



Creating Lean Enterprise Value

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Creating Value Workshop
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MIT



Agenda

- Origin of Lean
- Lean Aerospace Initiative
- Enterprise Value Perspective
- Transforming the Enterprise
- Implementation Insights
- Next Steps

Lean was Born out of Necessity

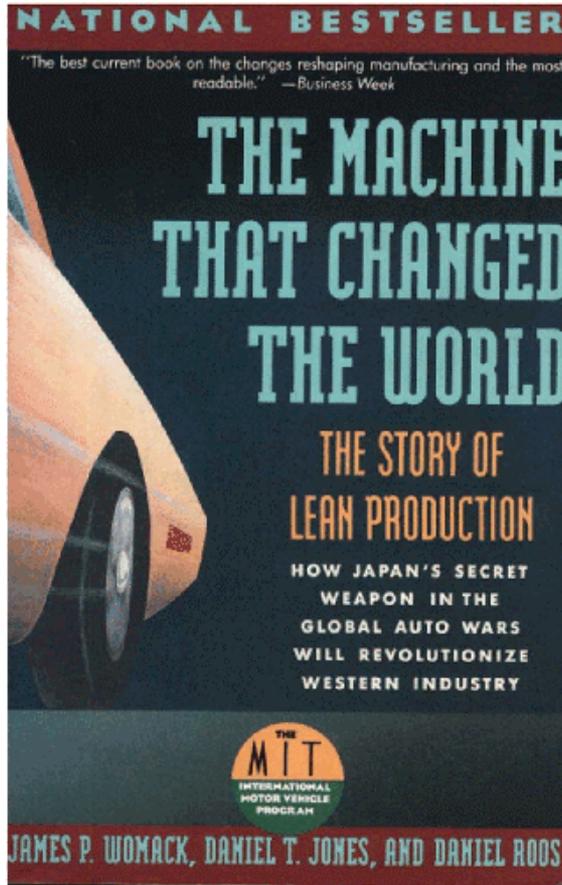
August 15, 1945 -- end of war with Japan

- Toyota faced a daunting challenge: How to succeed against Western mass production auto giants poised to enter Japanese market?
- Kiichiro Toyoda to Taiichi Ohno: “Catch up with America in three years.”
- Ohno’s challenge: How to design a production system exploiting central weaknesses of mass production model

Japan’s dilemmas

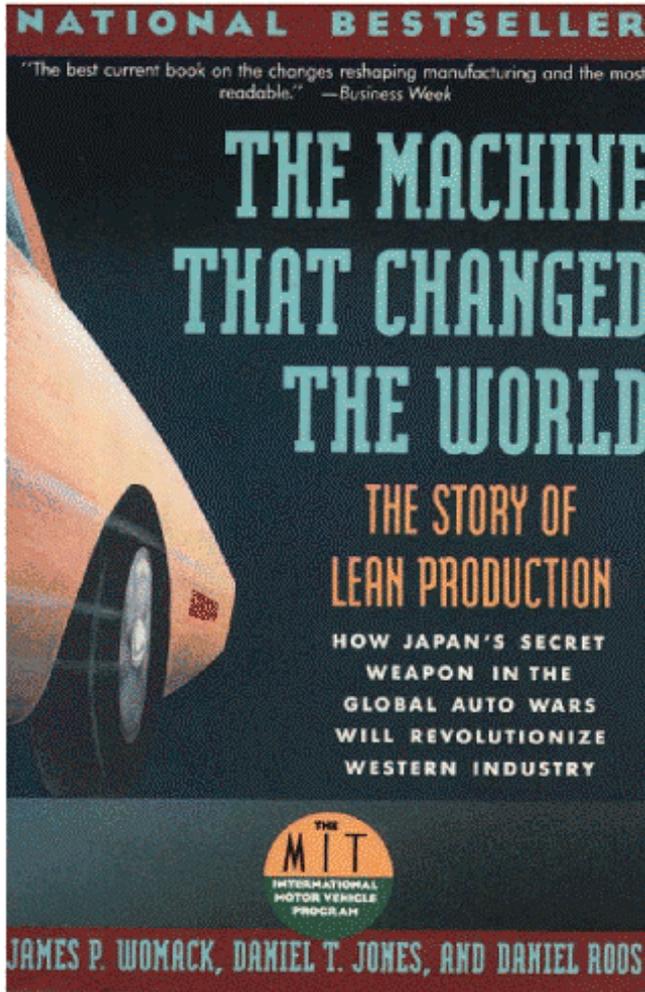
- Small & fragmented market, depleted workforce, scarce natural resources, little capital
- Lean evolved as a coherent response to this challenge over a number of decades -- a dynamic process of learning and adaptation later labeled as “lean production” by Western observers

Use Less, Offer Greater Variety, Higher Quality, and More Affordable Products in Less Time



- Best Japanese auto companies developed a fundamentally different way of making things
- These companies changed the dynamics of international competition
- New goals in manufacturing systems -- combined benefits of craft and mass production
 - Improved quality
 - High productivity
 - Efficiency at low volumes
 - Production flexibility
 - Rapid, efficient development cycle
 - Product mix diversity
- Lean production contrasts with traditional mass production paradigm
- Systemic principles are transferable

1993 Genesis of the Lean Aerospace Initiative



US Air Force asked:

Can the concepts, principles and practices of the Toyota Production System be applied to the military aircraft industry?

Yes!



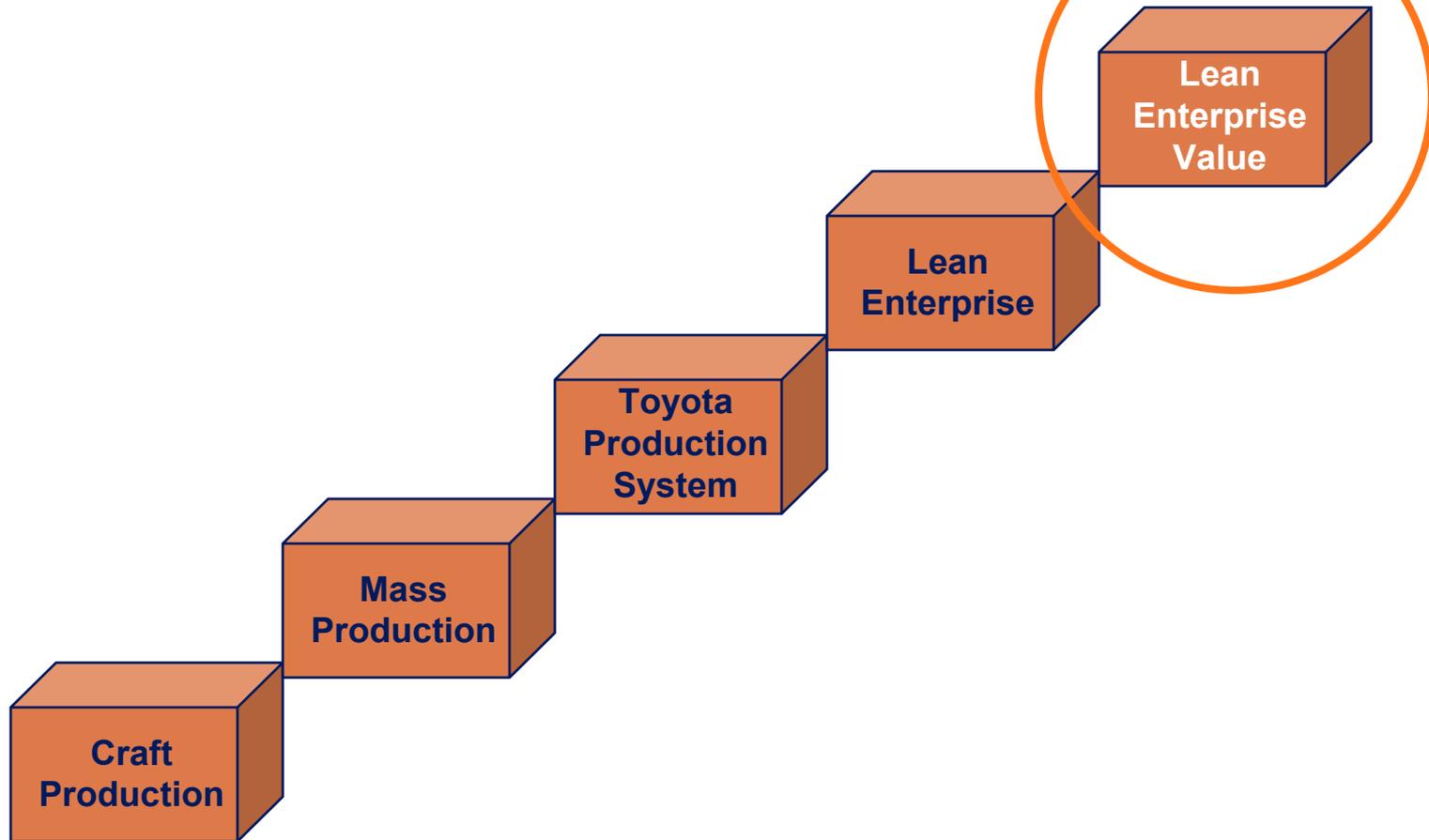
Lean Aerospace Initiative

Consortium

- **Airframe, engine, avionics, missile and space companies**
- **Air Force agencies and System Program Offices (C-17, F-22, JSF, Training)**
- **NASA, Army, Navy, NRO**
- **Pentagon—OSD, AF HQ**
- **International Association of Machinists**



New Lean Thinking: Evolving Paradigms





Lean Enterprise Value: The New Lean Thinking

Lean is not just a matter of eliminating waste, rather becoming lean is a process of eliminating waste with the goal of creating value for enterprise stakeholders.

