Reduction initiatives enable us to more effectively use our resources and deliver on more opportunities

"Process innovation is our answer .....”

Source: Rockwell Collins Annual Report 2007
Rockwell Collins Case Study


- Each employee averages 40 hours of education per year
- Focusing on 21st-century-style learning by tailoring education to fit the individual
- Apprentice like environment through online mentoring
- Knowledge management data base, with expertise location
- Fluid communities of practice
Enterprise Transformation Roadmap

**STRATEGIC CYCLE**

- **Determine Strategic Imperative**
  - Articulate Business Case for Lean
  - Focus on Stakeholder Value
  - Leverage Lean Gains

- **Perform Stakeholders Analysis**

- **Define As-Is Value Stream**

- **Perform Enterprise Assessment**

- **Create Vision of Future State**

- **Define “To-Be” Enterprise Value Stream**

- **Perform Gap Analysis**

**PLANNING CYCLE**

- **Understand Current State**
  - Perform Stakeholders Analysis
  - Define As-Is Value Stream
  - Perform Enterprise Assessment

- **Engage Leadership in Transformation**
  - Convey Urgency
  - Foster Executive Lean Learning
  - Obtain Executive Buy-In
  - Establish Executive Lean Transformation Council

**EXECUTION CYCLE**

- **Envision & Design Future Enterprise**
  - Create Vision of Future State
  - Define “To-Be” Enterprise Value Stream
  - Perform Gap Analysis

- **Align Enterprise Infrastructure**
  - Align Organization
  - Align Incentives
  - Empower Change Agents
  - Rationalize Systems & Policies
  - Align Metrics

**A Committed Leadership Team**

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

- **Align Organization**
- **Align Incentives**
- **Empower Change Agents**
- **Rationalize Systems & Policies**
- **Align Metrics**

- **Implement & Coordinate Transformation Plan**
  - Develop Detailed Project Implementation Plans
  - Synchronize Detailed Plans
  - Implement Projects and Track Progress
  - Commit Resources
  - Provide Education & Training

- **Create Transformation Plan**
  - Identify Key Enterprise Improvement Project Areas
  - Determine Impact Upon Enterprise Performance
  - Prioritize, Select and Sequence Project Areas
  - Publish Communication Plan

- **Alignment Requirements Identified…**

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

- **Implement & Coordinate Transformation Plan**
  - Develop Detailed Project Implementation Plans
  - Synchronize Detailed Plans
  - Implement Projects and Track Progress
  - Commit Resources
  - Provide Education & Training

- **Engage Leadership in Transformation**
  - Convey Urgency
  - Foster Executive Lean Learning
  - Obtain Executive Buy-In
  - Establish Executive Lean Transformation Council

- **Implement & Coordinate Transformation Plan**
  - Develop Detailed Project Implementation Plans
  - Synchronize Detailed Plans
  - Implement Projects and Track Progress
  - Commit Resources
  - Provide Education & Training

- **Create Transformation Plan**
  - Identify Key Enterprise Improvement Project Areas
  - Determine Impact Upon Enterprise Performance
  - Prioritize, Select and Sequence Project Areas
  - Publish Communication Plan

- **Alignment Requirements Identified…**

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

**Source:** Nightingale, Srinivasan and Mize

© 2008 Massachusetts Institute of Technology  D. Nightingale - MM/DD/YY- 21

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

- 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

ESAT

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

http://lean.mit.edu

© 2009 Massachusetts Institute of Technology /BAE Systems /Nightingale 05/05/09-22
What Is LESAT?

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

World Class

Assessment Matrix

Capability maturity model

Supporting materials

http://lean.mit.edu
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”

http://lean.mit.edu
Cost Modeling

Policy & Contracts

NASA
U.S. AIR FORCE
U.S. ARMY

10 Academic Theses

Commercial Implementations

SystemStar™
SEER
PRICE

COSYSMO Model

Proprietary Implementations

- SEEMaP
- COSYSMO-R
- SECOST
- Systems Eng. Cost Tool

Academic Curricula

SMU
MIT
George Mason University
NOVA Polytechnic Institute and School
UC San Diego
University of Southern California

Collaborate
Deploy
Enable
Create
Co-Evolving Research, Products, and Tools

Legend

Assessment | Resource | Transformation | Training

Research | Expanding Knowledge Base

Production Operations Transition to Lean (POTTL)

Lean Enterprise Model (LEM)

Lean Enterprise Self-Assessment Tool (LESAT)

Lean Enterprise Self-Assessment Tool (LESAT) Facilitator Guide

Lean Now Workshop

Lean Academy

Supplier Networks Reference

Supplier Networks Roadmap

Supplier Mgmt. Self-Assessment

Lean Enterprise Value Book

Lean Product Development

Product Development Value Stream Mapping (PDVSM)

Transformation Roadmap

Government Lean Enterprise Self-Assessment Tool (GLESAT)

Systems Engineering Leading Indicators

Leading Indicators

Research

Expanding Knowledge Base

LAI Facilitator

Lean Enterprise Product Development Simulation

Lean Enterprise Value Short Course

Lean Enterprise Value (LEV) Simulation

Lean Facilitator

Transition to Lean Guides

Transition to Lean (TTL)

Lean Enterprise Self-Assessment Tool (LESAT)

