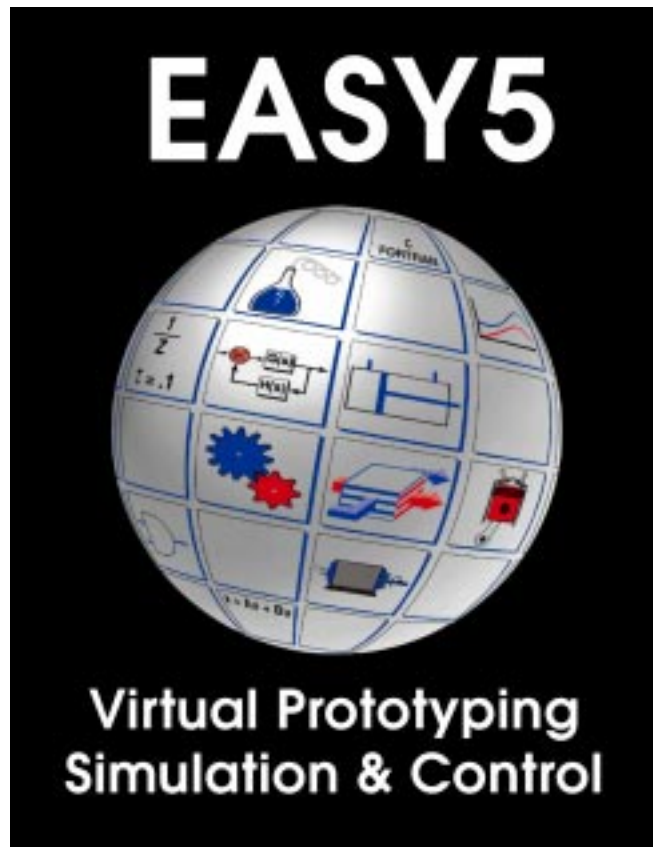


***BOEING***

## Integrating Boeing's Systems Design Environment



**Bruce Fritchman**

**May, 2000**

# 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

```
graph TD; C[Computers  
Electronics  
Software] --- A[Avionic]; C --- E[Electrical]; C --- M[Mechanical]; C --- P[Propulsion];
```