-Lean Enterprise Value, Palgrave Publishing



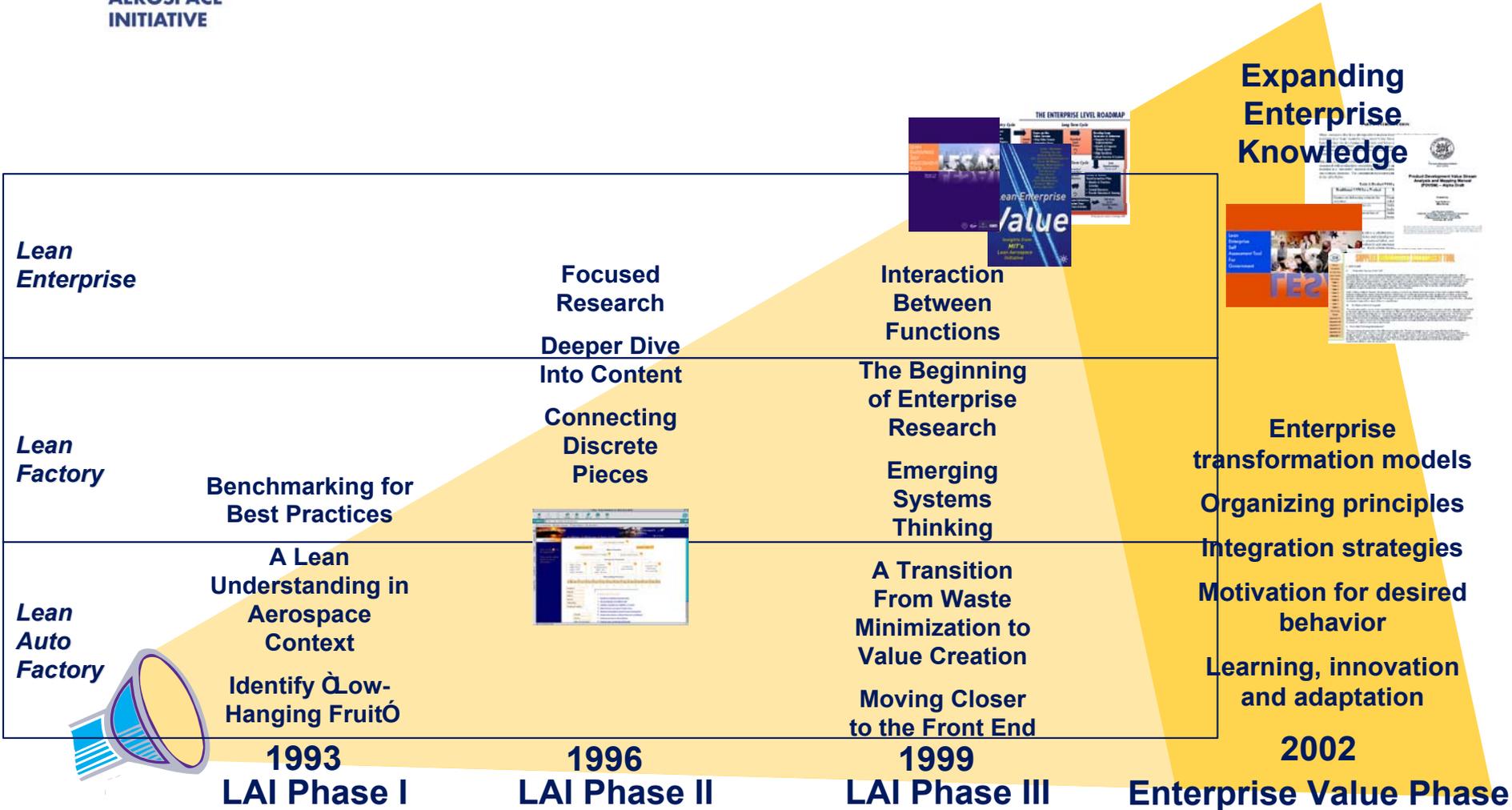
An Evolution In Consortium Priorities: Enterprise Goals

LAI Mission: Research, develop and promulgate knowledge, principles, practices and tools to enable and accelerate the envisioned transformation of the greater US aerospace enterprise through people and processes.

1. Support the on-going lean transformation of industry
2. Enable lean value-creating supplier base
3. Support lean transformation of the government
4. Educate and train stakeholders in value-creating lean principles and practices
5. Improve effectiveness of organizations and all the employees across the total enterprise
6. Support member lean implementation efforts by sustaining tools and knowledge base and by sponsoring outreach events



LAI Knowledge is Expanding to the Entire Enterprise



Enterprise Value Perspective



Islands of Success Across the Enterprise

C-130J production

- Throughput of extrusion shop from 12 days to 3 minutes

Automatic code generation

- 40% reduction in time
- 80% improvement in quality

Military electronic modules from commercial lines at TRW

- 73% cost reduction

F-16 Build-to-Print Center

- 75% cycle time reduction

777 floor beam

- 47% assembly time reduction

P & W General Machining Center

- 67% reduction in lead time

Delta IV launch vehicle

- 63% reduction in floor space

GE Lynn aircraft engine facility

- 100% on time deliveries

Joint Direct Attack Munition (JDAM)

- 63% reduction in unit cost



Additional Examples: Lean Works In Multiple Process and Industries

- **Export licensing:**
 - 56 steps to 21 steps
 - 52 handoffs to 5 handoffs
 - Cycle time from 60 days to 30 days
 - 50% 1st pass yield to >90% 1st pass yield
- **Payroll:**
 - Reduced non-value added steps by 50%
 - 15 forms to 1 form
 - Reduced signatures/ approvals by 25%
- **Recruiting:**
 - Cycle time from 14 days to 48 hours
 - 50% reduction of paper resumes
- **Proposal:**
 - Cycle time from 30.6 days to 7 days
- **Program support:**
 - \$3M savings
- **Interface management:**
 - Proposal, contract, billing, and collection steps
 - Generated \$21M additional cash
- **Engineering order release:**
 - Cycle time from 76 to 4 days
 - Total queue time from 56 days to 60 minutes
- **Process definition:**
 - Work package completion cycle from 4 months to 3 weeks
- **Financial reporting:**
 - 13 weeks to 3 weeks



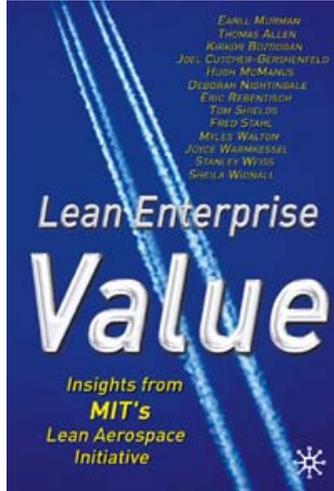
More Potential for the Enterprise

Value Propositions-Selected Examples

- **Maintained F-16 sales price and decreasing order-to-delivery time by up to 42% while production rate decreased 75%**
- **C-17 unit priced decreased from \$260M to \$178 M for final 80 aircraft of 120 aircraft buy.**
- **JDAM unit price of \$15K compared to initial estimate of \$68K.**
- **Northrop Grumman ISS lean enterprise implementation reduced throughput times for major systems by 21 to 42%.**
- **IAM Boeing St. Louis 2001 contract incorporated appropriate lean principles and practices.**
- **Both JSF competitors aggressively adopted lean principles and practices in their designs.**



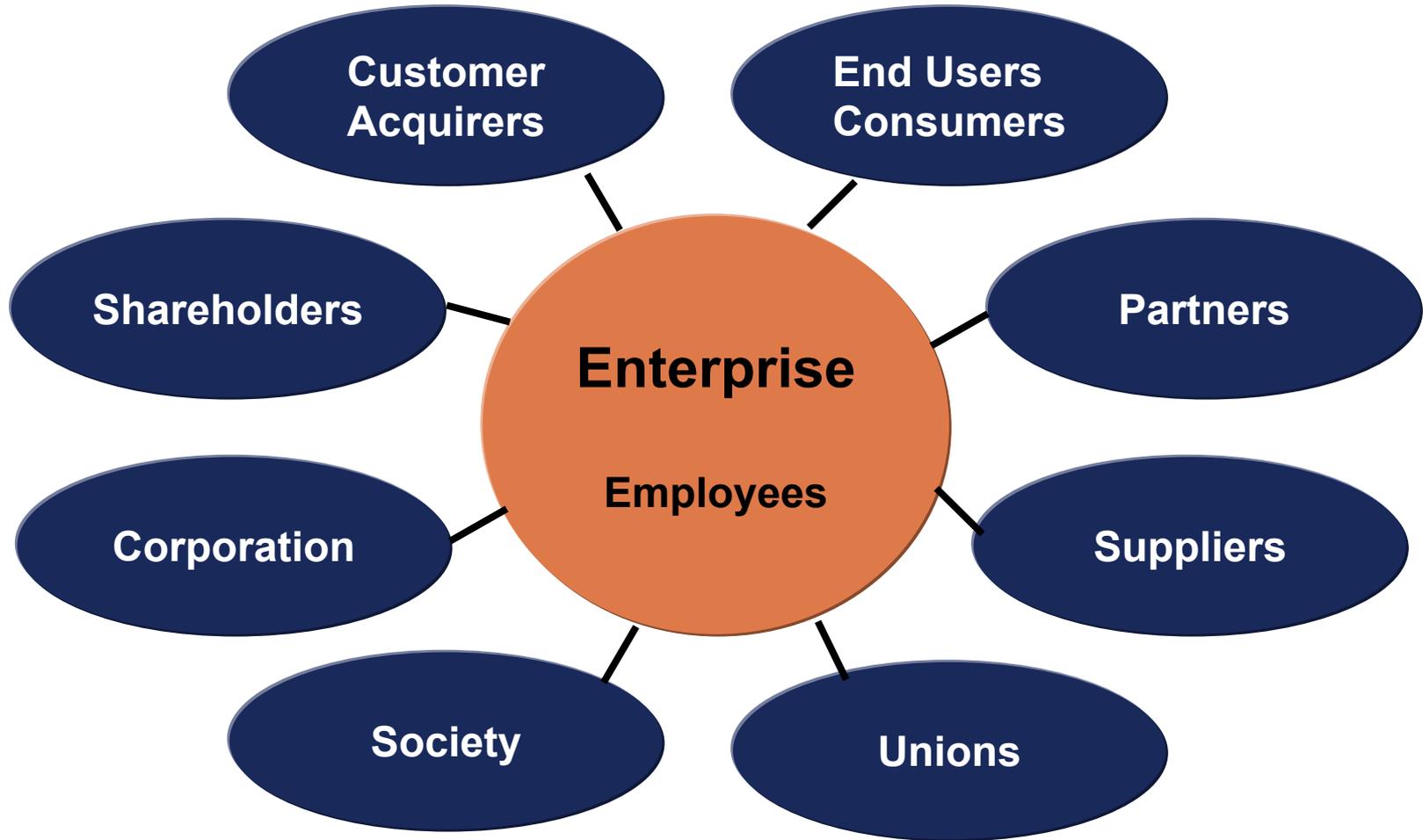
Lean Enterprise Value Concepts



“The core challenge for industry in the 21st century involves identifying and delivering value to every stakeholder. Meeting that challenge requires lean capability at the enterprise level.”

