LEAP - Lean Effects on Aerospace Programs
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Research Sponsored By Lean Aerospace Initiative
纲要

- What is LEAP?
- Research approach
- Case study achievements and highlights
- Case study implementations
- Synthesis
What is LEAP?

- Exploratory study conducted by students and staff at MIT
- Requested by LAI Executive Board
- Two questions to be answered
  - What has been the impact of lean on the US aerospace industry?
  - To what degree have lean principles diffused through the industry?

Assess accomplishments
Identify key enablers and future challenges
Approach

- **Survey**
  - Broad overview of lean implementation in industry
  - Representative of US aerospace industry
  - In progress

- **6 Case Studies**
  - Selected cases of successful lean transformation
  - Diverse set of programs and products
  - Site visits and structured interviews
  - Outcomes, enablers, and future challenges identified
Case Study Approach

"Before" Organizational Performance

"Turning Point"

"After" Organizational Performance

Road Ahead to Future Improvement

Imperative to Change

Strategies Practices Methods

Business as Usual

Time

e.g. 1990 e.g. 1992 e.g. 2000 e.g. 2005

Business as Usual
Case Studies

1996-2001

Boeing Commercial Airplane Group, Wichita, KS

25% decrease in unit cost
50% decrease in labor hours/unit
1992-2001

Lockheed Martin Aeronautics Company, Ft. Worth, TX

Nearly constant price with decreasing production rates (180 to 24/year) and significantly improved system capability
2000-2002

Rockwell Collins - Melbourne, FL

1st test yield improved by as much as 50%

37% increase in labor productivity
1999-2001

*Raytheon Missile Systems, Louisville, KY*

Integration of repair and upgrade with new system delivery

50% reduction in cycle time
1992-2001

Raytheon Missile Systems (RMS), Tucson, AZ

"...cut the cost of a missile from $1 million to $250,000 in seven years, doubled deliveries in 12 months, and improved reliability to three times what RMS contracted for."

Integration of production and sustainment

Source: Miller, W. Industry Week Best Plant Award (1999)
1995-2000

*Lockheed Martin Astronautics Company, Littleton, CO*

Production cycle time reduction of 50%
Imperative: Keeping up with increasing demand

1996 Critical mass for change
Quality focus
“Process Kaizen” - obvious and urgent
“System Kaizen” - emergent
Lean maturity assessment

2001 Supply chain partnerships
New VPs of Operations and Engineering
Emphasis on customer
New policies to improve quality

Separation of programs and core
functional groups
Formal IPT implementation on
programs

Formalization of Lean group

Corporate focus on lean
showing top-down
commitment

<table>
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<th>Year</th>
<th>Event Description</th>
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<td>May</td>
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<td>Lean implemented upstream – no more starvation</td>
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<tr>
<td>Oct.</td>
<td>2001</td>
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**Rapid implementation and learning leading to significant productivity improvements**
Phalanx Implementation

- Management mandates strategy to improve Phalanx
- Raytheon acquires Hughes
- Completed integration of program enterprise
- Phalanx adopts Hughes Agile program
- Navy Depot privatized by Raytheon, new production moved from Tucson to Louisville

Expanding Raytheon Six Sigma throughout the enterprise (to customers and sustainment infrastructure)
1988-1997 AMRAAM produced at both Raytheon & Hughes

1997 AMRAAM adopts Hughes Agile program

1998 Raytheon & Hughes consolidated in Tucson

1999 Raytheon Six Sigma

Ongoing lean government relationship

TSPR contract

Six Sigma/Lean tools institutionalized
**Atlas Implementation**

EELV competition
Commercial competitive pressure
Projected growth in market

1995

Goal: Reduce costs while maintaining mission success

1996

Value relationships with suppliers initiated

1997

Kaizen events
Helping suppliers become lean

1998

LM-21 Initiative - Lean and 6 Sigma

1999

Lean training events
Reorganization around value streams

Supplier incentives
Supplier mentoring program

2000

2001

Goal: double capacity without doubling the facility
Case Study Synthesis

- 6 different cases
- 6 different timelines
- 6 different implementations
- 6 lean success stories
- In addition, there were some commonalities
  - Achievements
  - Enablers
  - Future challenges
Common Achievements

- Quality improvements
  - Test yield
  - Reliability

- Cycle time reduction
  - Lean cells
  - Entire production line

- Customer satisfaction improvement
  - Repeat orders
  - Oversight elimination

- Cost reduction
  - WIP Inventory
Common Enablers

- Leadership
  - Top-down commitment and support
  - Vision
- Empowered multi-discipline teams
- Communication throughout the program
- Significant changes to processes throughout the program
- Lean training
Future Challenges

- Recognizing and expanding achievements beyond the factory floor
- Greater integration across interfaces within program value stream
  - For example: customer oversight, supplier networks
- Greater integration within multi-program enterprises
  - For example: design commonality, process standardization
● Basic lean principles apply to a wide range of products and programs

● Lean can be successfully implemented in various ways -- no one recipe

As shown by the case study examples:

● Lean transformations have taken place in the aerospace industry

● The journey of transformation is on-going

● Enterprises are committed to future lean efforts