

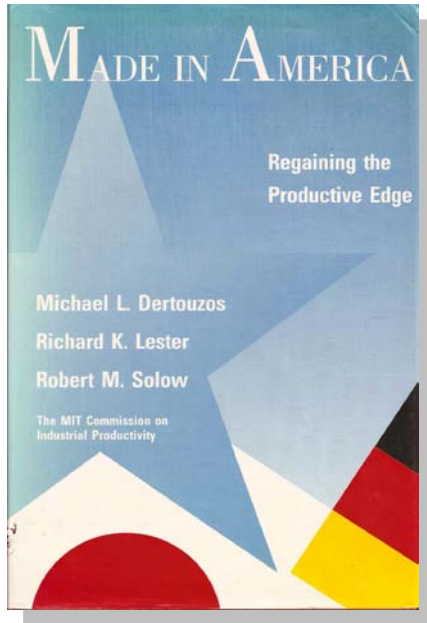


Principles of Lean Enterprises

Professor Debbie Nightingale
Massachusetts Institute of Technology
May 05, 2009

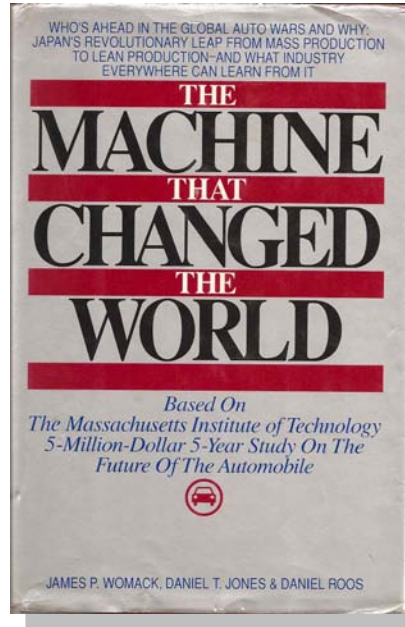
- **LAI Overview**
- **Lean Enterprise Principles**
- **Transformation Strategies**
- **New Products, Partnerships and Events**
- **Findings, Insights and Road Ahead**

MIT Studies on Industrial Productivity



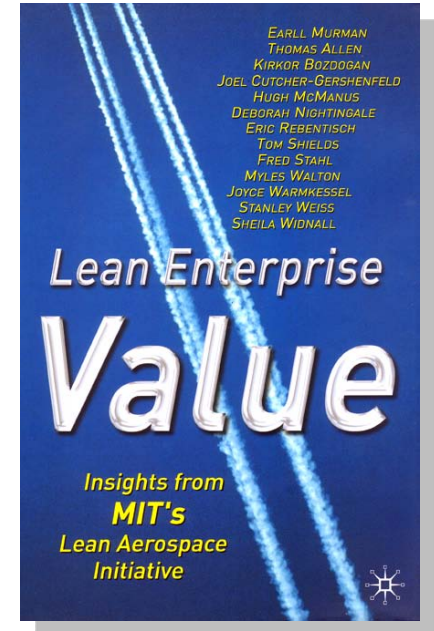
1989

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.

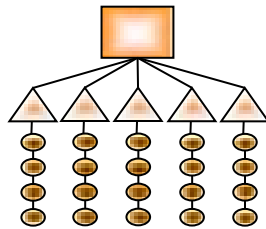


2002

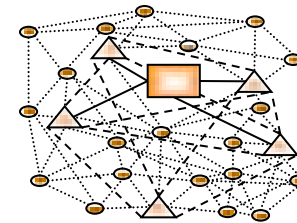
Translated Lean principles to aerospace and enterprise context.

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 Members Share A Goal: Enterprise Excellence

NORTHROP GRUMMAN

BOEING

LOCKHEED MARTIN

**Rockwell
Collins**



Raytheon

USA
United Space Alliance



LAI 
LEAN ADVANCEMENT INITIATIVE™

ULA
United Launch Alliance



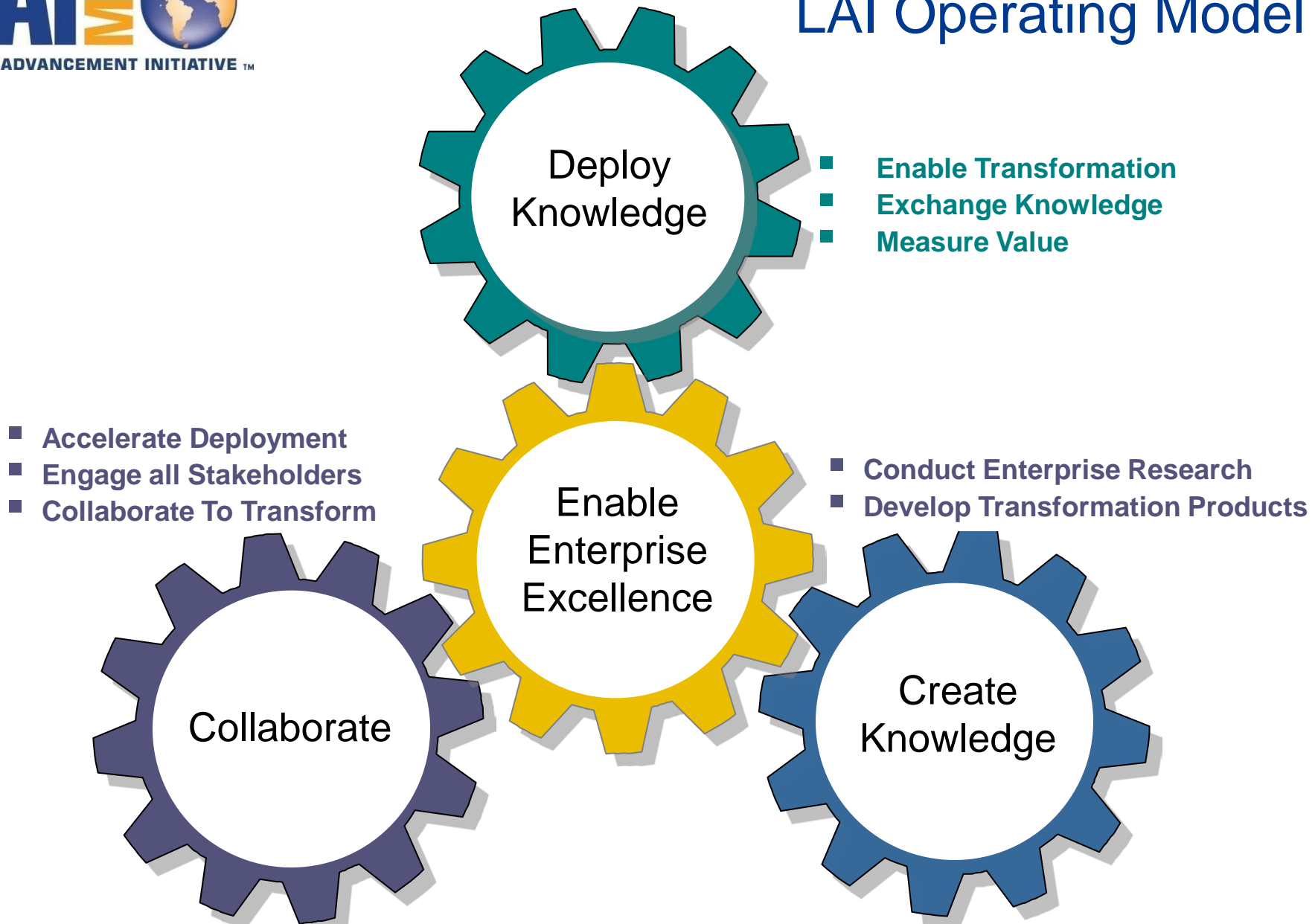
 **Pratt & Whitney**
A United Technologies Company