- Stakeholders
- Creating Value
- The Three Levels of Enterprise
- Value Creation Framework
- Enterprise Level Lean Principles

Enterprise Stakeholders





Creating Value

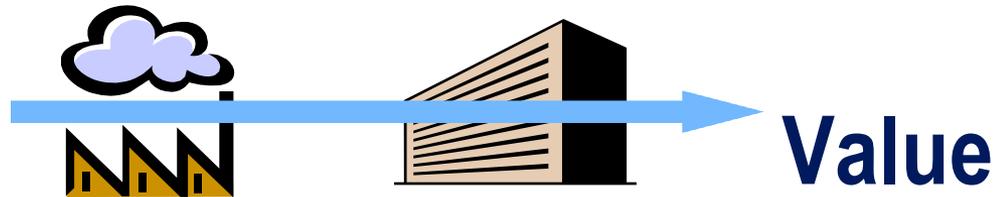
Delivering what stakeholders want and need.

For example:

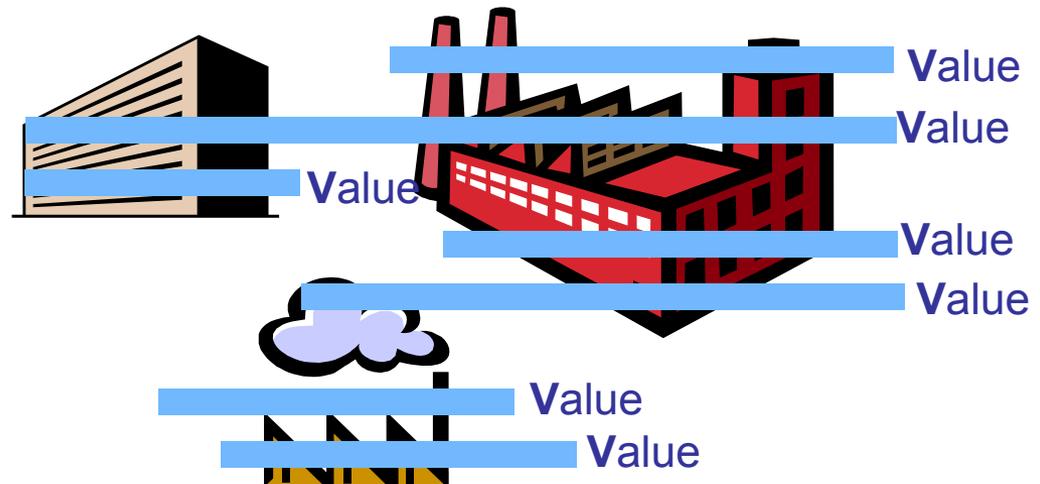
- Timely, quality products at a reasonable price to customers
- Competitive returns on investments to shareholders
- Rewarding work environment, stable jobs for workforce
- Early and informed involvement of suppliers
- Environmental and civic responsibility to the public

A Total Enterprise Can Be . . .

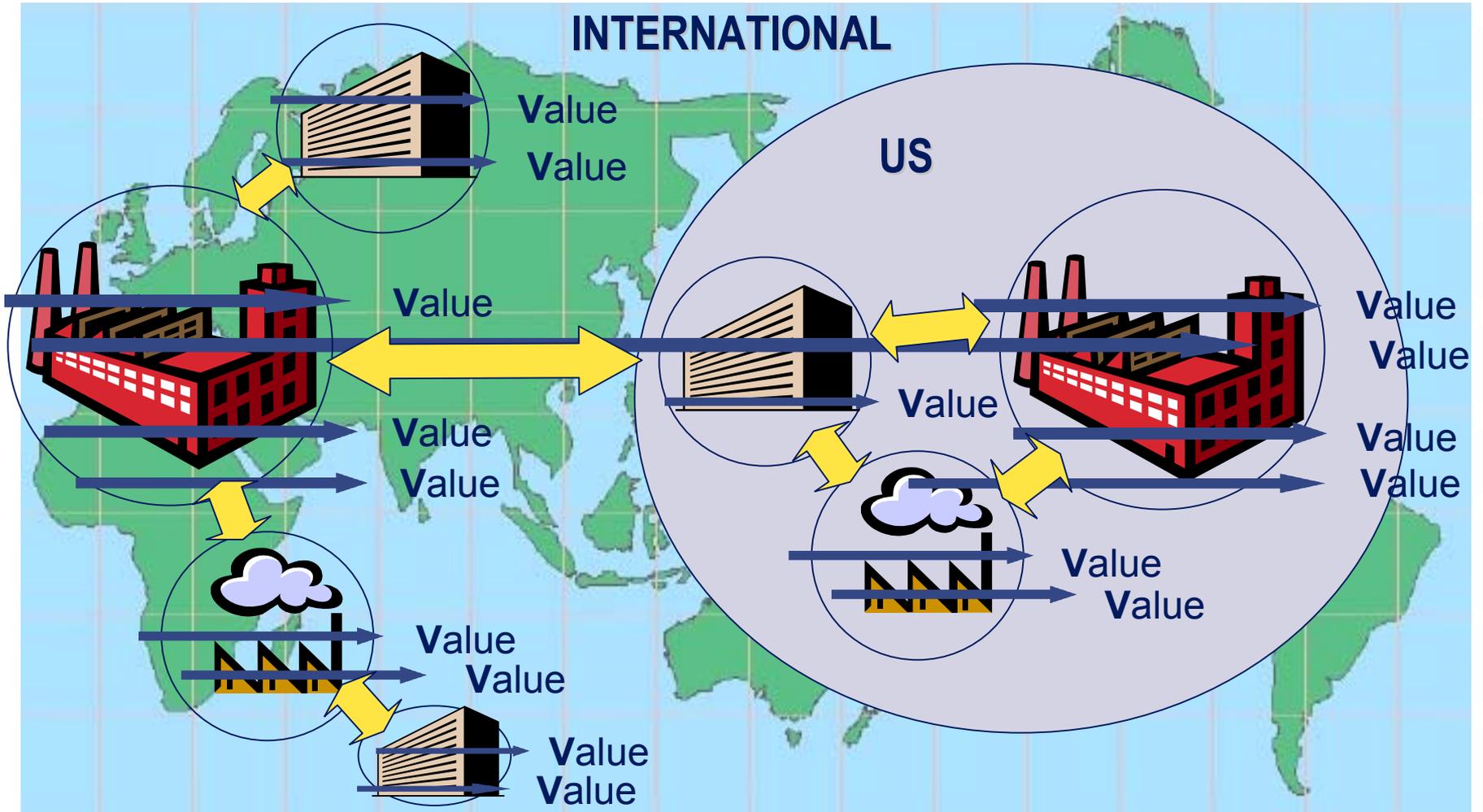
A Program Enterprise



A Multi-Program Enterprise



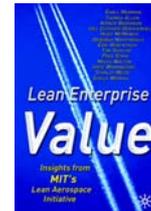
... The Global Enterprise



The Total Enterprise

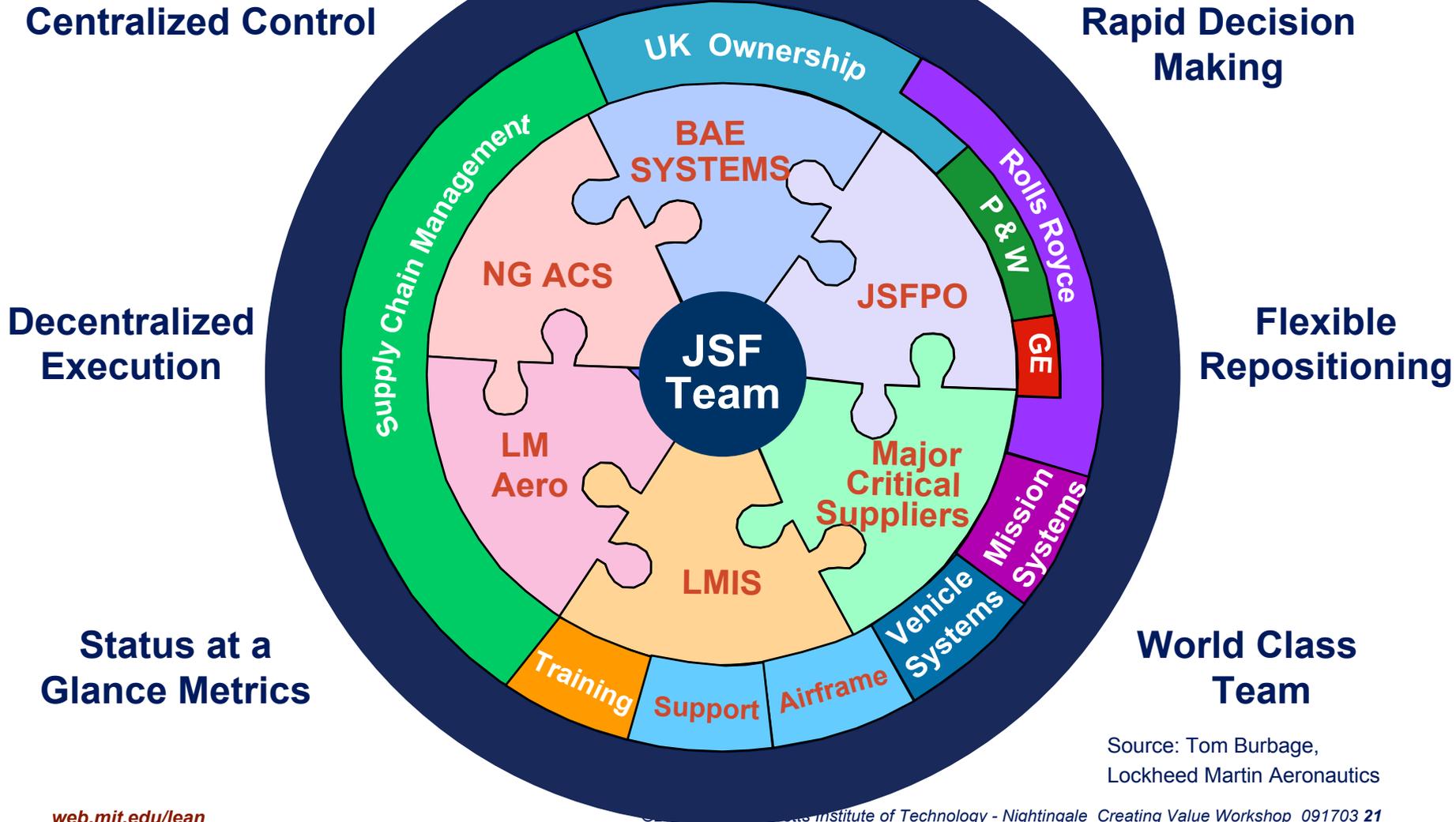
“A lean enterprise is an integrated entity that efficiently creates value for its multiple stakeholders by employing lean principles and practices.”