Legend

Product Development Value Stream Mapping (PDVSM)
Knowledge Exchange Events

**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

**Knowledge Exchange Event - Sept. 2008**

- Event was hosted by: U.S. Army

**Knowledge Exchange Event - November 2008**

- Event was hosted by: Raytheon

---

http://lean.mit.edu

© 2009 Massachusetts Institute of Technology /BAE Systems /Nightingale  05/05/09- 28
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
Future State Architecting Process

Future State Architecting Process

Evaluating

Future State

Architecting

Present State

Transformation

Future State

Future State

Future State
Enterprise Architecting – Enables Greater Efficiency and Effectiveness

- Effective integration – managing complex interdependencies
- System optimization, not local optimization
- Knowledge-based enterprise capabilities
- Achieving desired future state characteristics
  - Agility
  - Flexibility
  - Reconfigurability
EA Example: Reduce Time to Market Imperative

Streamlined Integrated Product/Process Development Process; Design standardization and reuse

IPD teams with representatives from engineering design, manufacturing and suppliers; collaborative team members with holistic perspective

IPD members must understand critical dimensions of product life cycle

Responsive support structure, enabled by standardized components and reliable products

Modular and platform product architectures to promote reuse, standardization, technology insertions, etc.

Global product development and manufacturing; ITAR restrictions

Information Technology

Engineering Data Management System to support new process

Reduce time to market for new product introduction

IPD teams with representatives from engineering design, manufacturing and suppliers; collaborative team members with holistic perspective

IPD members must understand critical dimensions of product life cycle

Products / Services

Responsive support structure, enabled by standardized components and reliable products

Modular and platform product architectures to promote reuse, standardization, technology insertions, etc.

Global product development and manufacturing; ITAR restrictions

Information Technology

Engineering Data Management System to support new process

Reduce time to market for new product introduction

IPD teams with representatives from engineering design, manufacturing and suppliers; collaborative team members with holistic perspective

IPD members must understand critical dimensions of product life cycle
LAI Research Groups Address 4 Grand Questions

1. How can I understand the way my organization currently operates within its larger context?

2. How can I define and evaluate the future possibilities for a more efficient and effective enterprise?

3. What are the most effective strategies and tactics to achieve these future possibilities for my enterprise?

4. How can I best manage the enterprise change process?

**FOCUS of RESEARCH**
- ESE Approaches
- SE Effectiveness Indicators
- Studies of ESE Practices (with MITRE)

**Enterprise Architecting - Enterprise Transformation (EA-ET)**
- Enterprise Value Analysis
- Enterprise Architecting
- IT as Enterprise Enabler
- Enterprise Cost and Metrics
- Enterprise Modeling

**Lean Enterprise Product Development (LEPD)**
- Lean Product Development
- Lean Systems Engineering
- Lean Software

**Enterprise Systems Engineering (ESE)**
- ESE Approaches
- SE Effectiveness Indicators
- Studies of ESE Practices (with MITRE)

**Enterprise Change Management (ECM)**
- Change Management
- Enterprise Change Philosophy
- Studies of Successful Change
- Distributed Leadership

http://lean.mit.edu
Addressing Open Challenges

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)

Rockwell Collins
- LAI shared lessons learned on creating systems of innovation,
- Identified areas of future research with the Global Technology development team at Rockwell Collins

http://lean.mit.edu
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
January 2009 Research Summit

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

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](http://lean.mit.edu) and on MIT TechTV [http://techtv.mit.edu](http://techtv.mit.edu)

http://lean.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)

http://lean.mit.edu
Highlights of Emerging Research

Major Robb Wirthlin
United States Air Force
MIT Degree Candidate:
Ph.D., Engineering Systems, 2009

- 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

---

**“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 best practices, products, and tools, and unique research consortia learned, and best practices.

LAI offers:

- unique opportunities to learn and share knowledge
- a portfolio of tools and innovative enterprises

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 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?

- Well documented
- Tailorable
- Trialability
- Information freshness
- Low barrier of entry
- Relative advantage
- Transparency
- Compatibility
- Demonstrates value
- On-going peer support
- Variaty of incentives
- Credibility
- Agility
- Flexibility
- Failure modes
- Enabled by IT
- Data validity/integrity
LAI Synergies

LAI Communities of Practice

- MIT School of Engineering
- SEA\textsuperscript{RI}
- MIT LFM Leaders for Manufacturing
- MIT\textsuperscript{sdm} system design and management
- EdNet\textsuperscript{LA}

http://lean.mit.edu

© 2009 Massachusetts Institute of Technology / BAE Systems / Nightingale 05/05/09- 43
Key Findings

• Industry is in its lean enterprise infancy
• There are significant correlations in the lean maturity of enterprise processes
• Leadership commitment and alignment is critical to lean enterprise transformation
• Infrastructure processes such as IT and HR are key lean enterprise enablers
• Management information feedback is present in high lean maturity enterprises
Enterprise Implementation Insights

- Transformation is continuous and takes years, not months
- Senior executive leadership, commitment, and involvement are critical success factors in enterprise transformation
- Biggest challenges is institutionalizing lean principles and sustaining the change
- Focusing on time forces everyone to think of “enterprise”
- Enterprises must be viewed as a holistic system
- Substantial potential in applying lean principles to the Enterprise
Upcoming Knowledge Exchange Events

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

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

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

Strategies for Cost Estimation
November 4, 2009
Location: TBD

http://lean.mit.edu
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/
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