BAE SYSTEMS

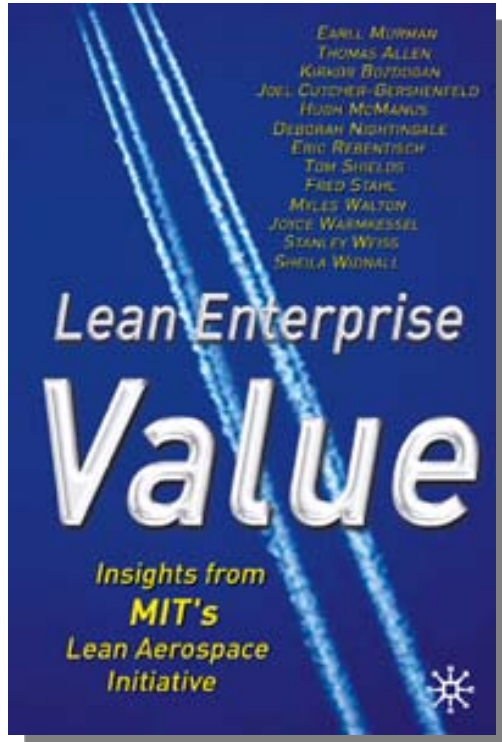
 **Sikorsky**
A United Technologies Company



LAI Operating Model



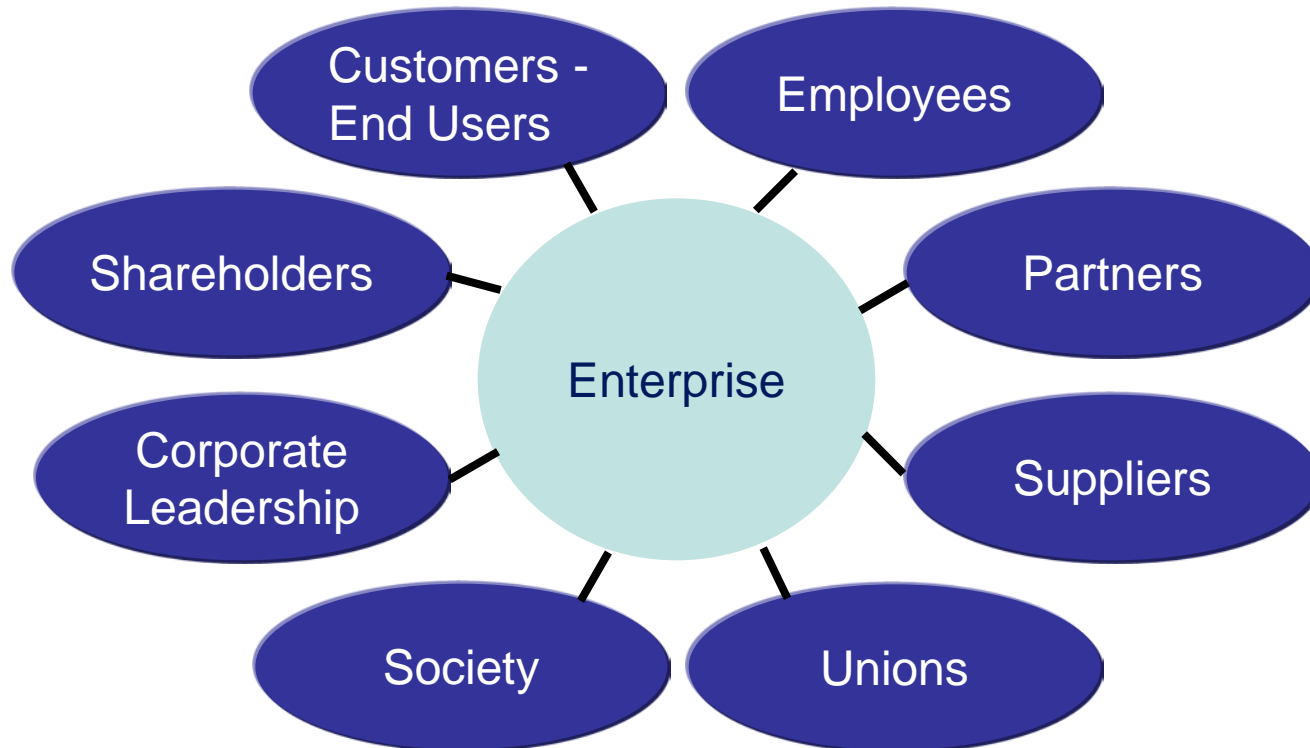
What is a Lean Enterprise?



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

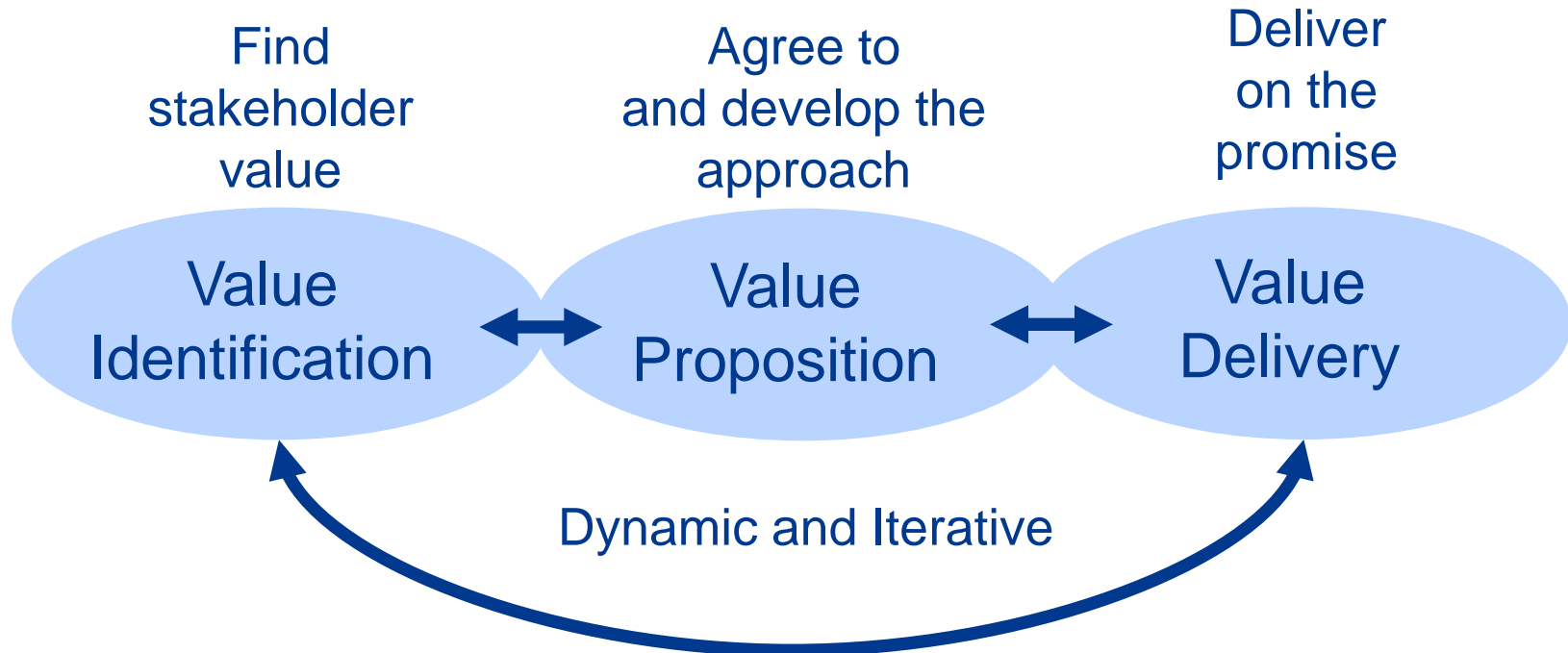
Murman et al., *Lean Enterprise Value*, Palgrave, 2002

Who Are Enterprise Stakeholders?

