Contents

➢ 21st century aerospace challenge

➢ Industry maturity perspectives

➢ Implications on the aerospace industry

➢ LAI direction
Aerospace has four core missions:
- Enabling the global movement of people and goods
- Enabling the global acquisition and dissemination of information and data
- Advancing national security interests
- Providing a source of inspiration by pushing the boundaries of exploration and innovation

These missions will never be routine and require the best technology and the best organizations

“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.”
Application of Lean across the total enterprise is needed to realize its full benefits. Leadership is critical at all levels.

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

---

**Better, Faster, Cheaper? - Lean Enterprises**

**Stakeholders**
- Customer Acquirer
- End User Consumer
- Partners
- Suppliers
- Union
- Corporation
- Shareholder
- Society
- Enterprise Employees

**Three Levels of Enterprises**
- Program
  - F22
  - Boeing
  - Lockheed-Martin
  - USAF
- Corporate or Government
  - Primes,
  - National or International
  - Government,
  - Suppliers,...
Success!

➢ Won the cold war

➢ Overpowering in all recent conflicts
The Needs of Aerospace Customers are Changing

From a focus on single vehicles to platforms...

To networks of platforms and...

More flexible challenges in their employment

Innovation in the industry is thus shifting from single vehicles to networks of capability
**Cost of Tactical Aircraft**

*Source: Augustine’s Laws*

- **Year of Initial Operation**
  - 1950

- **Then-Year Dollars**
  - Gross National Product: One Quadrillion
  - Defense Budget: One Trillion
  - Aircraft Unit Cost: One Billion
  - One Million
  - One Thousand

The graph shows the trend of Gross National Product, Defense Budget, and Aircraft Unit Cost from 1900 to 2150.
Lean Aerospace Initiative

DoD Product Development Time

Dev Cost ($M) ~ (1.36 + 0.03 x Dev Time(months))^4


8 MS Shields - 1/30/02 © 2002 Massachusetts Institute of Technology
web.mit.edu/lean
Model of Product and Process Innovation

➢ Rate of product innovation highest during formative years

➢ As product matures rate of process innovation overcomes product innovation

➢ Very mature products have low levels of both product & process innovations

Utterback’s Dynamics of Innovation Model

Fluid Phase: Rapid technology innovation, many firms founded

Transition Phase: Shakeout, competition shifts to process

Emergence of the Dominant Design

Specific Phase: Stable, small number of firms, competition shifts to price

Destabilizing changes in technology or process can destroy industry!

Dominant Design?

1958

1995
Dominant Design?

1953

1972

2002
Aerospace Industry

Typewriters: Open, moving carriage

Cars: enclosed steel body

Aeronautics: Jet transport and jet fighter-bomber

Government intervention motivated by cold war

Natural progression?

Industrial evolution and the emergence of the dominant design

Number of major U.S. Aerospace companies

Number of major typewriter companies

Number of major automobile companies
Implications of Post Dominant Design (Transition Phase)

➢ Little product differentiation
➢ Incremental product innovation
➢ Acquisition cost becomes focus
➢ Operating costs more of a concern
➢ Mergers, acquisitions & exits
➢ Process innovation dominates
➢ Organizations become more rigid & hierarchical
➢ Less risk taking

= AEROSPACE INDUSTRY?
Fine’s 3-D Concurrent Engineering Model

PRODUCT
- Performance Specifications

PROCESS
- Technology And process Planning
- Details, strategy
- Manufacturing System, Make/buy
- Time, Space, and Availability

SUPPLY CHAIN
- Recipe, Unit Process
- Product Architecture, and Make/buy

In a post dominant design environment two relationships predominate

- Product interactions become more interlinked with process and the supply chain
- Supply chain integration and process improvements have a predominant impact on cost

Design must be much more interactive with mfg & suppliers
Conclusions

➢ Aerospace industry innovation shifting to systems of systems

➢ In a maturing single product environment
  ➢ Product and life cycle cost predominate
  ➢ Best addressed by process & supply chain improvements

➢ Lean beyond the factory floor means shifting the enterprise focus to product realization from product design

➢ Enterprise strategy should change in recognition of this new competitive landscape
Achieved success in functional areas

- **Product development**
  - Design process improvements through application of Lean
  - Application of value stream analysis to make development and testing more efficient

- **Manufacturing systems**
  - Major process improvement efforts
  - Shifting from batch and queue to flow

- **Supplier networks**
  - Improvements in quality, supplier mgmt,
  - Improvements in communications, supplier roles
Major improvements through the integration of design, manufacturing and the supplier network
Frameworks for Integration…

➢ …from the manufacturing perspective

➢ …from the product development perspective

➢ …from the supplier networks perspective