**– *Lean Enterprise Value,*
Murman et al.**



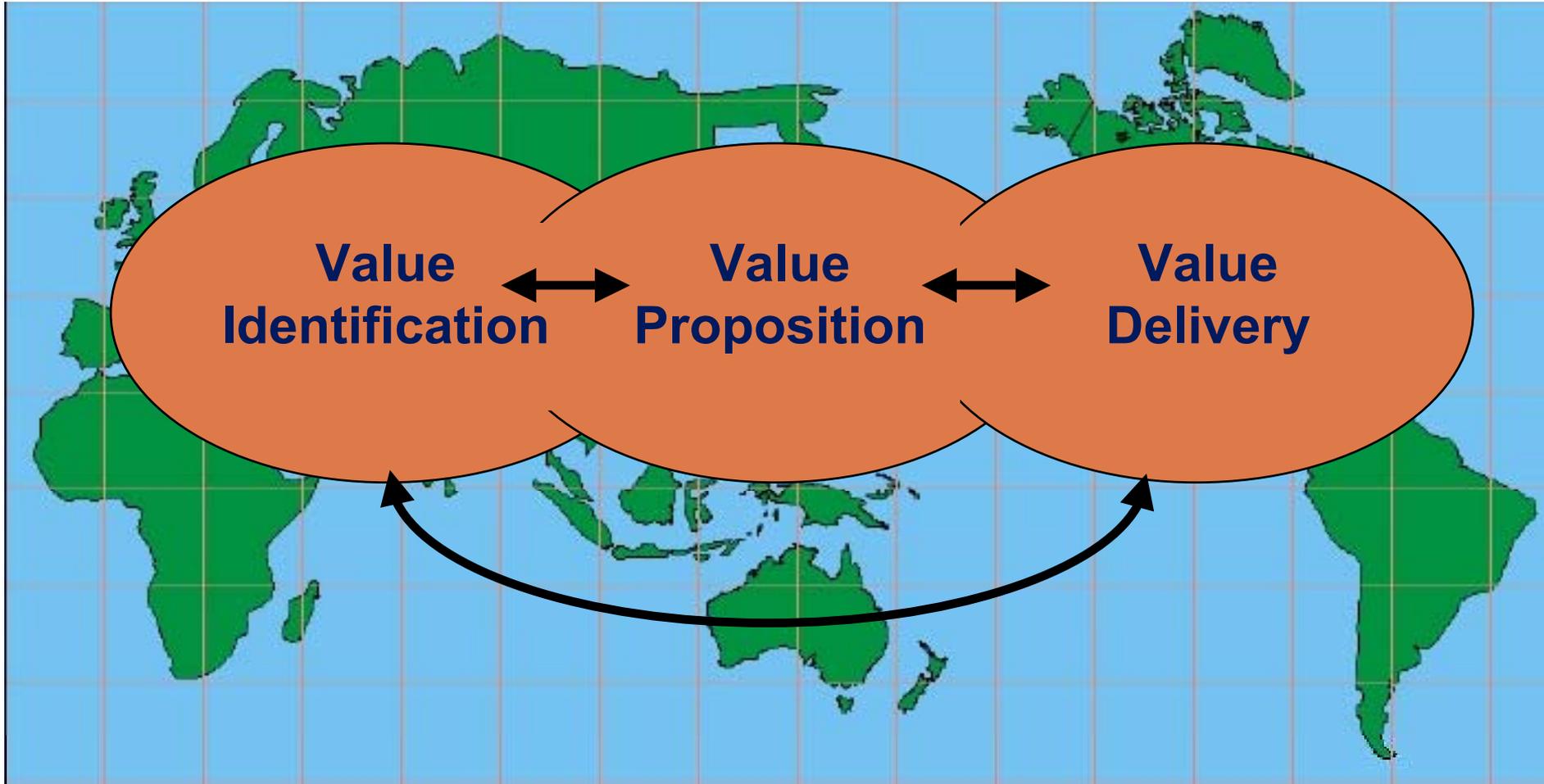


Enterprise Example: JSF Mega Program



Source: Tom Burbage,
Lockheed Martin Aeronautics

Value Creation Framework

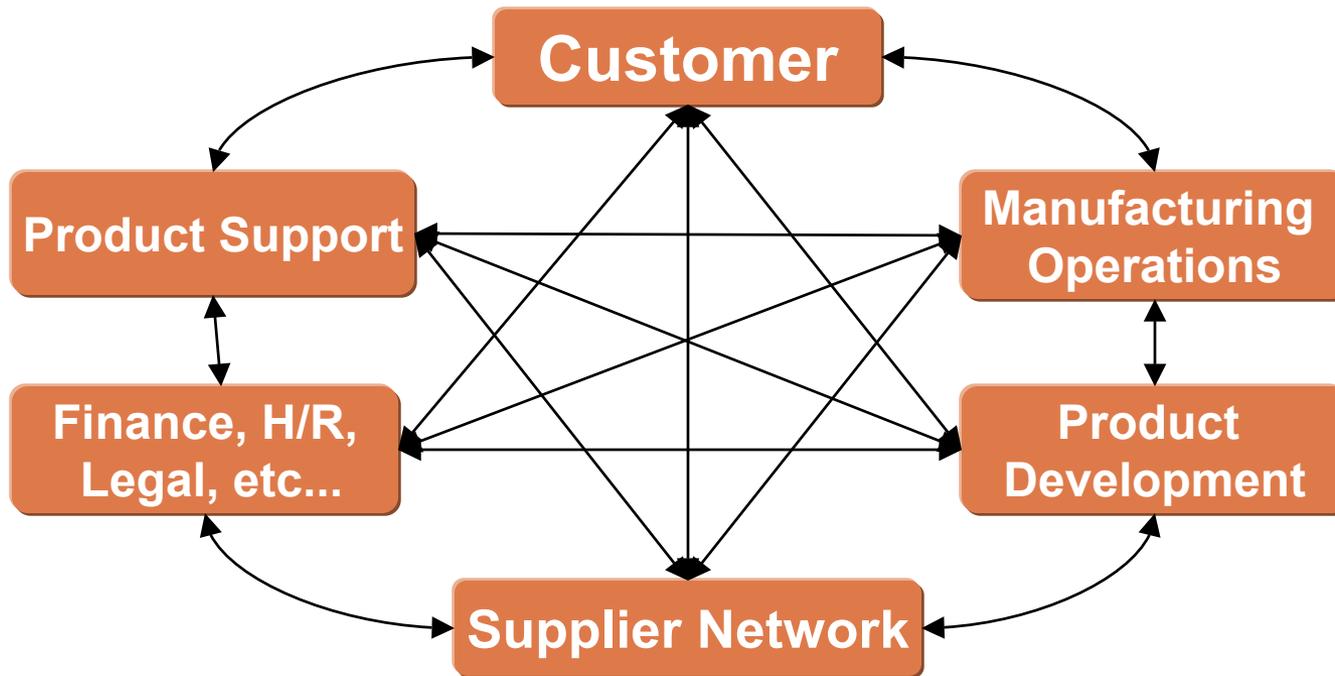




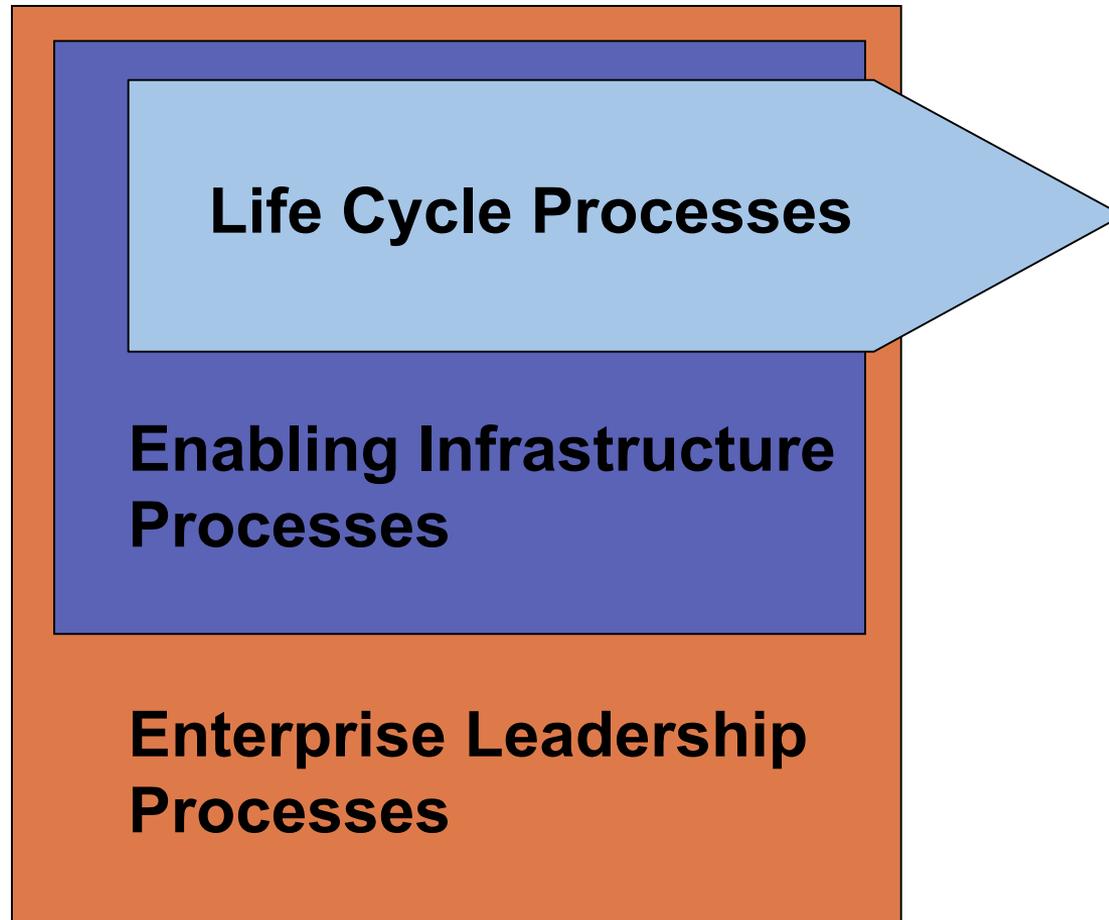
Lean Enterprise Value Principles

- Create lean value by doing the right job and doing the job right
- Deliver value only after identifying stakeholder value and constructing robust value propositions
- Fully realize lean value only by adopting an enterprise perspective
- Address interdependencies across enterprise levels to increase lean value
- People, not just processes, effectuate lean value

Integrated Enterprise



Process Architecture View of Lean Enterprise



Enterprise Process Architecture

Life Cycle Processes

- Business Acquisition and Program Management
- Requirements Definition
- Product/Process Development
- Supply Chain Management
- Production
- Distribution and Support

Enabling Infrastructure Processes

- Finance
- Information Technology
- Human Resources
- Quality Assurance
- Facilities and Services
- Environment, Health, and Safety

Enterprise Leadership Processes

- Strategic Planning
- Business Models
- Managing Business Growth
- Strategic Partnering
- Organizational Structure and Integration
- Transformation Management

Transforming and Assessing the Enterprise



Lean Enterprise Implementation Processes and Tools

Implementation Issue

What are the key lean principles and practices?