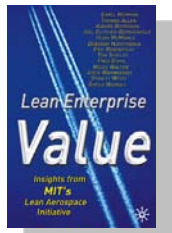


Any group or individual who can affect or is affected by the achievements of the organization's objective

Value Creation Framework



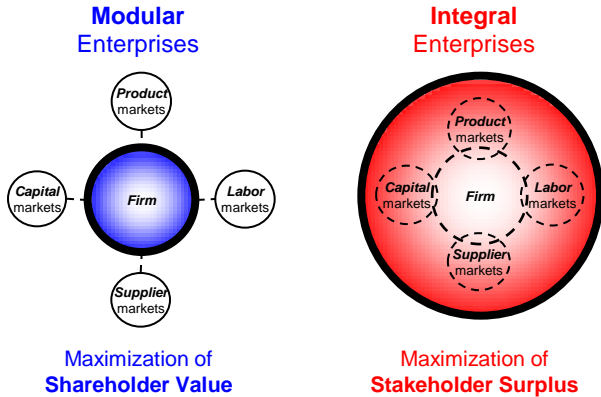
Do the RIGHT job – Do the job RIGHT



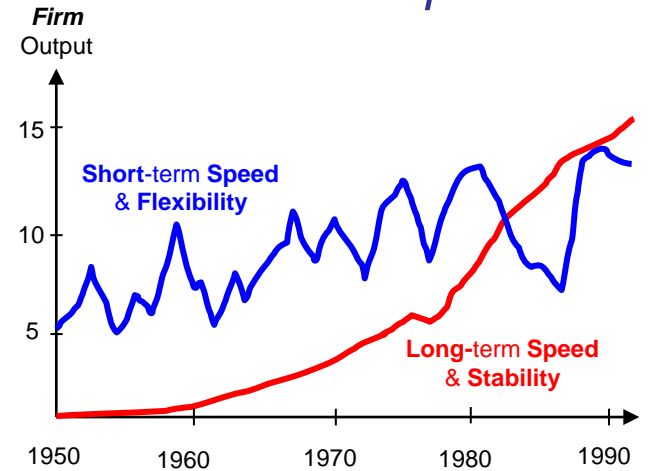
Source: Murman, E., et al., *Lean Enterprise Value: Insights from MIT's Lean Aerospace Initiative*, Palgrave, 2002.

The Evolution of Business Ecosystems: Enterprise Architecture Drives Performance

Ted Piepenbrock

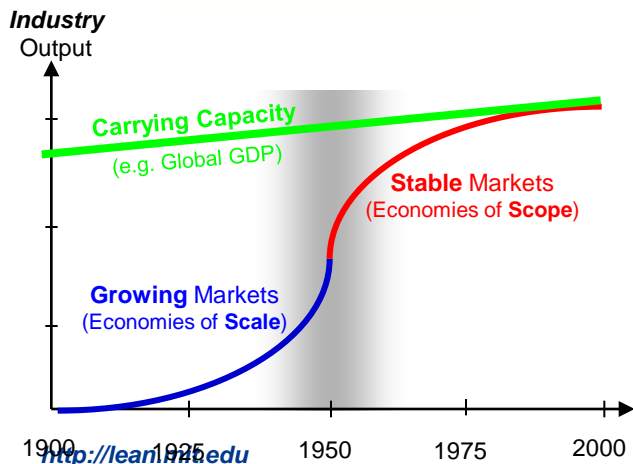


Competitive Dynamics

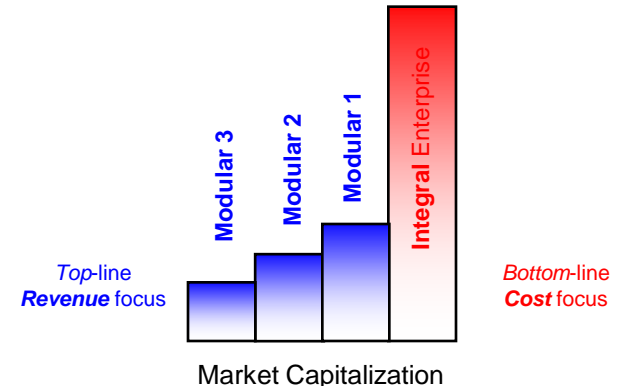


Enterprise Architectures

Firm Performance



Industrial Evolution



LAI - Expanding Enterprise Focus

Increasing Total
Enterprise
Effectiveness

EVOLUTION OF LEAN ENTERPRISE THINKING

Operations
Functional lean
successes
Manufacturing
Supplier Networks
"Islands" of Success

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

Success
through
*networked
enterprises*

Expanding the
lean boundaries
• Suppliers
• Customers
• Partners

1993

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.

Emphasize **organizational learning**.

7 Principles of Lean Enterprise Thinking

1.

Adopt a holistic approach to enterprise transformation.

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Cultivate leadership to support and drive enterprise behaviors.

7.

Emphasize organizational learning.

Rockwell Collins Case Study

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

- **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

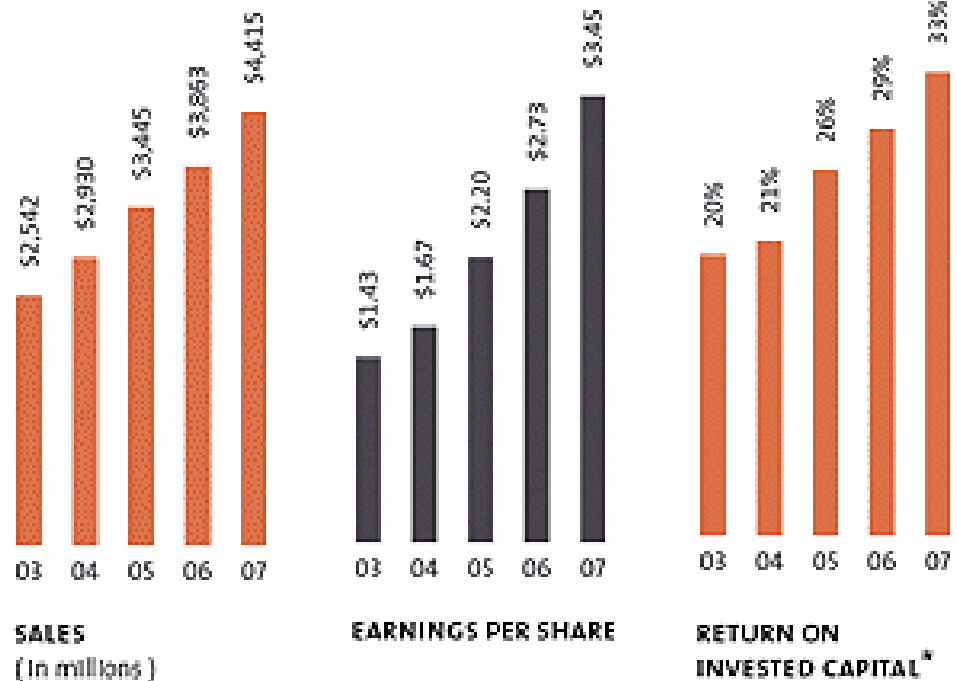
Rockwell Collins Case Study

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

3.

Focus on
enterprise
effectiveness
before efficiency.