# **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

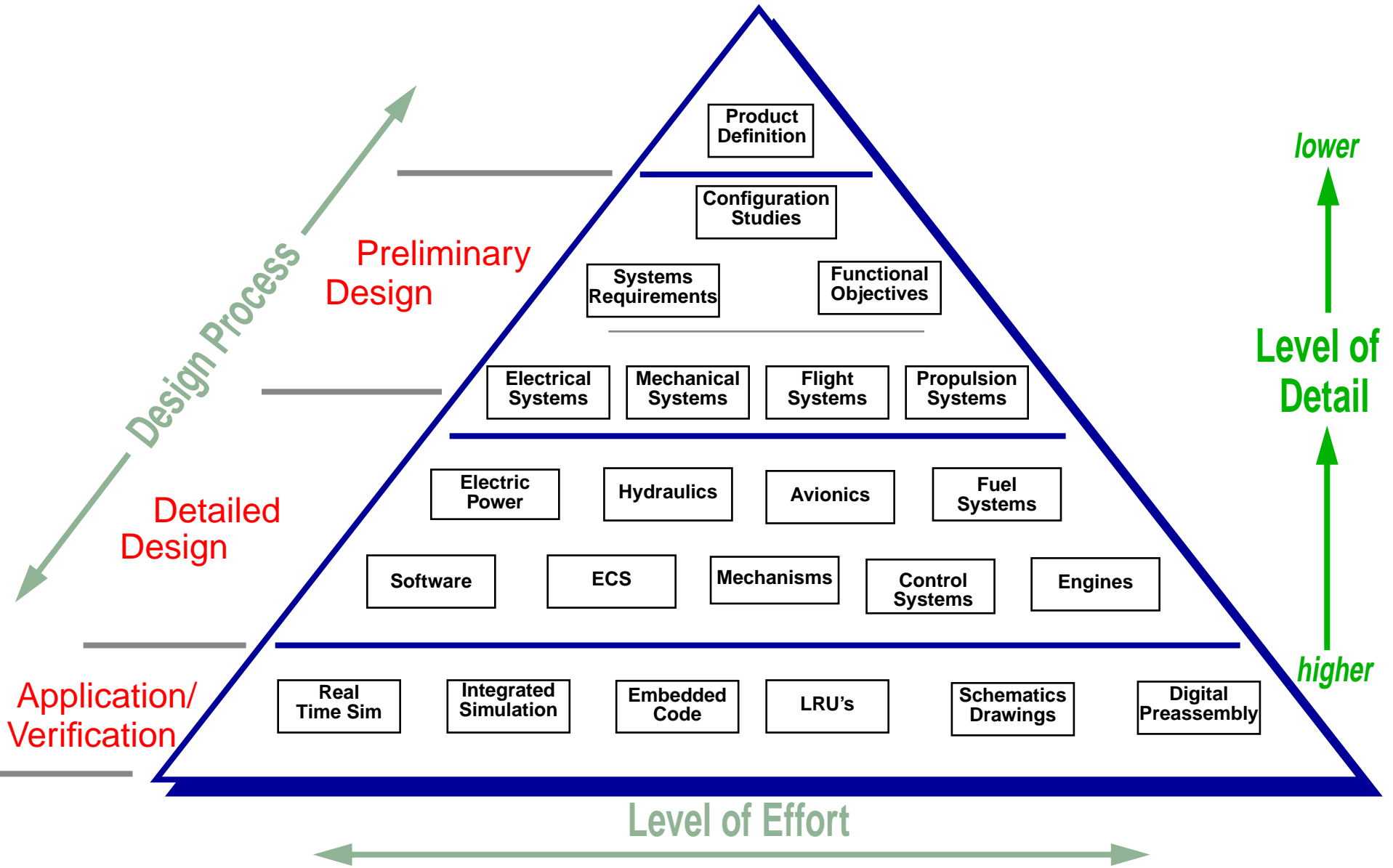
