

***Lean
Aerospace
Initiative***



***Enterprise Value:
The New Lean Horizon***

**LEAP - Lean Effects on
Aerospace Programs
March 27, 2002**

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MIT

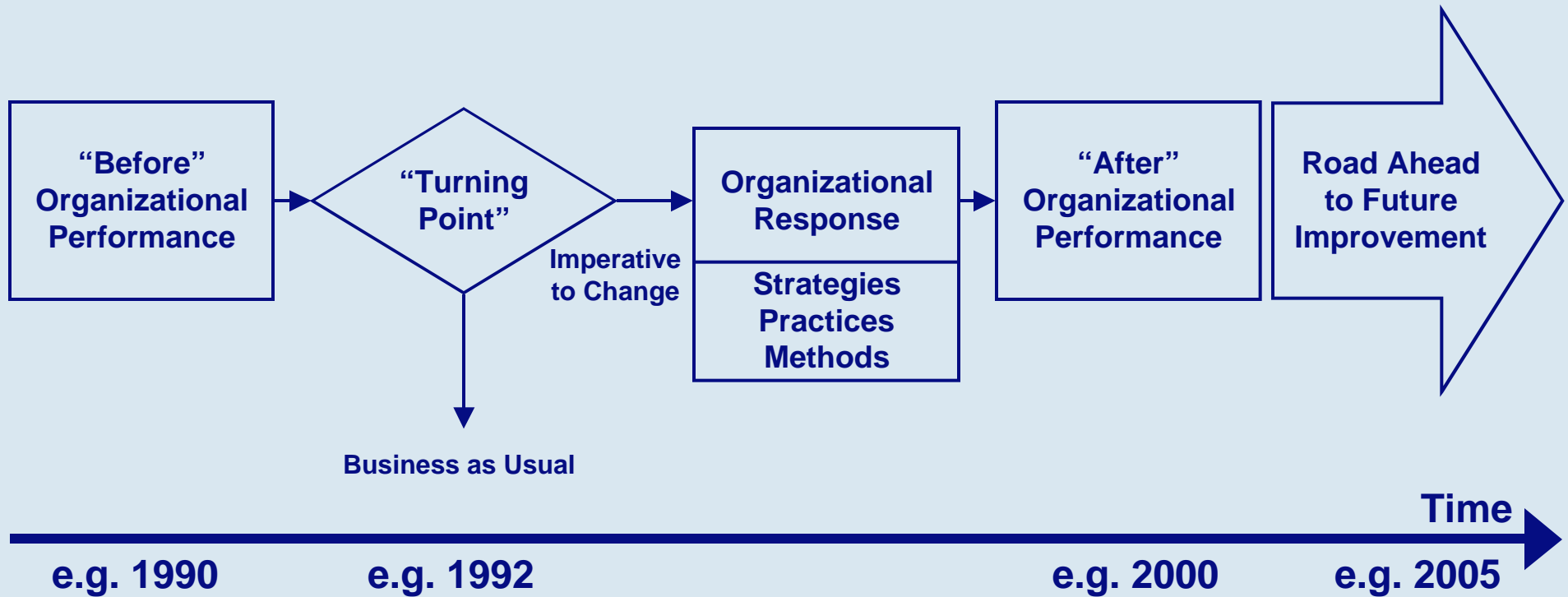
Research Sponsored By Lean Aerospace Initiative

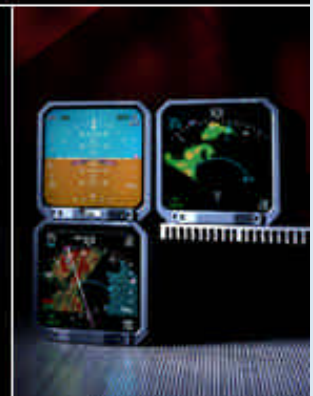
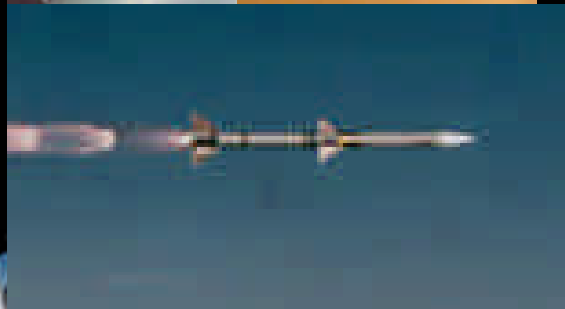
- **What is LEAP?**
- **Research approach**
- **Case study achievements and highlights**
- **Case study implementations**
- **Synthesis**

- **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

- **Survey**
 - **Broad overview of 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**