“Process innovation
is our answer

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

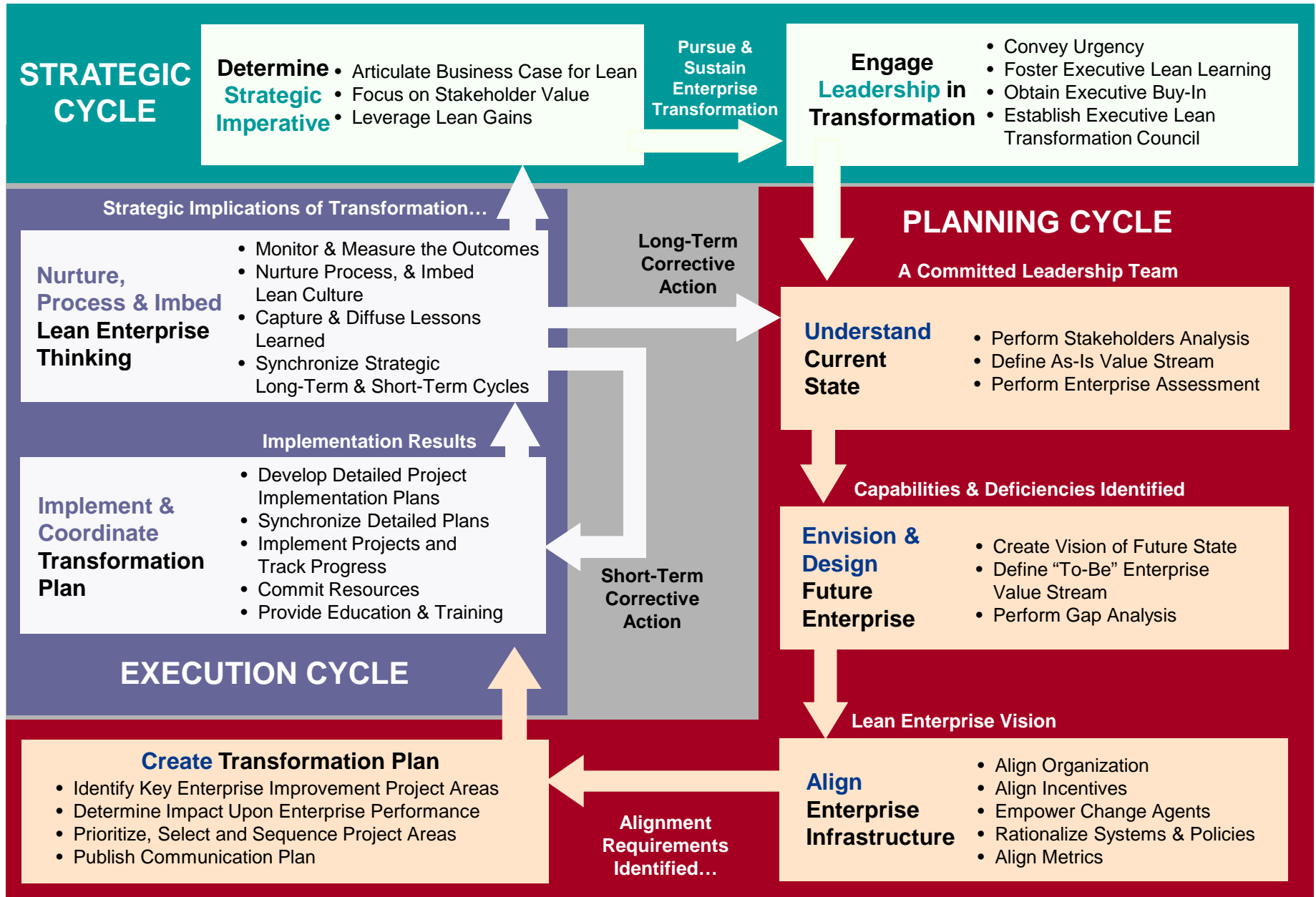
Source: Rockwell Collins Annual Report 2007

Rockwell Collins Case Study

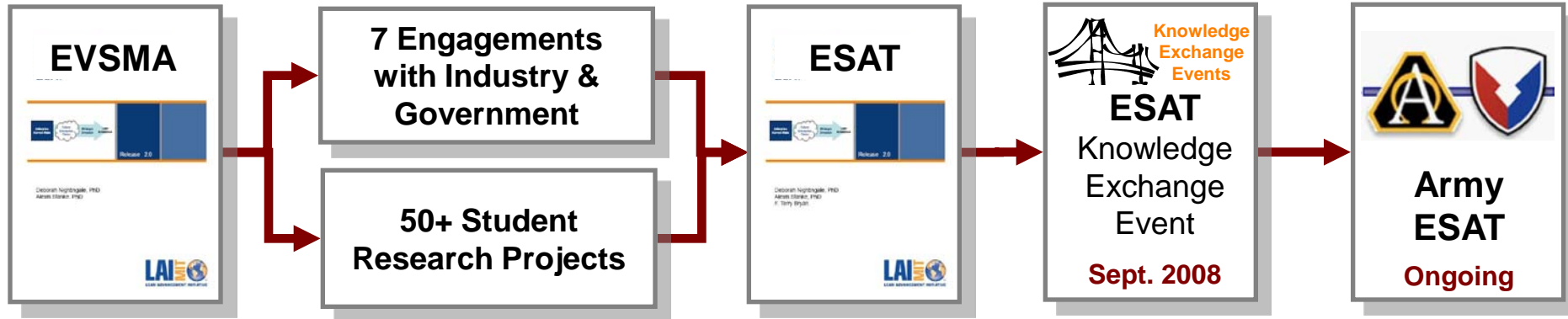
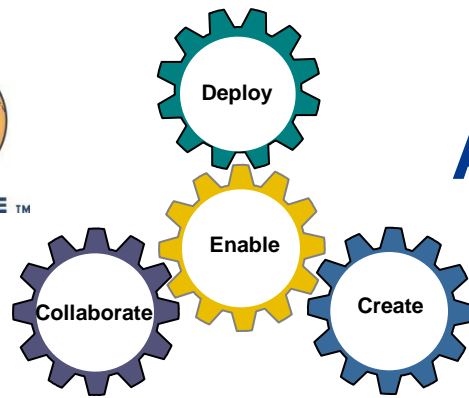
7.
Emphasize
organizational
learning.

- 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

LAI MIT Enterprise Transformation Roadmap



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

World Class



Assessment Matrix

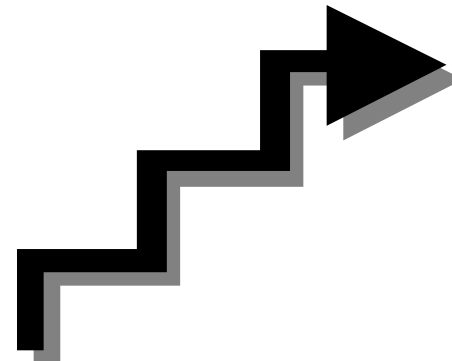
What Is LESAT?

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



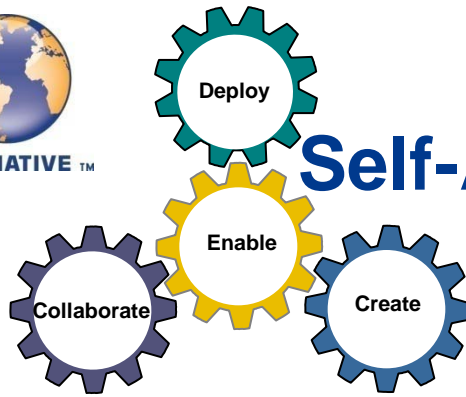
	1	2	3	4	5

Capability maturity model



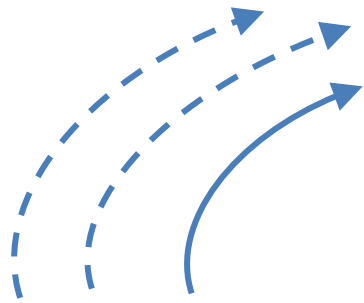
Supporting materials

LAI Enterprise Self-Assessment Tool (LESAT)

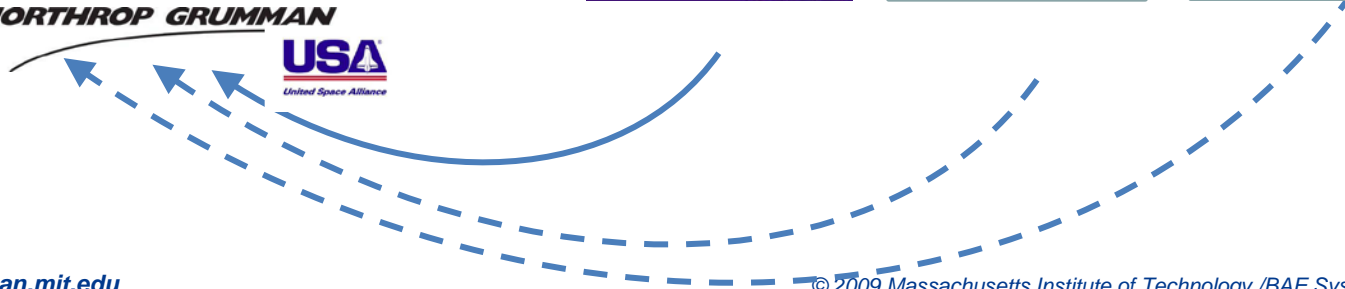
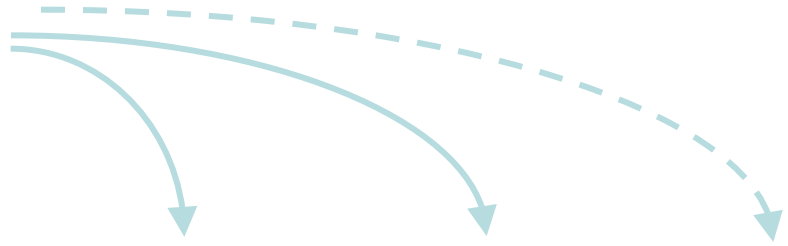


