DESIGN AND EXERCISE OF FLEXIBILITY IN THE BOEING 787 DREAMLINER

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Large Commercial Aircraft Enterprises as a Complex System

Nested Complexity

- Large system, large stakes
- Time scales
- Non-linear effects
- Evaluative complexity
- **Difficult to predict future behavior**

LAI Case Study:
**Market demand for aircraft derivatives, focus on Boeing 787 Dreamliner**

**Understand:**
- Use technology and architecture to create flexible 787 design
- Can existing Boeing enterprise architecture utilize flexible 787?

Physical Domain
- Aircraft
- Manufacturing
- Airports
- etc.

Institutional Sphere
- Manufacturers
- Suppliers
- Airlines
- Governments
- etc.
Flexibility in the 787 Technical Architecture and a Supporting Enterprise Architecture

**Flexibility** allows system configuration to adapt to future circumstances, at a reduced cost.

Boeing enterprise architecture able to take advantage of flexible 787 architecture?

Modular fuselage and wing design creates flexibility to more quickly and inexpensively create 787 derivatives.

Increased flexibility in meeting changing market demand.

To utilize flexible architecture, need for:
- timely analysis of market conditions and customer needs
- supply chain capable of changing assemblies quickly
**Overview:** framework for activities needed to enable, design and support flexible systems: both technically and within enterprise
Research to Date (II): Analysis of 787 Derivative Option

- **System Dynamics Model Overview:** evaluate benefits and costs of modular airframe and faster 787 derivative development and manufacturing times

- **Real Options Analysis Overview:**
evaluate value of option created by 787 modular airframe architecture
Research to Date (III):
Analysis of Boeing Enterprise Architecture (EA)

Product Architecture

Enterprise Architecture

787 Derivative
Product Development
Product Manufacturing

Customer Responsiveness / ID Changing Environment
Life-cycle planning
Design coordination
Flexible manufacturing

Global Supply Chain
Applicability of Research to LAI Members

Areas of Interest to LAI

- Use real options to cope with uncertainty
- Create and evaluate (benefits and costs) flexibility in technical architectures
- Enterprise architectures for harnessing benefits of flexibility

Research Focus

- Life-cycle flexibility framework addresses issues with flexibility throughout lifecycle, at technical system and enterprise levels
- Boeing 787 case study provides real world application at both the technical system and enterprise levels
Analysis of 787 Derivative Option

Option benefit – reduced time and cost related to designing and manufacturing 787 derivative

Option cost – development of the composite and manufacturing technology

Uncertainty – future demand for 787 derivatives

Exercise Exercise cost – the actual cost of designing and manufacturing variant

Expiration time – technological and/or economic life of the aircraft family