737 Fuselage Highlights

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



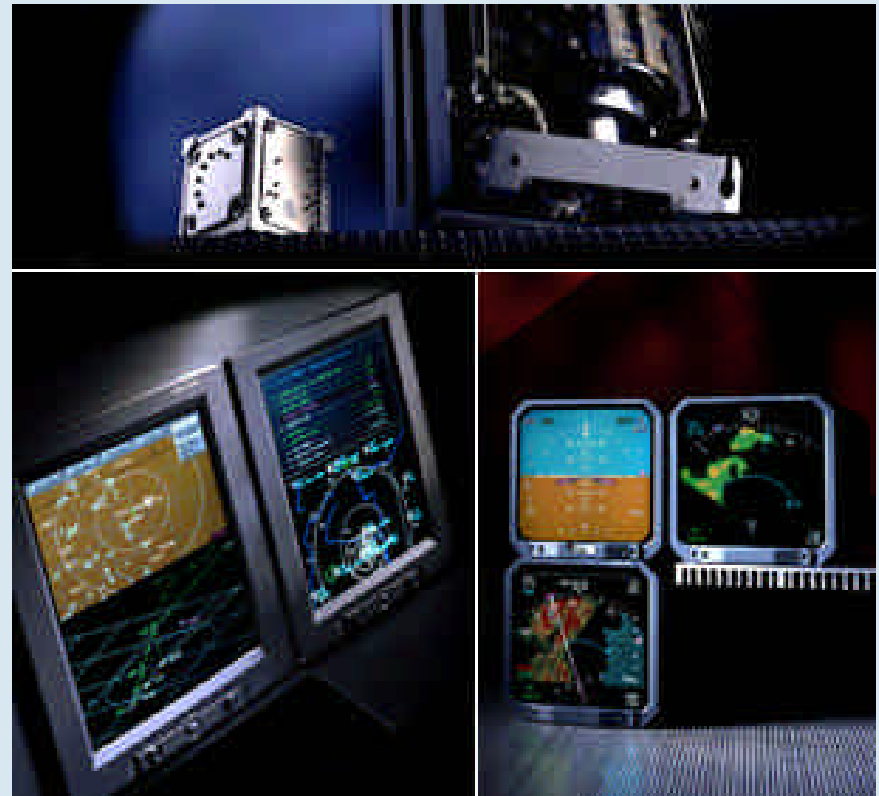
Nearly constant price with decreasing production rates (180 to 24/year) and significantly improved system capability