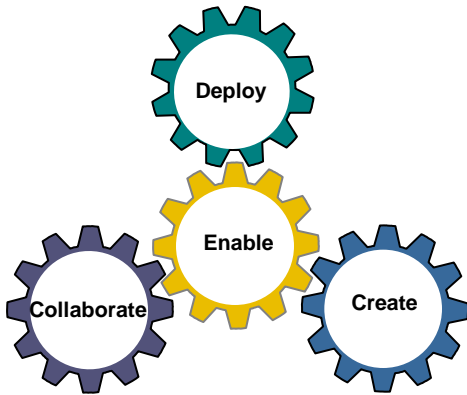
Downloaded more than
 3,400 times
 since 2003

LAI Research
 EVSMA
 ESAT
 Theses



LAI Consortium
 Usage Experience





Systems Engineering Leading Indicators

LAI + INCOSE + PSM
 Guide to SE
V.1.0 Leading Indicators
 June 2007



V.2.0
**Guide to
 Systems Engineering
 Leading Indicators**
December 2009
 LAI + INCOSE + PSM + SEARi



Magazine
 March
 2007

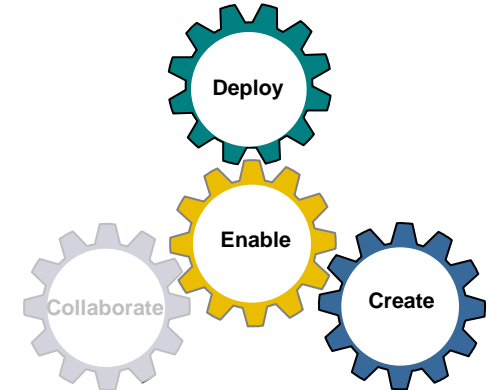
*“The leading indicators project is an excellent example of how academic, government and industry experts can work together to perform collaborative research that has **real impact** on engineering practice”*

- Version 2.0 development team includes 20+ participants from US, UK, and Australia
- Schedule aligned with DoD effort on systems engineering effectiveness



- 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

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

Cost Modeling



Commercial Implementations






Policy & Contracts

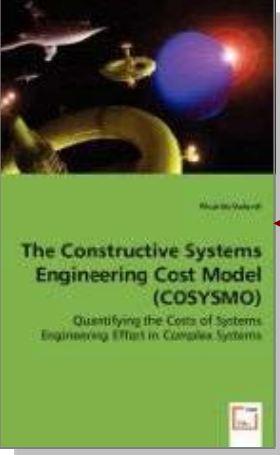





COSYSMO Model





$$PM_{NS} = A \cdot \left(\sum_k (w_{e,k} \Phi_{e,k} + w_{n,k} \Phi_{n,k} + w_{d,k} \Phi_{d,k}) \right)^E \cdot \prod_{j=1}^{14} EM_j$$


10 Academic Theses



Proprietary Implementations

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

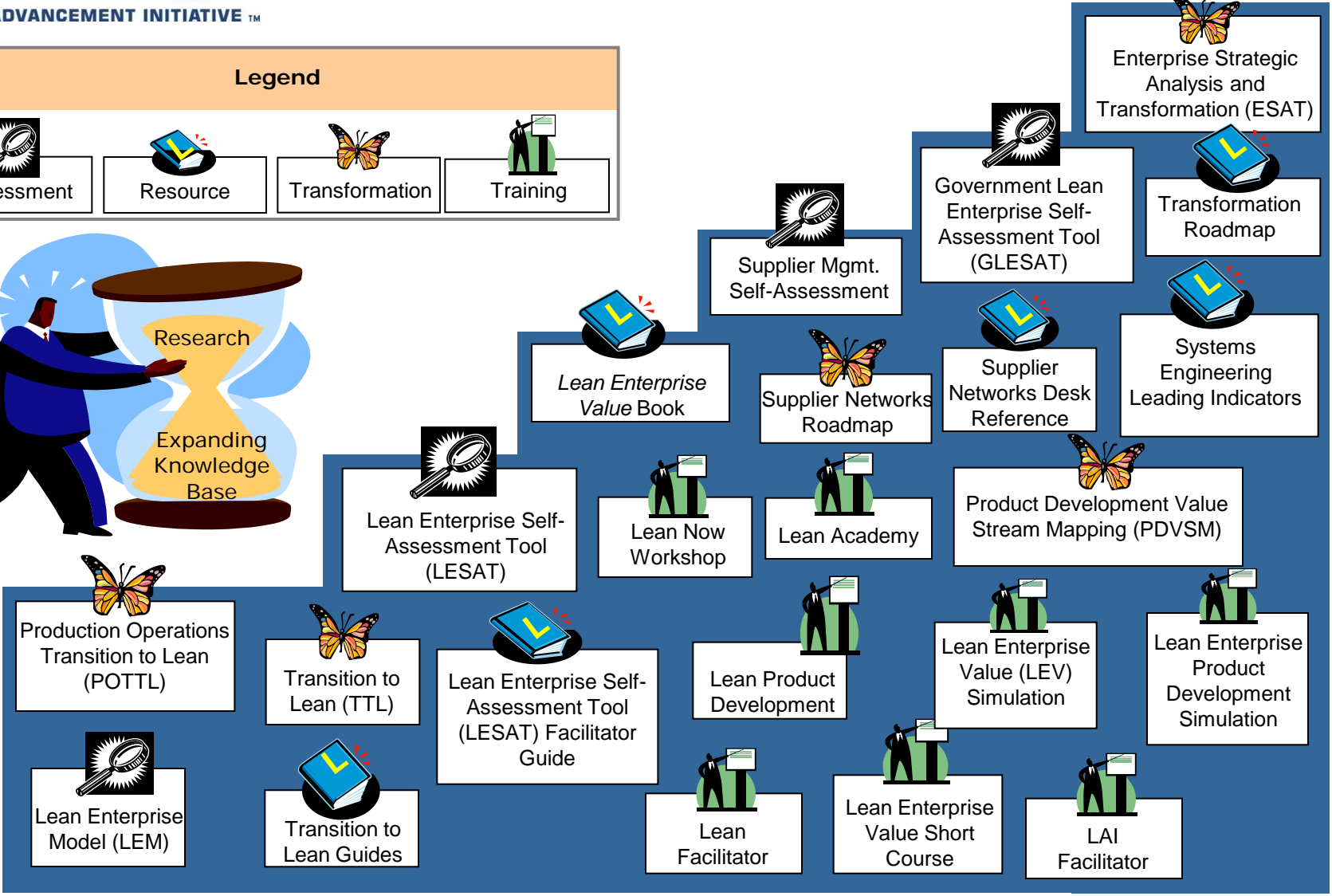
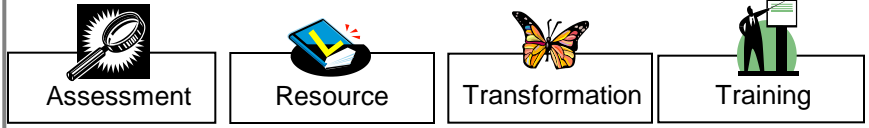
Academic Curricula