# Other Objectives

## Enterprise wide

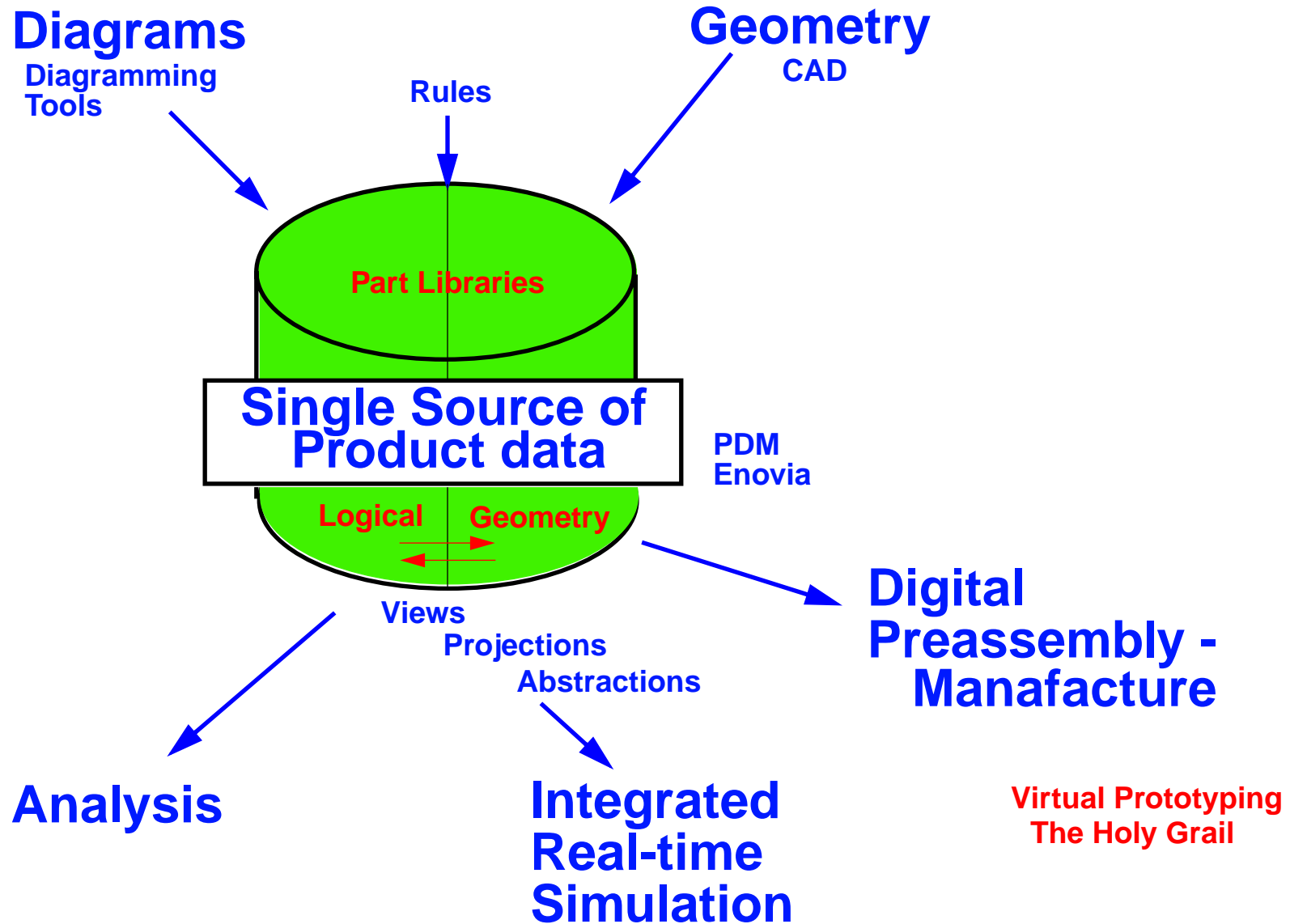
- Common processes
- Common tools
- COTS tools
  