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**

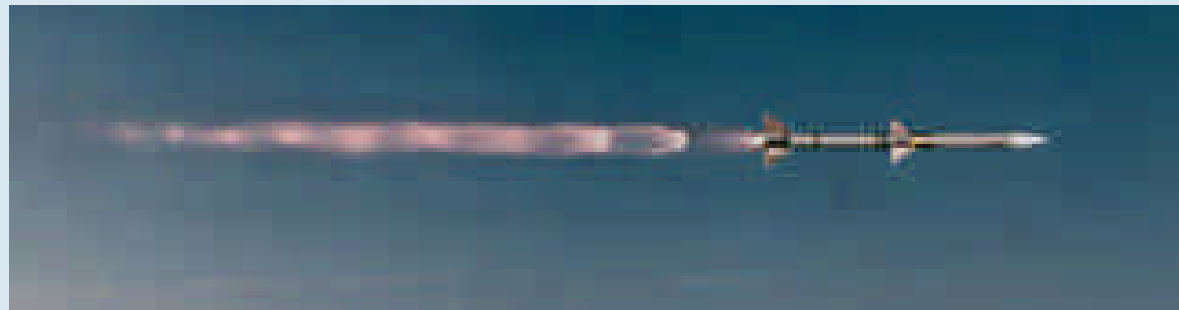


1992-2001

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





1995-2000

Lockheed Martin Astronautics Company, Littleton, CO



Production cycle time reduction of 50%

737 Fuselage Implementation

Imperative: Keeping up with increasing demand

Awareness

Understanding

Knowledge

Capability

Ability

Adaptability

Agility

1996 Critical mass for change

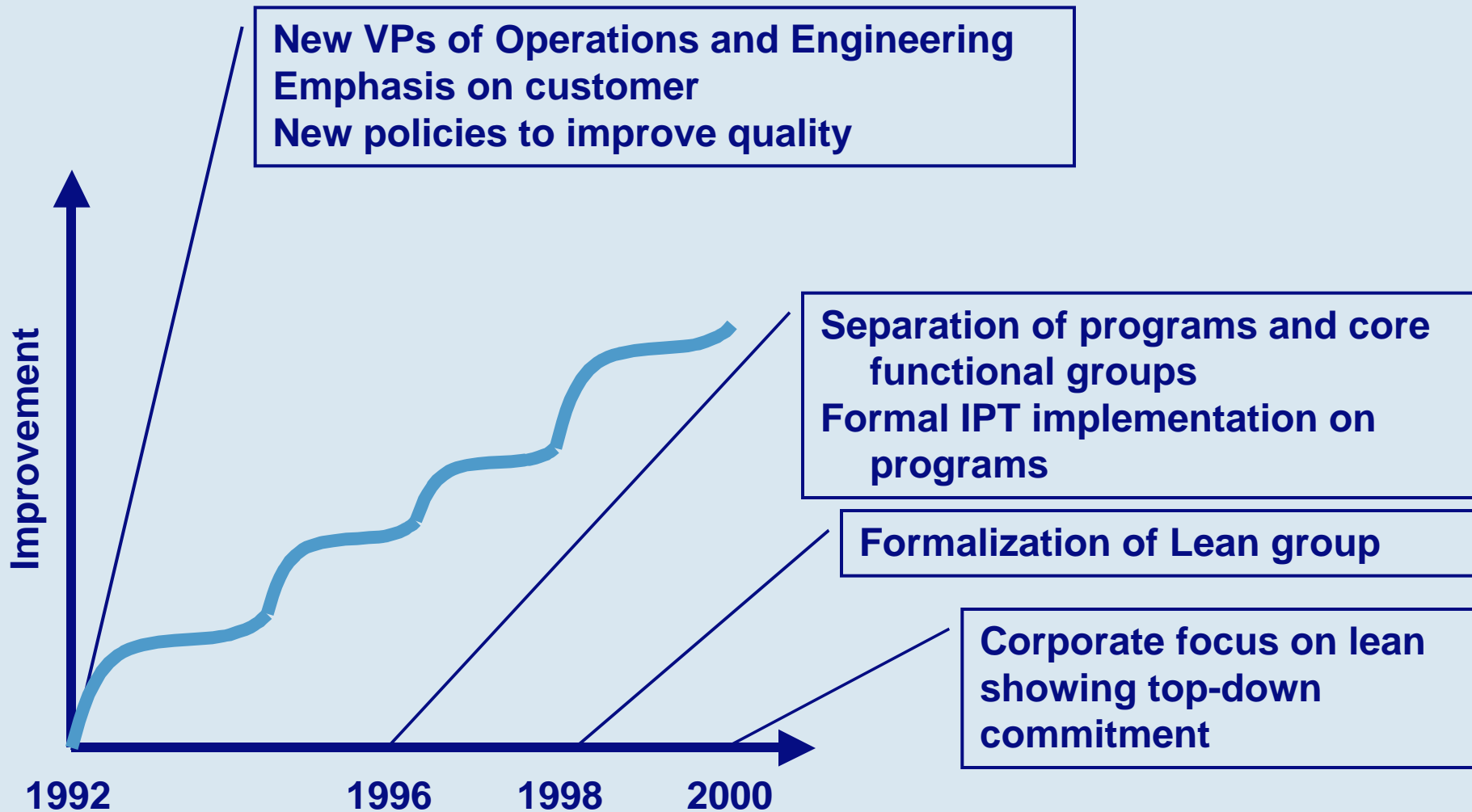
Quality focus

“Process Kaizen” - obvious
and urgent

“System Kaizen” - emergent

Lean maturity assessment

2001 Supply chain partnerships

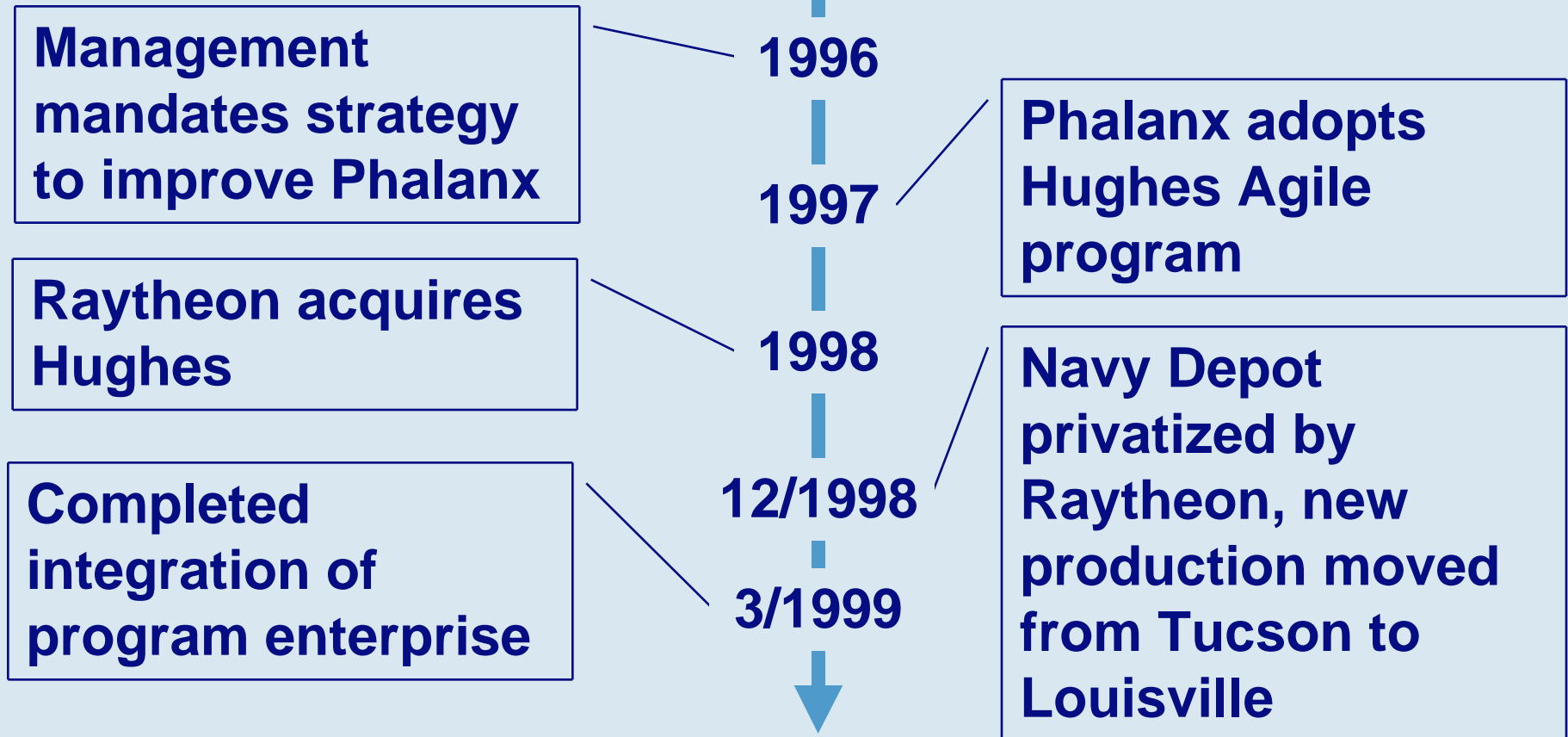


Commercial Aviation Electronics Implementation

May 2000	Facility Value Stream Mapping
Jul. 2000	First lean cell started
Sept. 2000	First lean cell complete
Oct. 2000	Second cell started
Jan. 2001	2 more cells in a different product area started
