Integrating Boeing’s Systems Design Environment

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Overview

Talk broadly and generally about the systems design process at Boeing
- where we think its going

Talk more specifically about several projects using EASY5 that are driving in that direction
What are Aerospace Systems?

Avionic:
- Control
- Navigation
- Avionics
- Flight Management

Electrical:
- Power
- Entertainment
- Cabin Management

Mechanical:
- Hydraulic
- Environmental
- Fuel
- Thermal
- Mechanisms
- Crew Systems

Propulsion:
- Jet Engines
- Rocket Engines
- Fuel

Computers
Electronics
Software
Integrating Boeing’s Systems Design Environment
What Does that Mean?

Integration of design processes:
Preliminary design - Detailed design - Verification and test

Integration of Boeing and vendor/supplier teams
Integration of Boeing with teaming partners

Cross functional integration

Integration of CAE tools
Integration of CAD and CAE tools
Integration with Product Data Manager PDM tools
Integration of “Single-Source” data
Integrated Systems Design and Modeling

Why?

Moving towards Virtual Prototyping

Reduced Design Cost & Cycle Time
  Early Systems Validation
  Integrated System Validation
    Reduced Mockups
    Reduced Testing

Improved Design Flow
  Preliminary Design to Detailed Design
  Cross Functional
  Vendors / Suppliers
  Teams and Partners

Move Towards Single-Source Product Data
  Configuration Control
Other Objectives

Enterprise wide
- Common processes
- Common tools
- COTS tools
- Eliminate legacy codes
Aerospace Systems Design Process
Moving Towards Model-Based Design

Level of Detail
higher • lower

Level of Effort

Design Process

Preliminary Design

Detailed Design

Application/Verification

Product Definition

Configuration Studies

Functional Objectives

Systems Requirements

Electric Systems

Mechanical Systems

Flight Systems

Propulsion Systems

Avionics

Hydraulics

Power

Systems

Software

ECS

Mechanisms

Integrated Simulation

Embedded Code

LRU’s

Control Systems

Digital Preassembly

Engines

Real Time Sim

Schematics Drawings

Real Time Sim

Integrated Simulation

Embedded Code

LRU’s

Schematics Drawings
Requirements Capture

Diagramming Tools

The Desire

Flight Computer

Auto Pilot

Hydraulic System

Model Generation
Analysis Tools
Design Verification
Preliminary Design - Detailed Design
The Tool Dichotomy

- Preliminary Design
  - fast
  - low detail
  - low skill level

- Detailed Design
  - fully detailed
  - high skill level
  - product definition

Many tools do not span the design process
Need tools and infrastructure that can "evolve" the design
Maybe we need to pay up front with detailed tools that will span the process
Vendors / Suppliers and the SSPD

Enterprise Wide Integration Labs

Enterprise Wide Engineering Models

Single Source of Product data

EASY5 GSDS

Vendors Suppliers

Models
- Functional
- Geometry

Boeing’s role as “systems integrator” may be facilitated by providing systems definition and integration tools web based
Supporting Integrated Systems Design
EASY5 Focus Areas

- Improved diagrams and schematics
- CAE tool integrations e.g. GSDS
- Linkages to CAD
- Investigating requirements and structure for PDM
- Real-time
- Develop processes to support teams, vendor/suppliers
  - web based
- CORBA interface between EASY5 and MAT
EASY5 Development
Driven by customer Needs

Ongoing Boeing projects driving development
Example - common tools / common models
Example - large-scale process integration using EASY5 MAT

The new MAT-based process has been used to compute Flight Loads for all of our commercial airplane derivatives since 1996

50% design cycle time reduction - solution phase flight loads analysis

Question - can we achieve similar benefits with our vendors?
Integrating GSDS with EASY5
BCA Requirements Capture - Detailed Definition - Autocode

GSDS Auto-code modules may be added as components in EASY5

EASY5 provides local desktop environment for GSDS definitions
C-17 Iron-Bird

Driving EASY5 real-time modeling development

Goal
- replace C-17 “iron-bird” physical mockup with detailed real-time simulation
- quad-redundant 4000 psi hydraulic system
Integrating EASY5 with CAD

Goal:
Use Generative Design infrastructure to automatically relate fluid system EASY5 functional models to CAD definition.

Develop framework for central library of vendor-supplied component models to be plugged in - pumps, valves, actuators.

Aerospace
- hydraulics
- environmental
- fuels

Mechanical CAD Definition

Boeing

Functional Schematic

Single Source of Product data

Suppliers

Analysis Model
Rocketdyne RAPID Project

Rocket engine design optimization process

- Geometry
- Fluid Properties

MAT

EASY5

- Integrate analyses
- Single system model
- Eliminate legacy code
EASY5 Touches Many Facets of Boeing’s Systems Design Processes

EASY5 suited to some systems / design phases more than others
In Conclusion

We are involved at high level with process planning, development and strategy teams.

We are involved at ground level assisting projects driving both process development and the development of EASY5.

We are striving to expand EASY5’s role as a key tool in the Boeing “enterprise” arsenal of standard processes and tools for Aerospace Systems Design.