How do I transform my enterprise to lean?

How do I assess my progress?



Enterprise Tool

Lean Enterprise Model (LEM)

Enterprise Transition to Lean Roadmap (TTL)

Lean Enterprise Self Assessment Tool (LESAT)



LEM Overarching Practices

Human-oriented Practices

- Promote lean leadership at all levels
- Relationships based on mutual trust and commitment
- Make decisions at lowest appropriate level
- Optimize capability and utilization of people
- Continuous focus on the customer
- Nurture a learning environment

Process-oriented Practices

- Assure seamless information flow
- Implement integrated product and process development (IPPD)
- Ensure process capability and maturation
- Maintain challenges to existing processes
- Identify and optimize enterprise flow
- Maintain stability in changing environment

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Lean Enterprise Transformation Issues

- Why do many lean transformation activities fail?
- What are the key success factors in implementing lean enterprise wide?
- How can we better assure that lean will impact bottom line results?
- Are there certain activities that are ideally performed before others?
- How do we assess an organization's "readiness to change"?



Enterprise Transition to Lean Roadmap

Entry/Re-entry Cycle

Adopt Lean Paradigm

- Build Vision
- Convey Urgency
- Foster Lean Learning
- Make the Commitment
- Obtain Senior Mgmt. Buy-in

Decision to Pursue Enterprise Transformation

Enterprise Strategic Planning

Long Term Cycle

Initial Lean Vision

Focus on the Value Stream

- Map Value Stream
- Internalize Vision
- Set Goals & Metrics
- Identify & Involve Key Stakeholders

Detailed Lean Vision

Develop Lean Structure & Behavior

- Organize for Lean Implementation
- Identify & Empower Change Agents
- Align Incentives
- Adapt Structure & Systems

Short Term Cycle

Environmental Corrective Action Indicators

Focus on Continuous Improvement

- Monitor Lean Progress
- Nurture the Process
- Refine the Plan
- Capture & Adopt New Knowledge

Detailed Corrective Action Indicators

Create & Refine Transformation Plan

- Identify & Prioritize Activities
- Commit Resources
- Provide Education & Training

Lean Transformation Framework

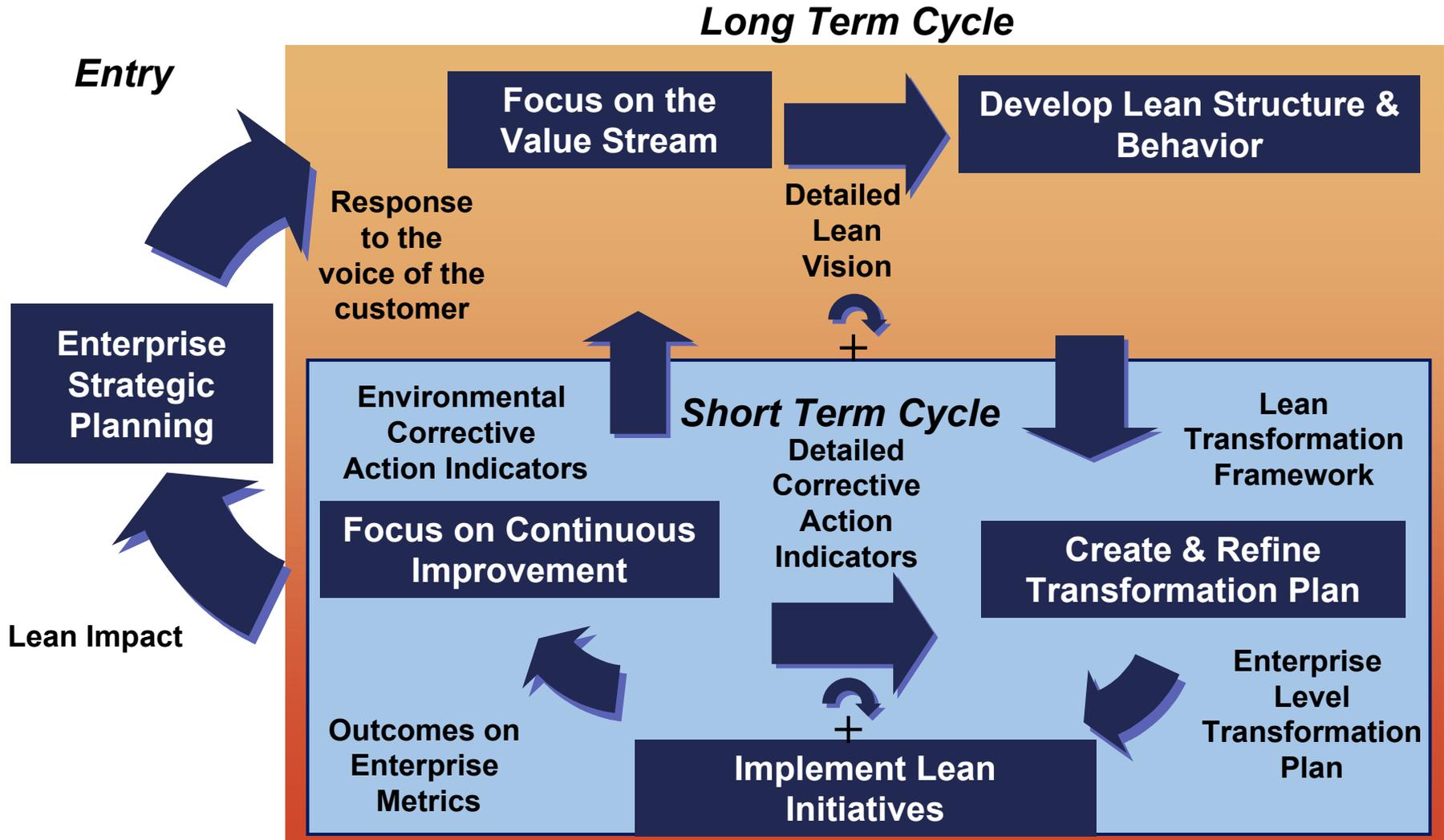
Outcomes on Enterprise Metrics

Implement Lean Initiatives

- Develop Detailed Plans
- Implement Lean Activities

Enterprise Level Transformation Plan

Enterprise Level Roadmap The On-going Lean Enterprise





Lean Enterprise Implementation Processes and Tools

Implementation Issue

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How Do I Assess My Progress?

- Enterprise TTL application highlighted need for assessment tool
- Lean Enterprise Self Assessment Tool (LESAT) developed by joint industry / government / MIT team in collaboration with UK LAI
- LESAT supports both
 - “As-Is” Analysis
 - AND
 - “To-Be” Vision
- Targeted at Enterprise Leadership Team

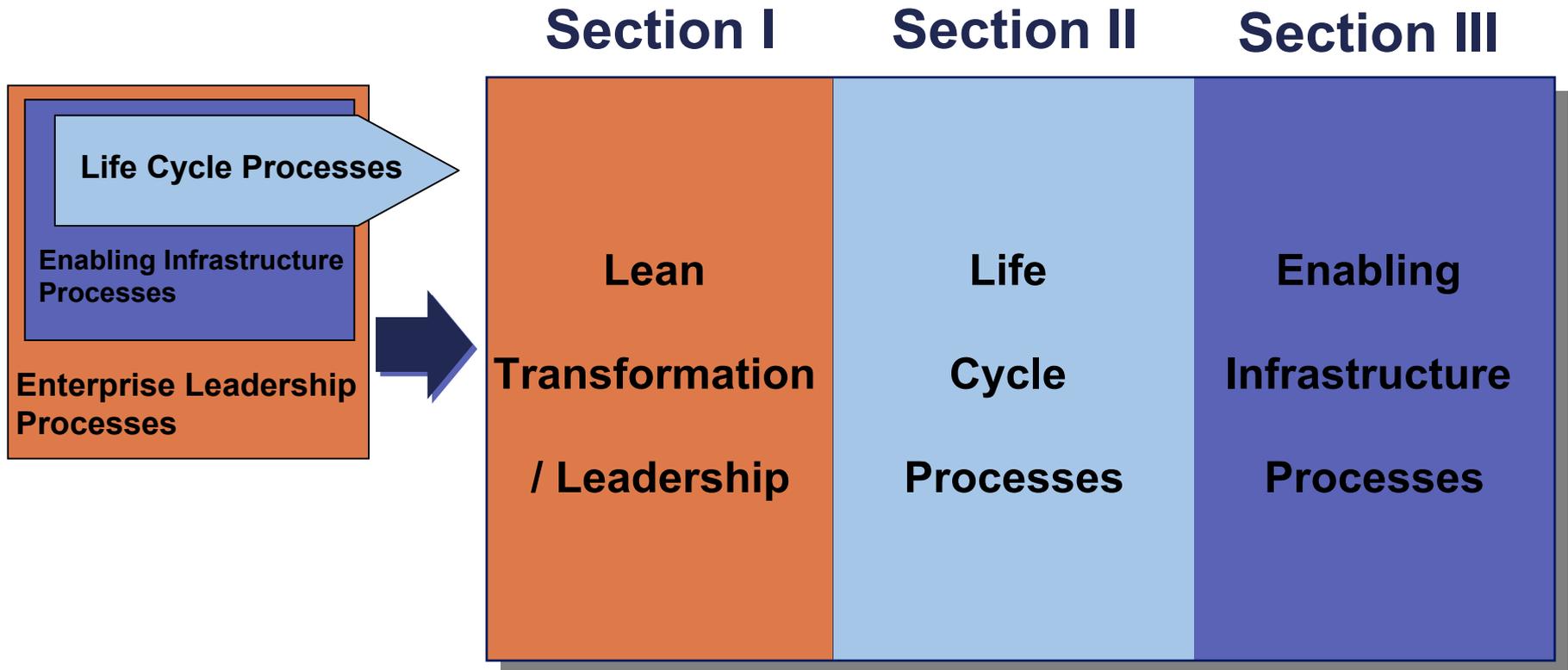
What Is LESAT?