Feb. 2001	Cells being starved by upstream processes
May 2001	Lean implemented upstream – no more starvation
Oct. 2001	4 more cells done

**Rapid implementation and learning leading to
significant productivity improvements**

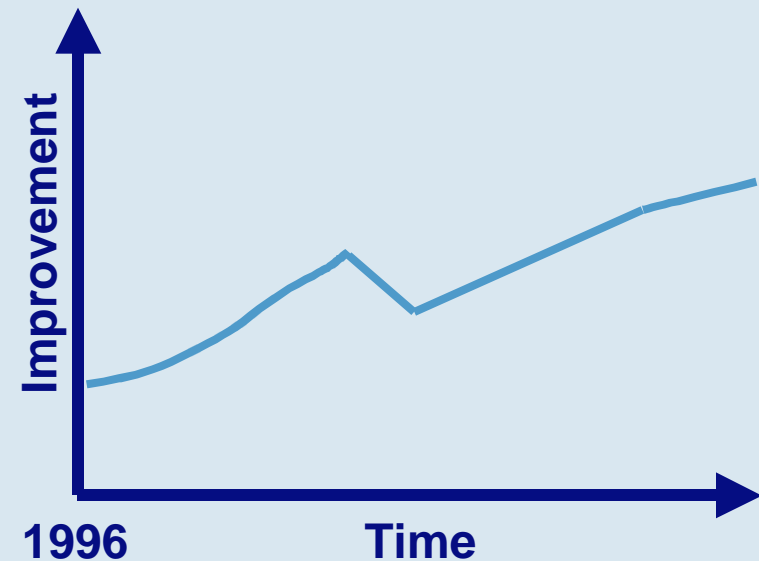
Phalanx Implementation



**Expanding Raytheon Six Sigma throughout the enterprise
(to customers and sustainment infrastructure)**

AMRAAM Implementation

- 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



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

- **Quality improvements**
 - **Test yield**
 - **Reliability**
- **Cycle time reduction**
 - **Lean cells**
 - **Entire production line**
- **Customer satisfaction improvement**
 - **Repeat orders**
 - **Oversight elimination**
- **Cost reduction**
 - **WIP Inventory**

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

- **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**