Legend



Knowledge Exchange Events



CHANGE MANAGEMENT

Knowledge Exchange Event

October 2008



Event was hosted by:
Pratt & Whitney
 A United Technologies Company

- 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

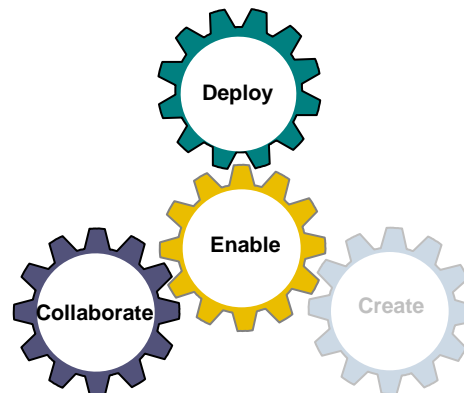
Knowledge Exchange Event

Sept. 2008

Event was hosted by:



U.S. Army



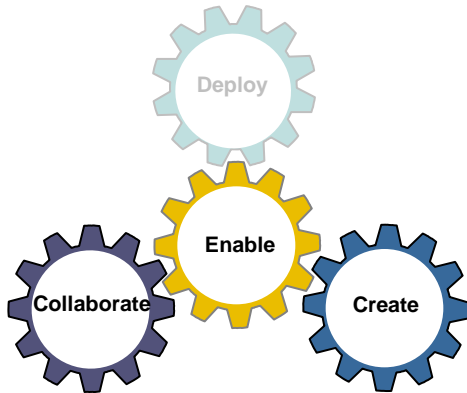
METRICS

Knowledge Exchange Event

November 2008

Event was hosted by:

Raytheon



Community of Practice

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

- Active participation
- Open and honest sharing

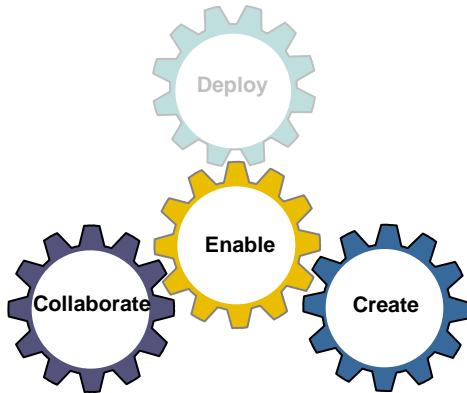


Product Development Community of Practice

- LAI's third PD benchmarking event hosted by Raytheon in June 2008 at the University of Arizona.
- MIT partnering with McKinsey and Co. to develop new global database identifying high-performance PD practices.
- 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



Community of Practice

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

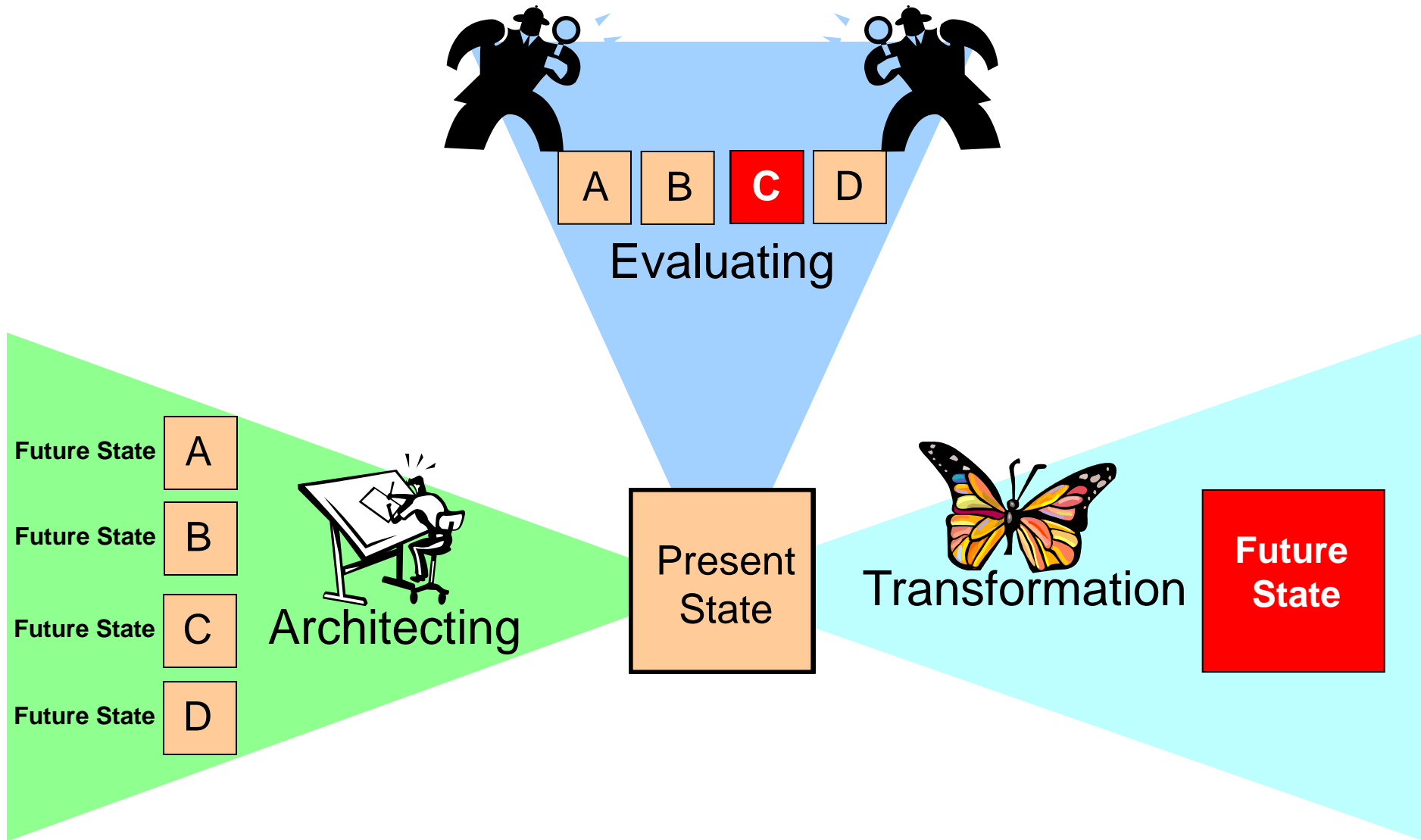
- Active participation
- Open and honest sharing