- A tool for self-assessing the present state of “leanness” of an enterprise and its readiness to change
- Comprised of:
 - Capability maturity model for enterprise leadership, life cycle and enabling processes
 - Supporting materials: (Facilitator’s Guide, Glossary, etc.)



LESAT Structure is Consistent with Enterprise Architecture





LESAT Section I: Example

I.B.3 Lean Enterprise Vision - new mental model of the enterprise

Level 1

Senior leaders have varying visions of lean, from none to well-defined

Level 2

Senior leaders adopt common vision of lean

Level 3

Lean vision has been communicated and is understood by most employees

Level 4

Common vision of lean is shared by the extended enterprise

Level 5

Stakeholders have internalized the lean vision & are an active part of achieving it



LESAT Section II: Example

II.C.2 Incorporate *Downstream Stakeholder Values* (Manufacturing, Support, etc.) into Products & Processes - *Understanding downstream stakeholders allows value to flow seamlessly to customer*

Level 1

Manufacturing issues are considered late in design

Level 2

Manufacturing & assembly issues are considered earlier in projects, but in an ad hoc manner. Supplier & cost considerations are limited

Level 3

Multi-functional teams include some downstream disciplines and key suppliers

Level 4

Priorities of downstream stakeholders are quantified as early as possible in design, and used for process evaluation and improvement

Level 5

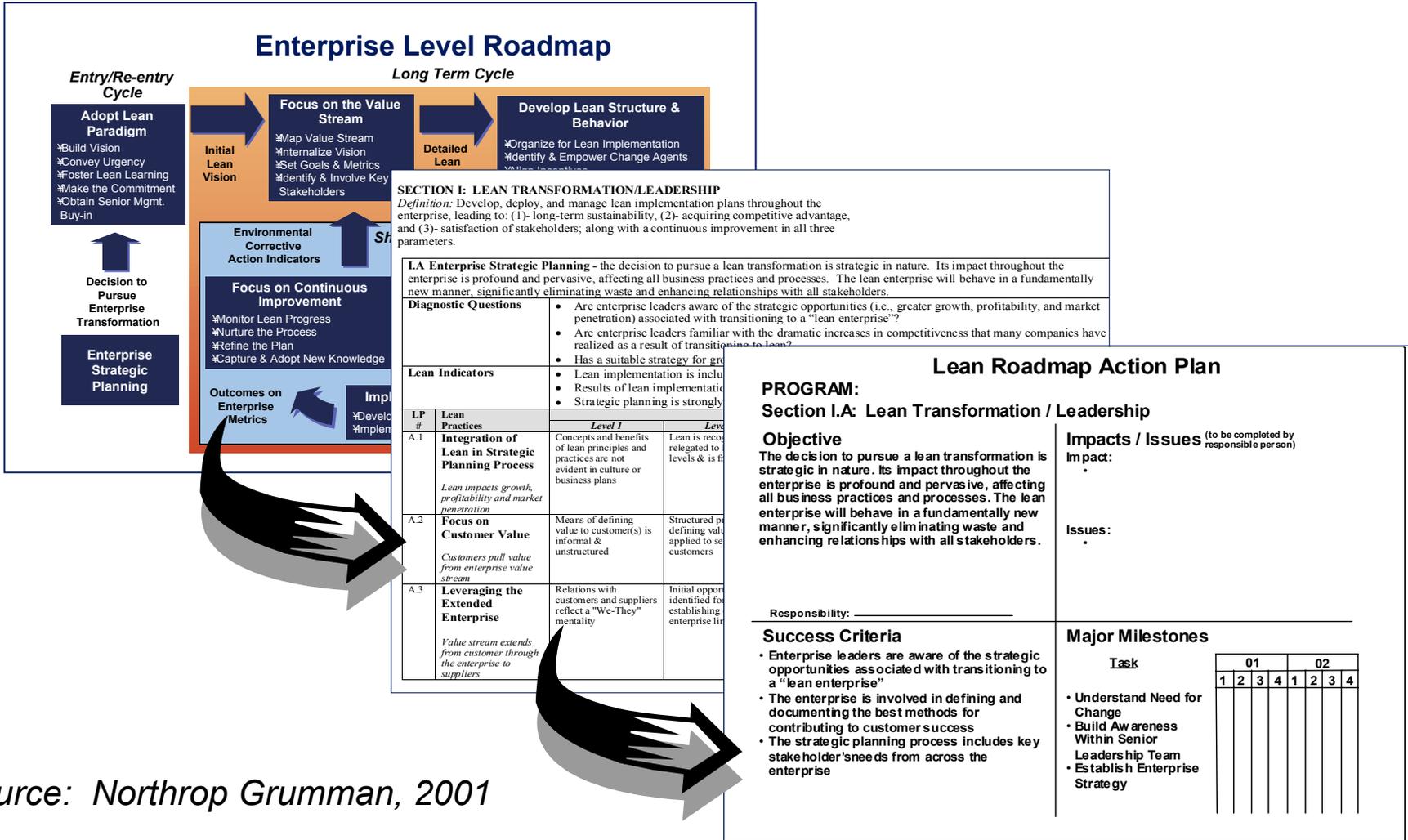
Downstream stakeholders' values in the extended enterprise are quantified, and balanced via tradeoffs, as a continuous part of the process



LESAT Section III: Diagnostic Questions

- Are common tools and systems being used across the enterprise?
- How well have the financial and accounting systems been integrated with non-traditional measures of value creation?
- How well can stakeholders retrieve financial information as required?
- Are human resource practices reviewed to assure intellectual capital matches process needs?
- Are enabling infrastructure processes being aligned to value stream flow?
- Do processes create the least amount of environmental hazards practical?
- Is the information technology system compatible with stakeholder communication and analysis needs?