- Eliminate legacy codes

# Aerospace Systems Design Process

## Moving Towards Model-Based Design



# Integrated Systems Design Process and the SSPD

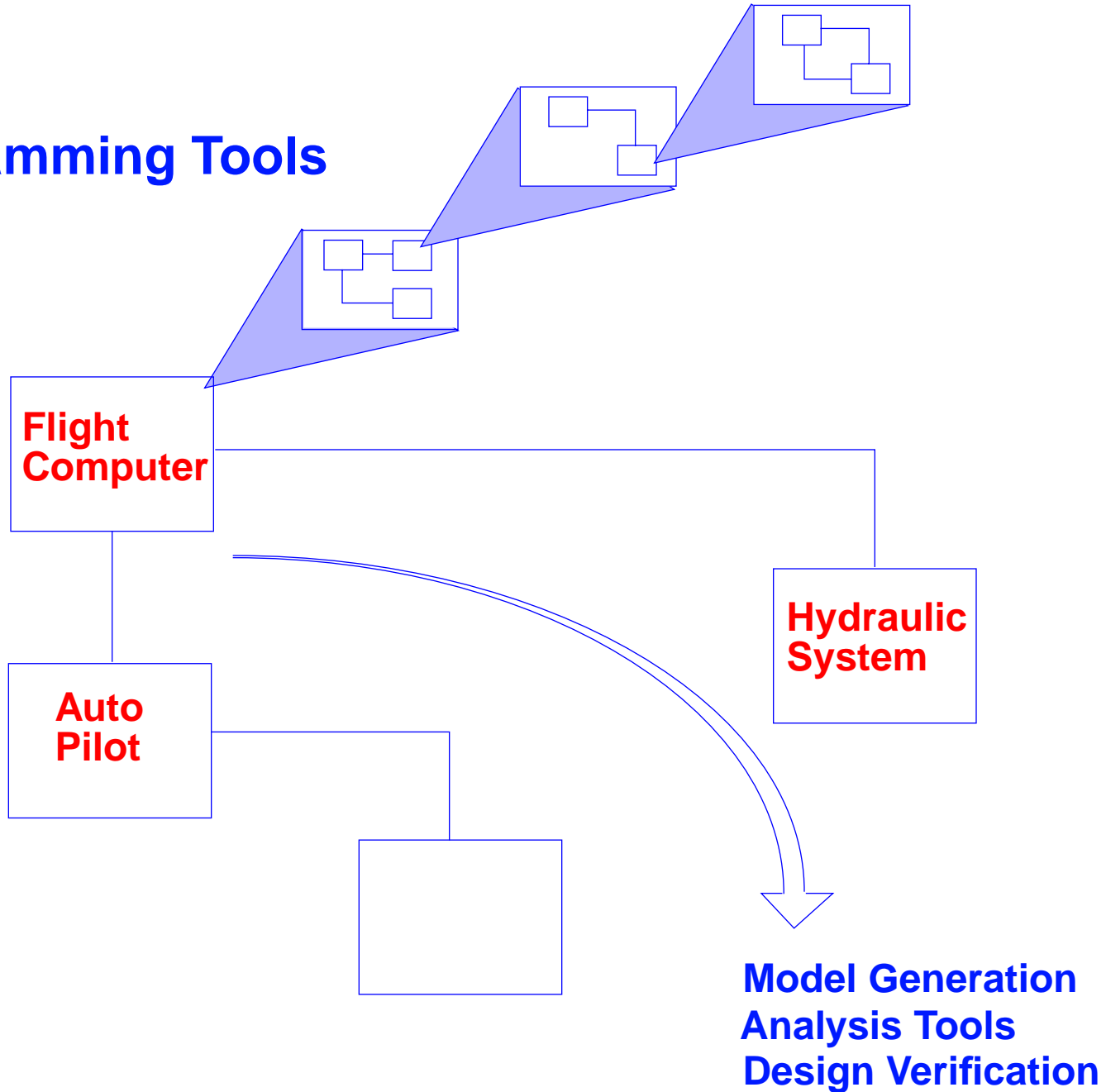




# Requirements Capture

## Diagramming Tools

The  
Desire