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

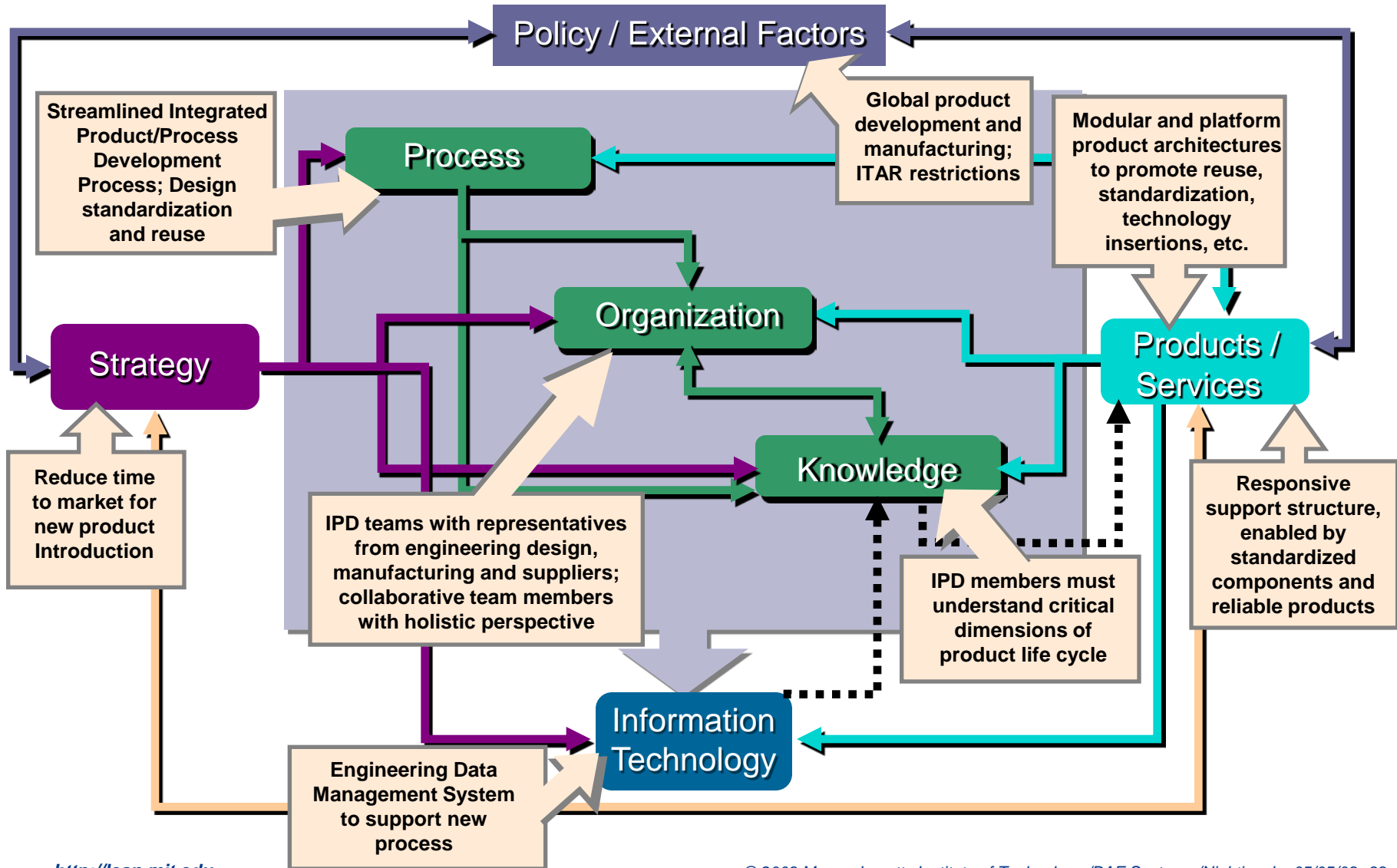


Enterprise Architecting – Enables Greater Efficiency and Effectiveness

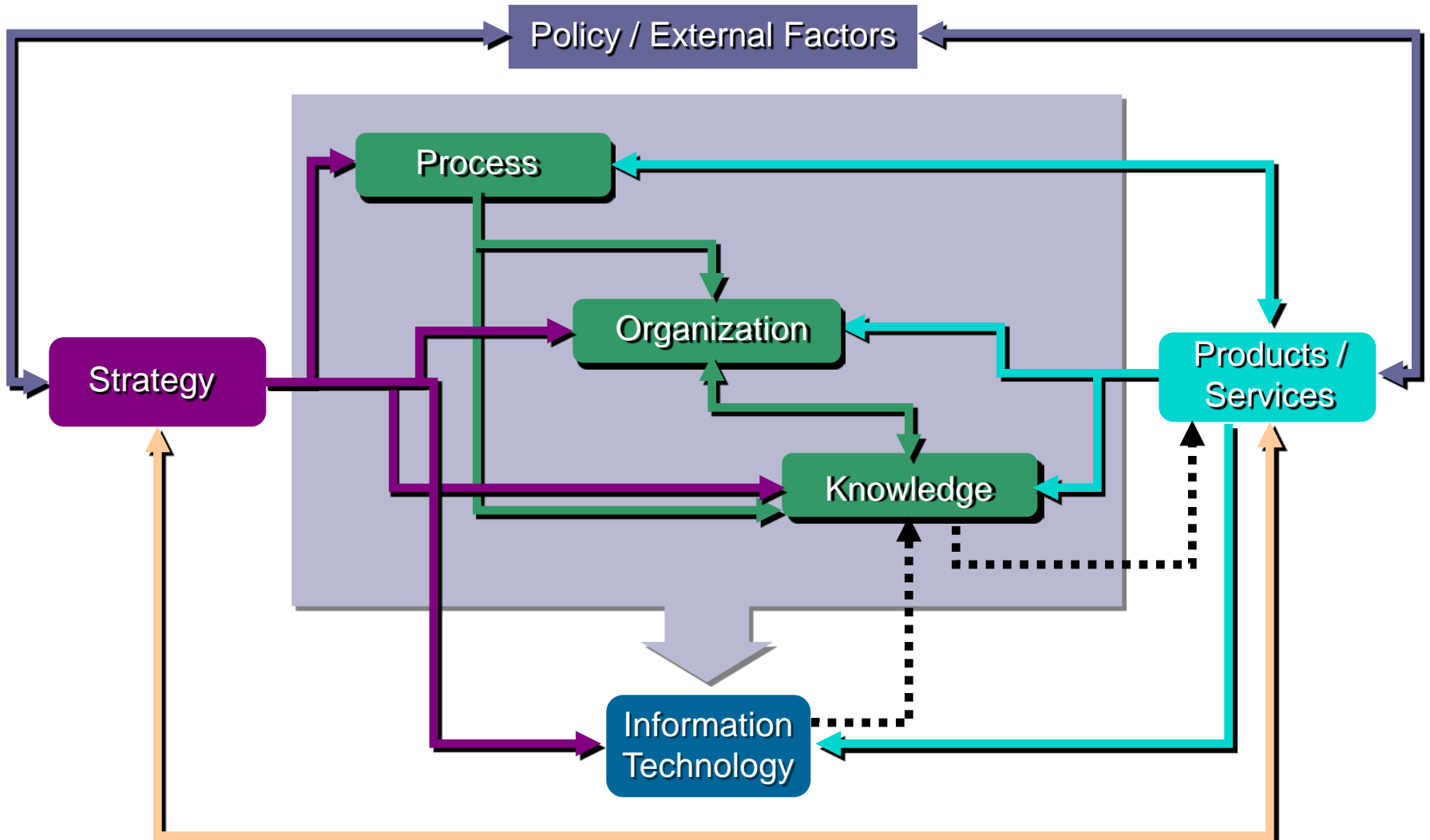


- Effective integration – managing complex interdependencies
- System optimization, not local optimization
- Knowledge-based enterprise capabilities
- Achieving desired future state characteristics
 - Agility
 - Flexibility
 - Reconfigurability

EA Example: Reduce Time to Market Imperative



Enterprise Architecture Framework



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**?

EA-ET

Enterprise Architecting - Enterprise Transformation

FOCUS of RESEARCH

- Enterprise Value Analysis
- Enterprise Architecting
- IT as Enterprise Enabler
- Enterprise Cost and Metrics
- Enterprise Modeling

LEPD

Lean Enterprise Product Development

FOCUS of RESEARCH

- Lean Product Development
- Lean Systems Engineering
- Lean Software

ESE

Enterprise Systems Engineering

FOCUS of RESEARCH

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

ECM

Enterprise Change Management

FOCUS of RESEARCH

- Change Management
- Enterprise Change Philosophy
- Studies of Successful Change
- Distributed Leadership

Addressing Open Challenges



Boeing Phantom Works

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

Literature Review
(Standards, Academic Literature)

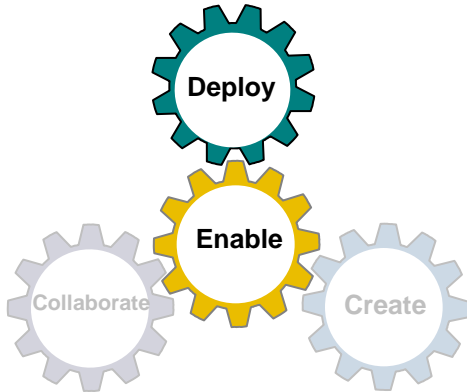
Expert Interviews
(Industry, Government, Academia)

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



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 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