Industry Application of TTL and LESAT Action Plans Linked to Assessment Results



Source: Northrop Grumman, 2001

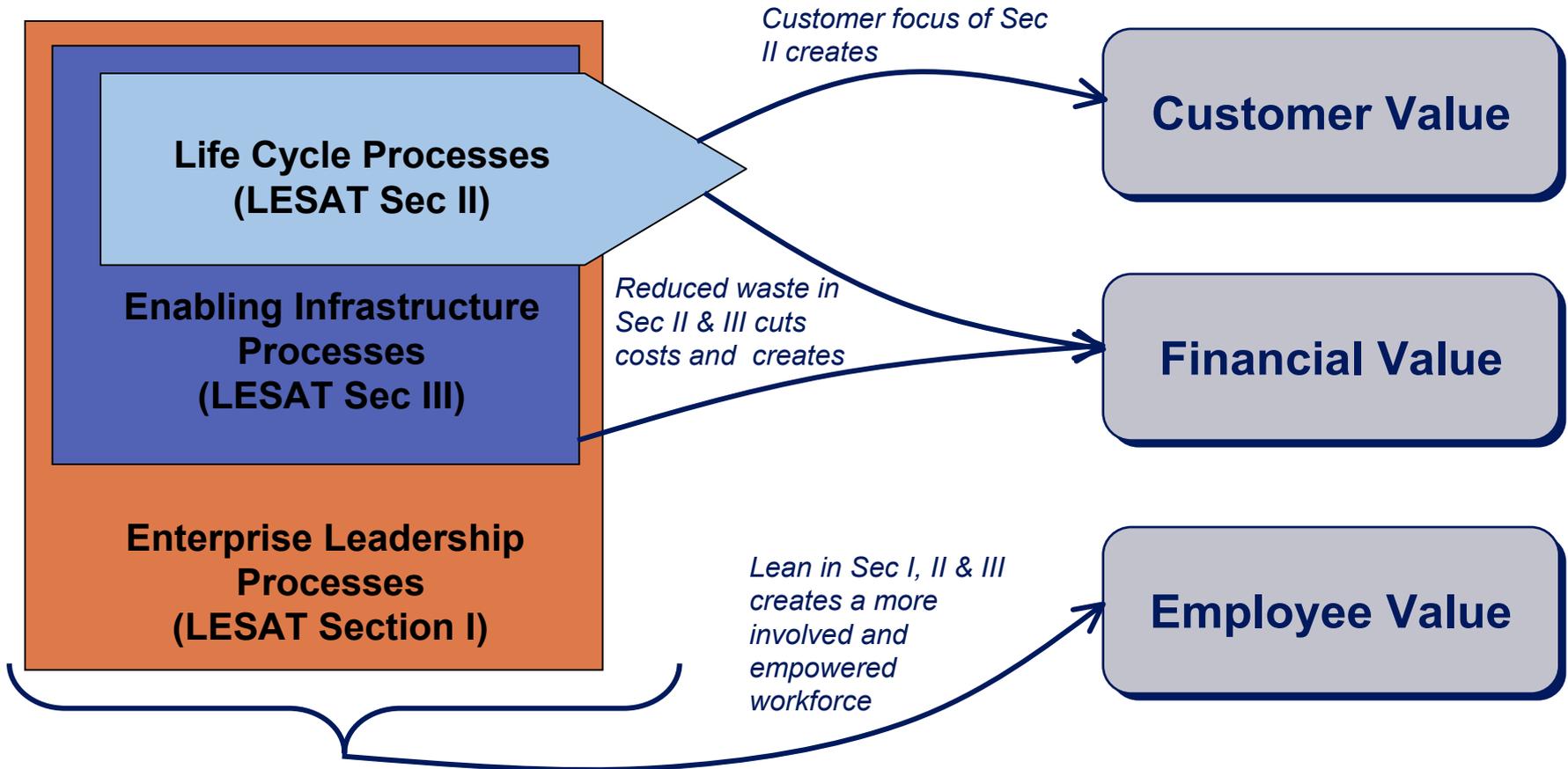
Enterprise Implementation Insights



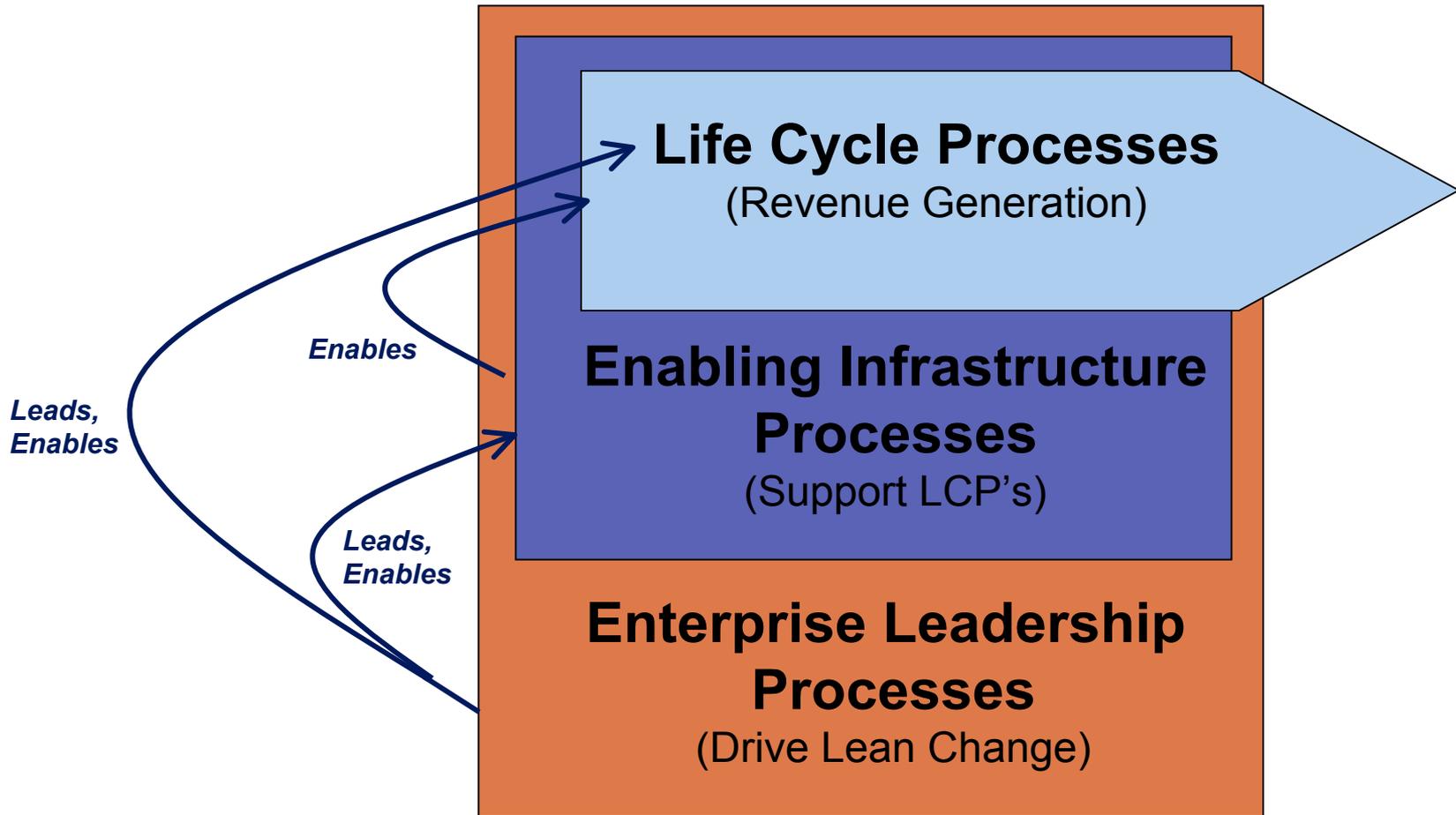
LESAT as a Leading Indicator of Improved Enterprise Value Delivery

State of Enterprise Leanness
(LESAT - Leading Indicators)

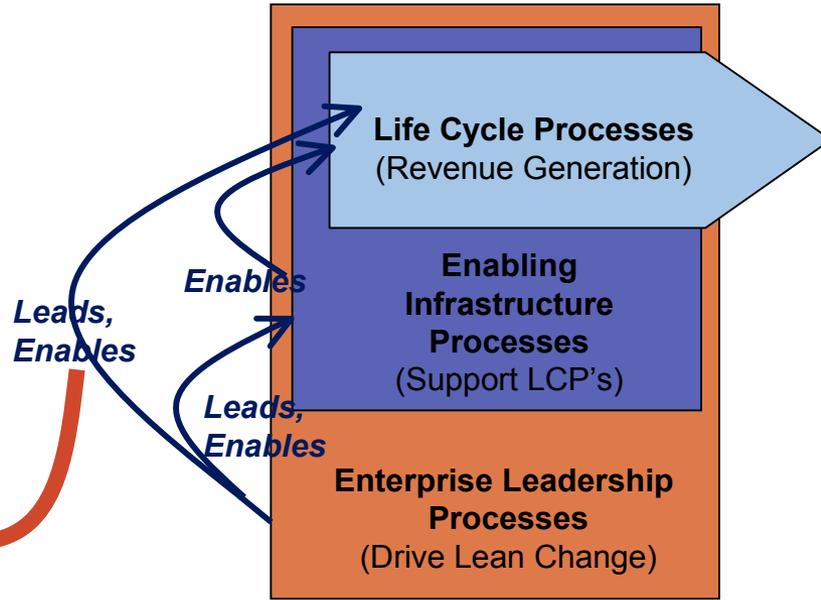
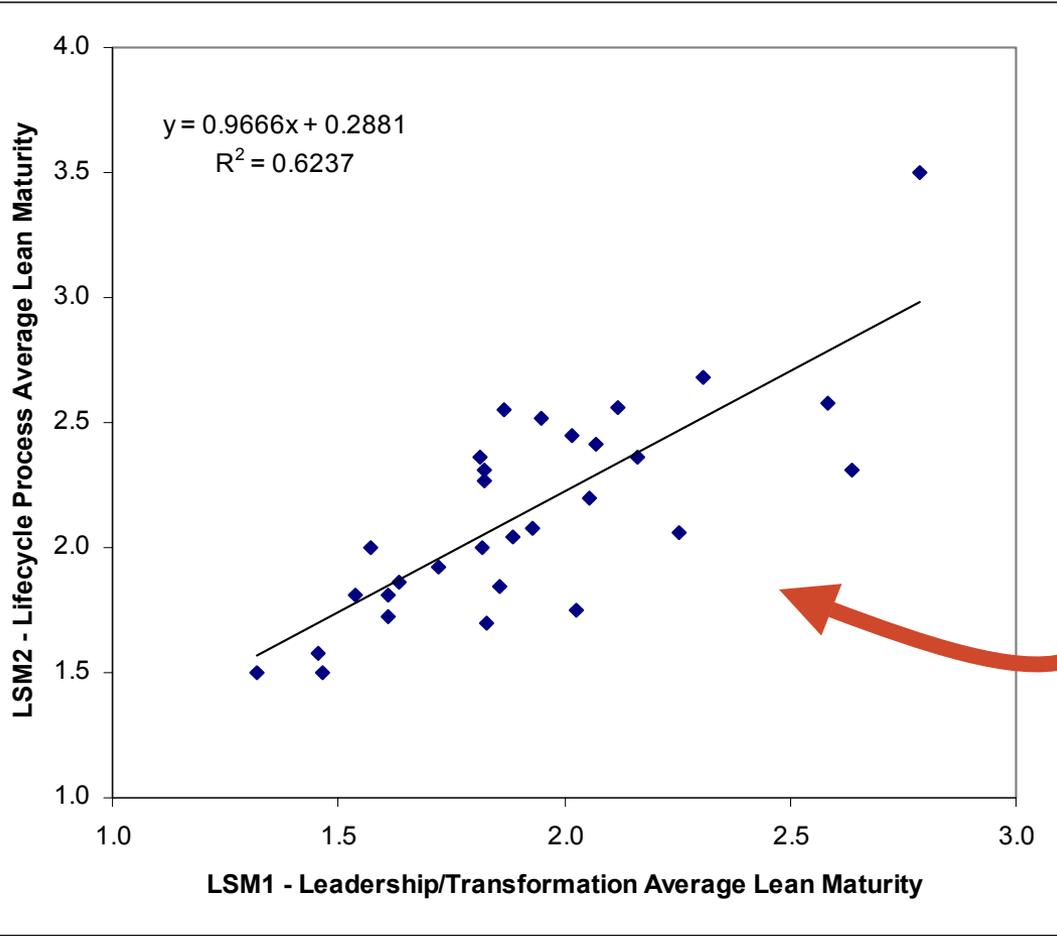
Enterprise Performance Measures
(Lagging Indicators)