# Preliminary Design - Detailed Design

## The Tool Dichotomy



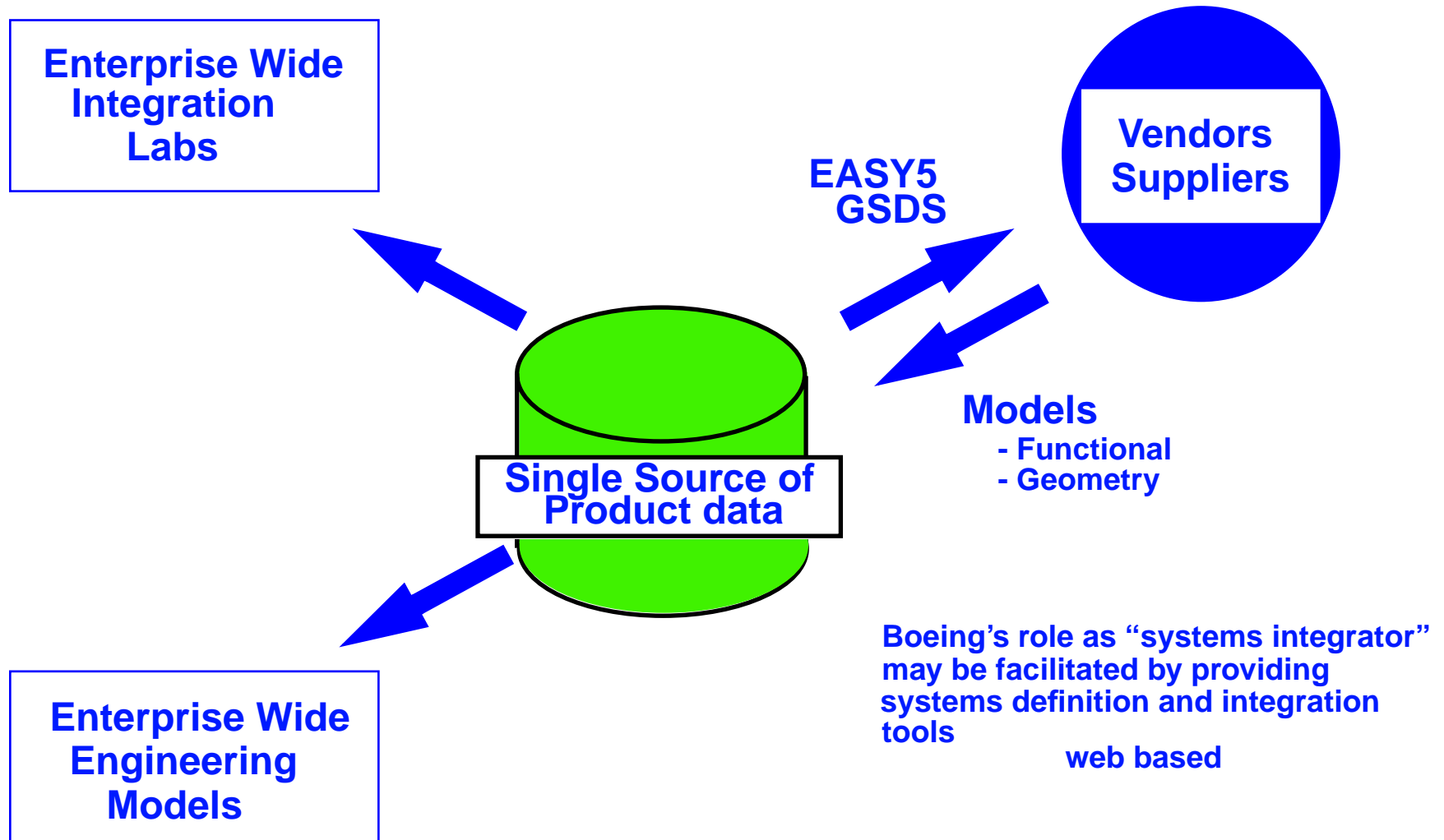
EASY5

Many tools do not span the design process

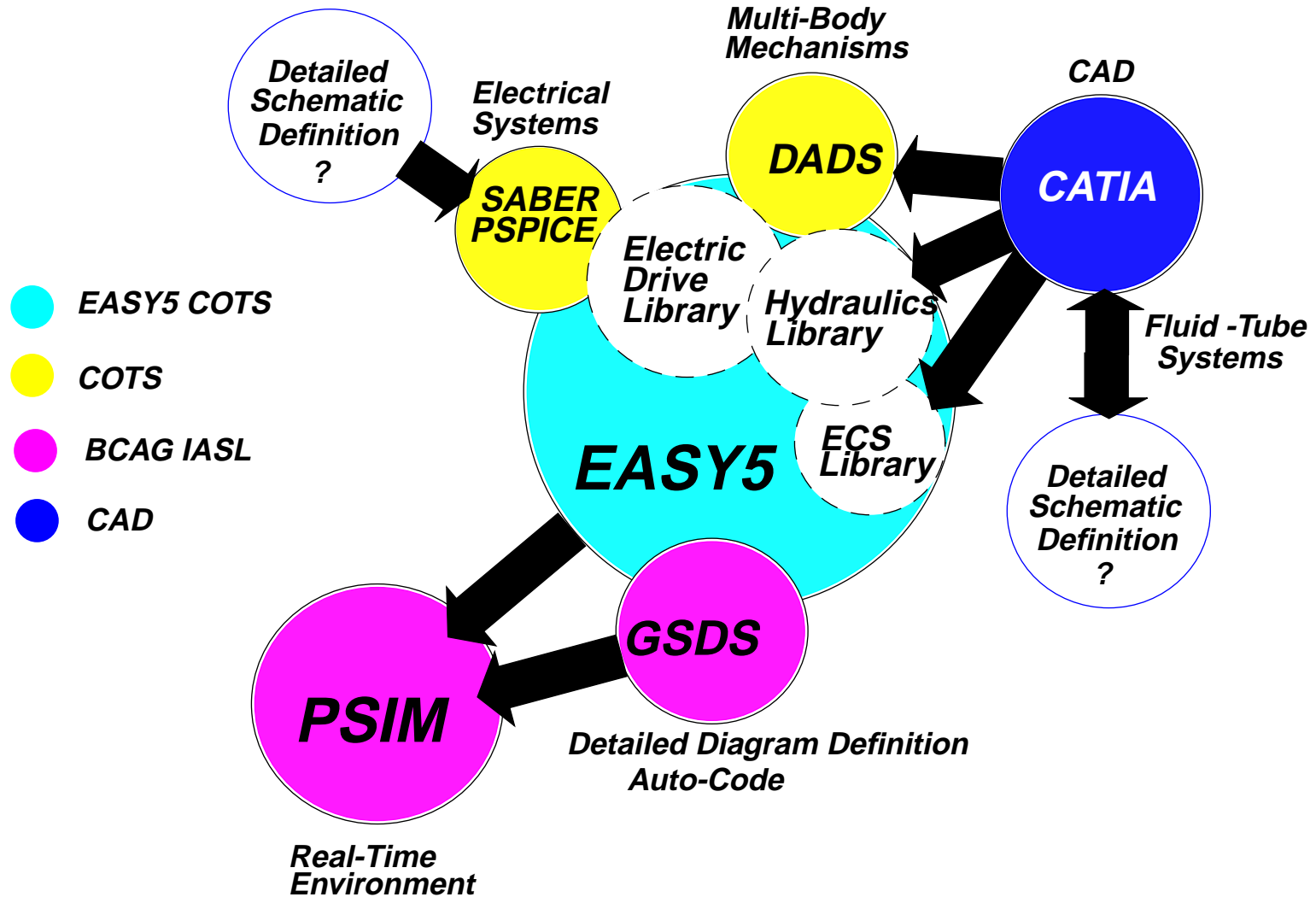
Need tools and infrastructure that can “evolve” the design