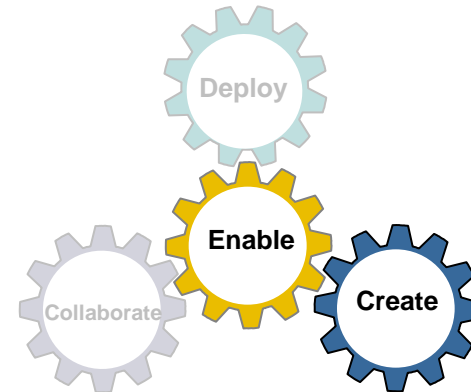
Videos

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



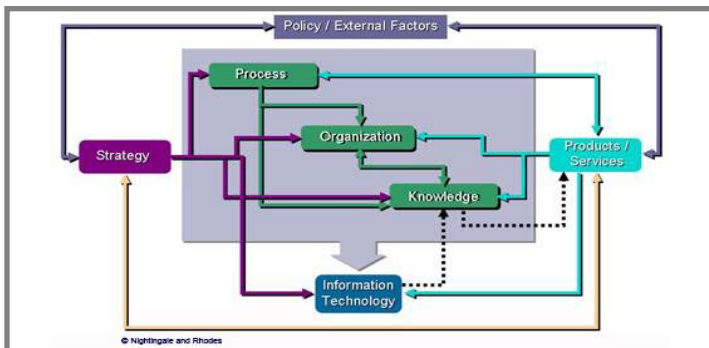
- Strategic-level modeling and simulation of Enterprise Architecture to address key question directly affecting bottom-line results
 - Analyzes investment tradeoffs across multiple business units
 - Provides guidance on how to most effectively incentivize a company's business units and allocate R&D discretionary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

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



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

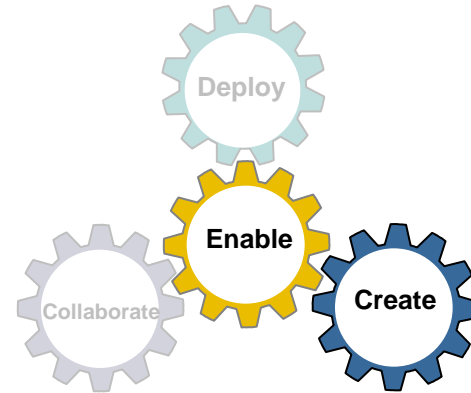
See this presentation on Video
 at the LAI website (<http://lean.mit.edu>)
 and at MIT Tech TV (<http://techtv.mit.edu>)



Highlights of Emerging Research

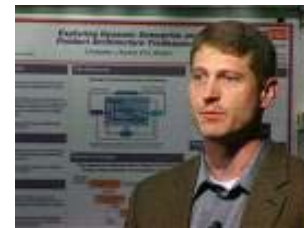


Major Robb Wirthlin
 United States Air Force
 MIT Degree Candidate:
 Ph.D., Engineering Systems, 2009



- 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”



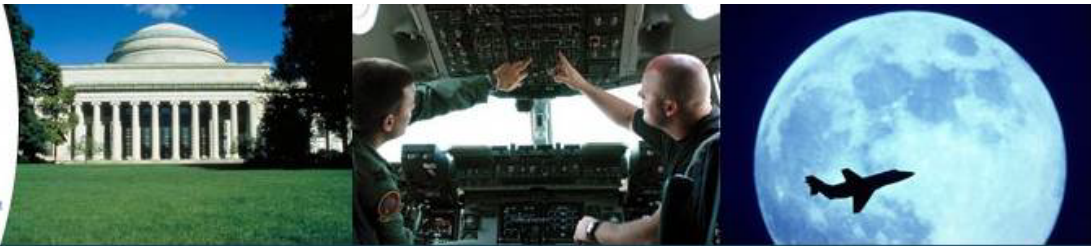
Presented by
Major Robb Wirthlin
 at the
LAI 2009 Enterprise Transformation Research Summit

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

Swim Lane	Pre-MS "A" (Concept Refinement)	Pre-MS "B" (Technology Development)	Pre-MS "C" (System Development & Demonstration)	Pre-Full Rate Production (Production & Deployment)	Operations and Sustainment
User					
Requirements					
Money					
Acquisition	Scope of Model				
Contractor					

Time →

Everything Is Here: lean.mit.edu



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Watch video footage
LAI 2009 Enterprise Transformation Research Summit

Knowledge Exchange Events

Member Login

Username
 Password
 Remember me



Welcome

The Lean Advancement Initiative offers organizational modeling, thinking, products, and tools, a unique research consortium, and a community of learners, and best practices.

LAI offers:

- unique opportunities to learn and share organizational knowledge
- a portfolio of thought leadership
- innovative enterprise solutions

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.

RESEARCH OVERVIEW	PRODUCTS OVERVIEW	PUBLICATIONS OVERVIEW
RECENT RESEARCH	ENTERPRISE STRATEGIC ANALYSIS FOR TRANSFORMATION	LAI EDUCATIONAL NETWORK (EDNET)
	ENTERPRISE TRANSITION TO LEAN	PRESENTATIONS
	ENTERPRISE VALUE STREAM MAPPING AND ANALYSIS	CASE STUDIES
	GOVERNMENT LEAN ENTERPRISE SELF-ASSESSMENT	EVENTS
	LAI LEAN ACADEMY™	PRODUCTS
	LEAN ENTERPRISE MODEL	LEAN NOW!
	LEAN FACILITATION KIT	REPORTS
	LEAN ENTERPRISE VALUE	PUBLISHED ARTICLES
	LEAN ENTERPRISE SELF ASSESSMENT TOOL (LESAT)	WORKING/WHITE PAPERS
	LEAN ENTERPRISE VALUE SIMULATION (LEV)	THESES
	MANUFACTURING SYSTEM DESIGN FRAMEWORK MANUAL	RESEARCH
	PARTNER PRODUCTS	WORKSHOPS
	PRODUCT DEVELOPMENT TRANSITION TO LEAN (PDT)	
	PRODUCT DEVELOPMENT VALUE STREAM MAPPING (PDVSM) MANUAL	
	PRODUCTION OPS TRANSITION TO LEAN	
	SUPPLIER TOOLSET	
	SYSTEMS ENGINEERING LEADING INDICATORS GUIDE	

Spotlight

March 31 - April 02, 2009

Achieving Enterprise Excellence: LAI 2009 Annual Meeting

Keynote speaker Lieutenant General N. Ross Thompson will discuss the Army's ongoing collaboration with LAI as the Army develops an enterprise-level platform for change.

Upcoming Events

- Mar 31, 2009
LAI Executive Board Meeting
 Mar 31, 2009
- Achieving Enterprise Excellence: LAI Annual Meeting**
 Apr 01, 2009
- Achieving Enterprise Excellence: LAI Annual Meeting**
 Apr 02, 2009
- Achieving Enterprise Excellence: LAI Annual Meeting**

Featured News

- LAI Offers International Lean Enterprise Product Development Research Opportunity**
- LAI Leads US Army Leadership**

Summit Videos: lean.mit.edu



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HOME ▶ EVENTS ▶ LAI 2009 ENTERPRISE TRANSFORMATION RESEARCH SUMMIT ▶ ADOPTION OF MEASUREMENT TOOLS AT BAE SYSTEMS AND RAYTHEON

Knowledge Exchange Events



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MIT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Adoption of Measurement Tools at BAE Systems and Raytheon



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

What Makes measurement systems Adoptable?
(survey Qs)

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

MIT TechTV

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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



**Knowledge
Exchange
Events**

Network - Share - Learn

May 14, 2009

**Using LESAT for
Transformation**

Host:
MIT,
Cambridge, MA



**Knowledge
Exchange
Events**

Network - Share - Learn

August 4-5, 2009

**Sustaining Lean
Practices Through
Industry Education**

Host:
Boeing,
Seal Beach, CA



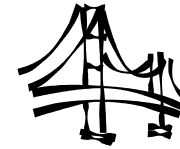
**Knowledge
Exchange
Events**

Network - Share - Learn

October 28-30, 2009

**Sharing Lean
Change Success
Stories**

Host:
TBD



**Knowledge
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November 4, 2009

**Systems
Engineering and
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**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