Proposed Leading Indicator Relations in Lean Enterprise Transformation



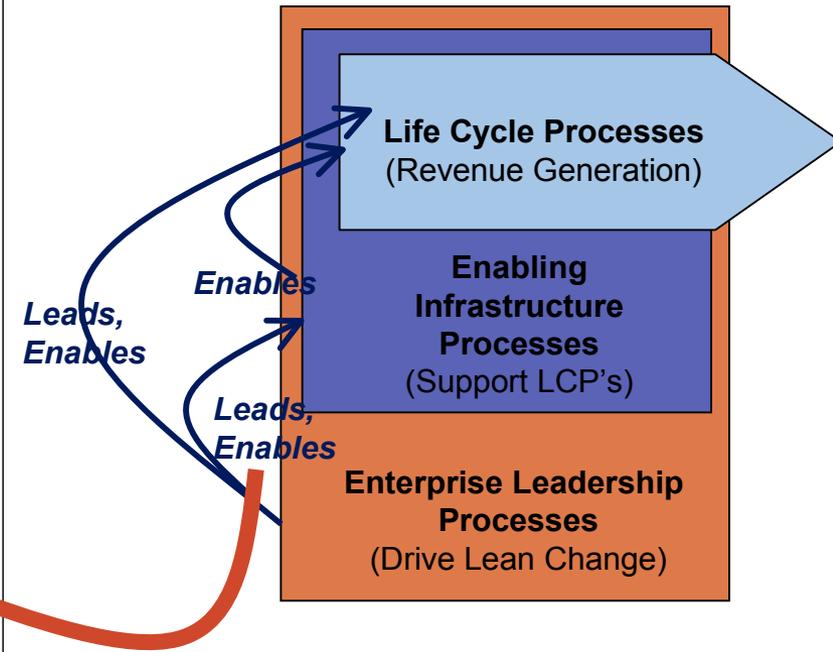
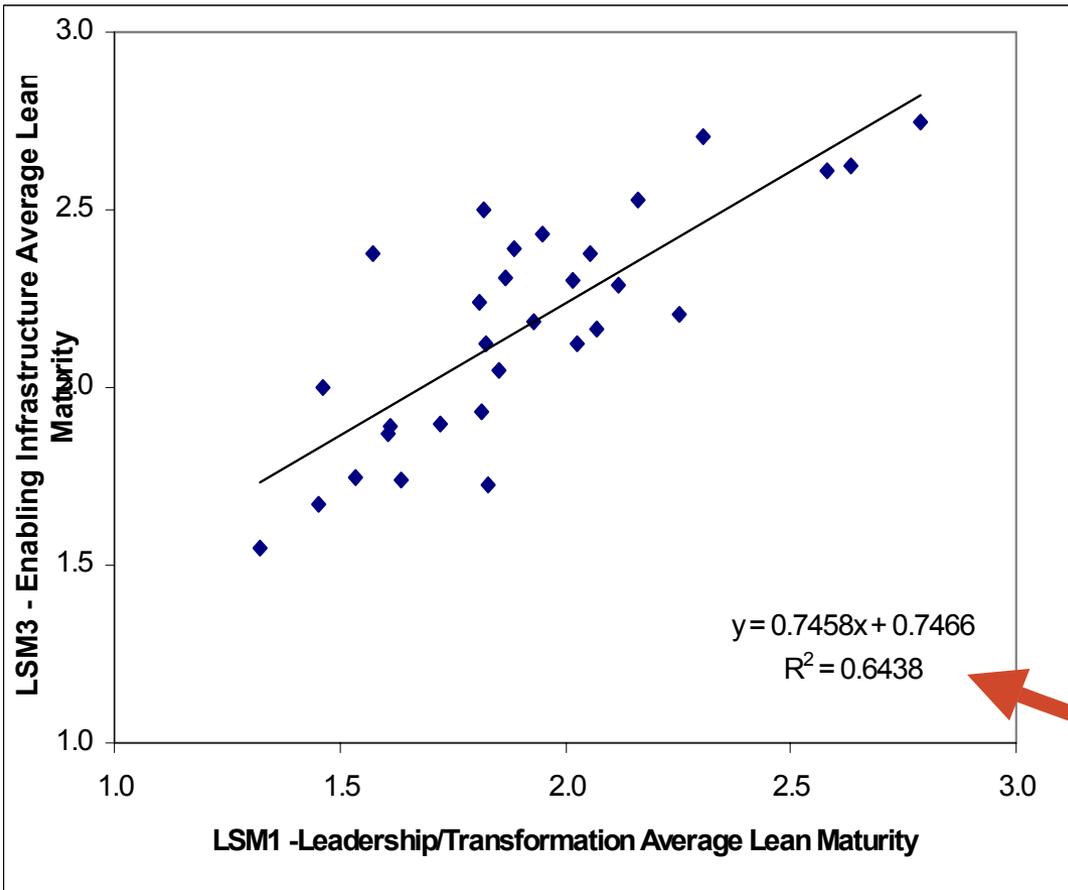
Leadership and Lifecycle Processes



Enterprises exhibiting high lean maturity in Leadership/Transformation processes exhibit high lean maturity in Lifecycle processes



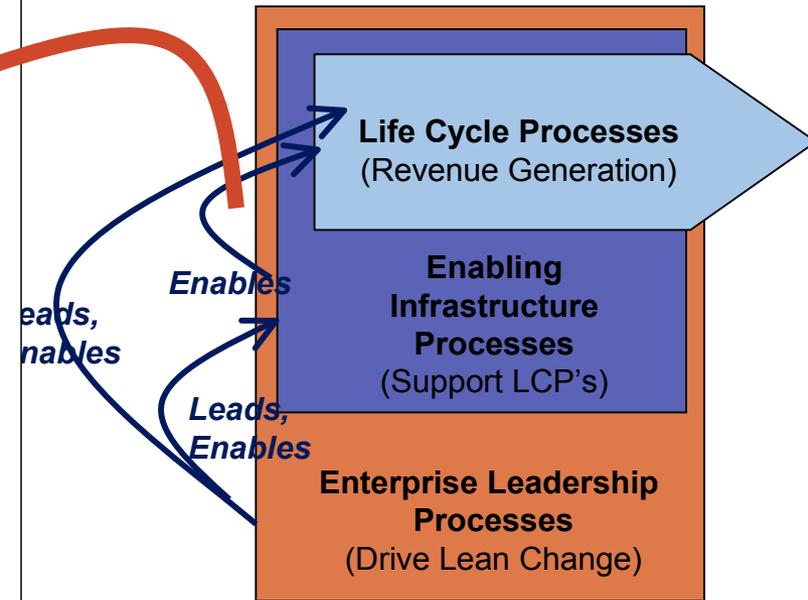
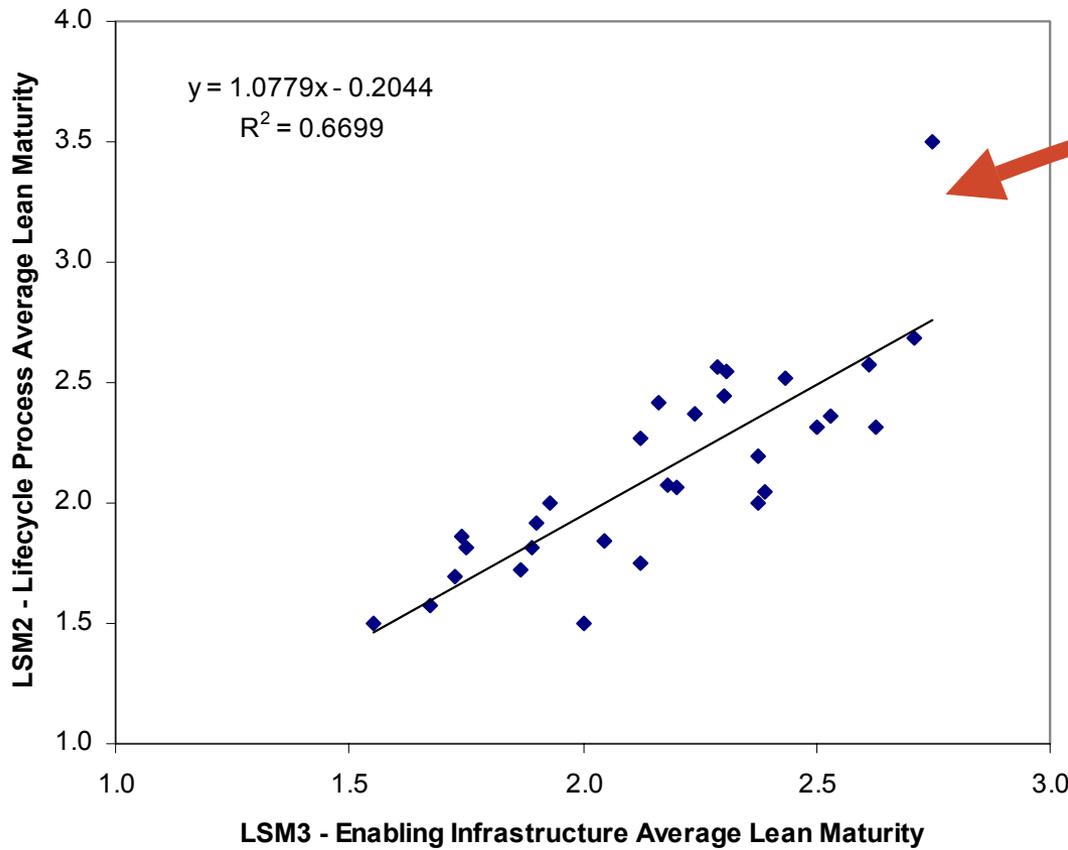
Leadership and Enabling Infrastructure



Enterprises exhibiting high lean maturity in Leadership/Transformation processes exhibit high lean maturity in Enabling Infrastructure processes



Enabling Infrastructure and Lifecycle Processes



Enterprises exhibiting high lean maturity in Enabling Infrastructure processes exhibit high lean maturity in Lifecycle processes



Main Empirical Findings

- 1) The aerospace industry is in its lean enterprise infancy
- 2) There are significant correlations in the lean maturity of enterprise processes
- 3) Leadership commitment is critical to lean enterprise transformation
- 4) Management information feedback is present in high lean maturity enterprises



“The notion that you can drive lean from the bottom up is ‘pure bunk’.”

-Mike Rother
Becoming Lean, 1998



Enterprise Leadership

- Major undertaking to transform enterprise from mass-production orientation to one based on Lean
- Comprehensive change initiative - touches every person and process in the organization
- Enterprise Leader ***must*** lead a change initiative of this magnitude
- Success depends upon the personal involvement, understanding, and leadership of enterprise leader
- **CANNOT BE DELEGATED**



“The soft stuff is the hard stuff”

-Chris Cool, VP, Lean Enterprise
Northrop Grumman, ISS Sector



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 and sustaining the change
- Focusing on time forces everyone to think of the “enterprise”
- Enterprises must be viewed as a holistic system
- Substantial potential in Enterprise



Enterprise Assessment Insights

- Differences in perception were disclosed between management layers
 - VP's: "We're highly committed!"
 - Directors: "Doesn't look like it to us!"
- The "gap" analysis between current levels and desired levels helped identify strategic "holes" in the enterprise and its processes
- The discussion resulting from the assessment analysis proved a healthy diagnosis tool for the enterprise more so than the exact scores
- A more holistic understanding of the role of leadership, core, and enabling processes in delivering value almost always ensued

Next Steps

Goal: rapidly deliver capability to war fighter

- Initially focus on industry and government interfaces
- Prototype processes
 - Inactive contract closeout, Alpha contracting, CTF
- Leverage collective knowledge and efforts
 - Led by industry SMEs: Raytheon, Northrop Grumman, Lockheed Martin, Boeing, Textron, Rolls Royce, P&W, Rockwell Collins
 - Supported by LAI research, knowledge, and tools
 - Achieved by joint industry and government teams
- Approach
 - Pre-engagement to obtain leadership buy-in
 - Workshop to provide training
 - Initial VSM of program or process
 - Focused events to follow-up
 - Implement improvements and realize results
 - Leverage prototypes to broaden scope of initiative





Enterprise Value Focus: Research Imperatives

Evolving integrated aerospace enterprises that efficiently create value for multiple stakeholders by employing lean principles and practices

- Program enterprises
- Multi-program (multi-divisional) enterprises
- US aerospace enterprise

Emphasis on:

Designing lean enterprises

Enabling lean transformation of enterprises

Evolving and adapting lean enterprises



Enterprise Value Focus: Key Questions

- How to architect/design future lean enterprises?
 - Lifecycle value creation perspective
 - Organizing principles
 - Integration strategies
- How to accelerate lean enterprise transformation?
 - Workforce and cultural change
 - Metrics for motivating desired behavior
 - Information technologies
- How to build evolving and adapting lean enterprises?
 - Evolutionary acquisition & spiral development
 - Knowledge management
 - Fostering innovation across acquisition value stream

Realizing Enterprise Potential