Maybe we need to pay up front with detailed tools that will span the process

# Vendors / Suppliers and the SSPD



# Integrated Systems Design Environment BCA View



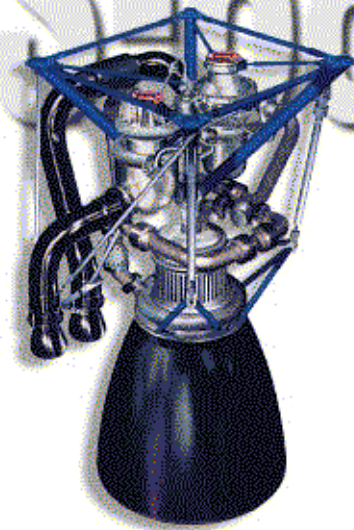
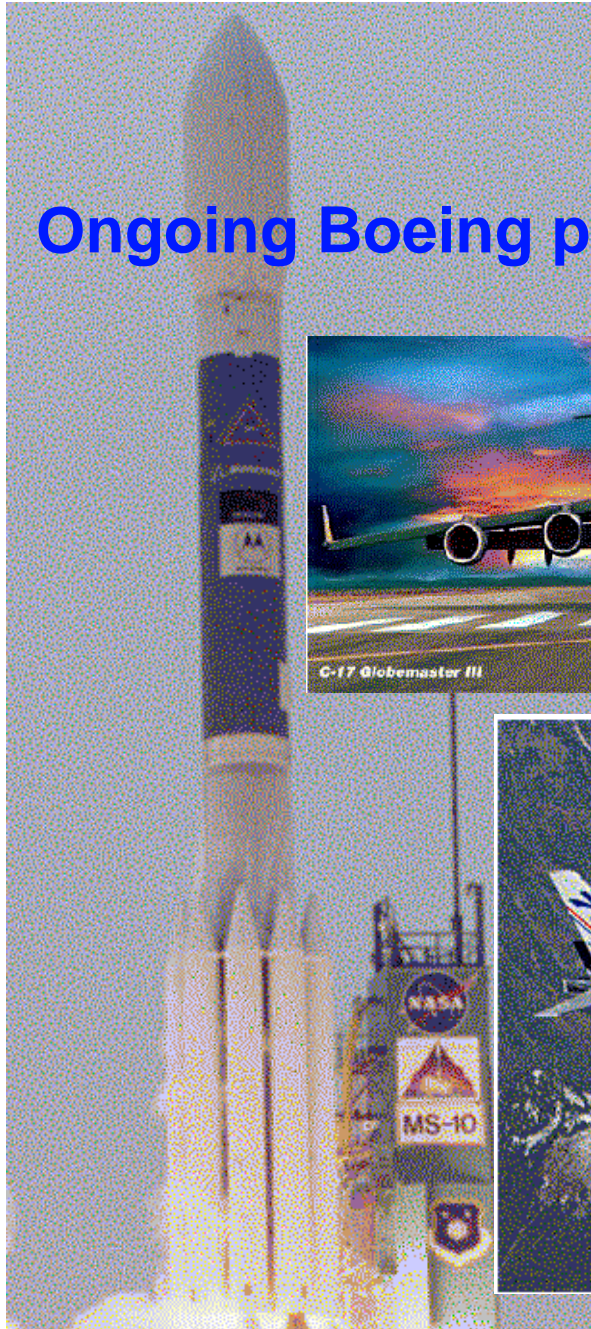
# Supporting Integrated Systems Design

## 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

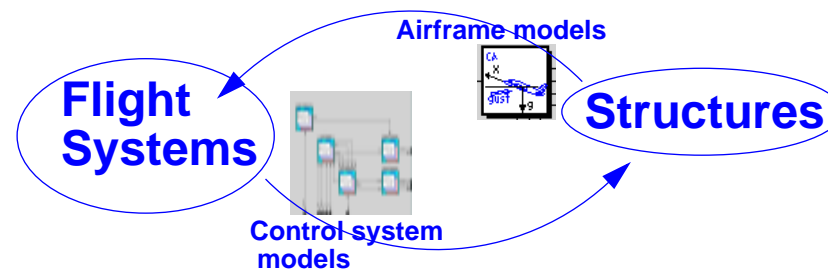


MS-10

# BCA Structures Dynamic Flight Loads

Example - common tools / common models

Example - large-scale process integraton using EASY5 MAT



Common Analysis Environment

Flight Systems and Structures engineers see the same picture



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

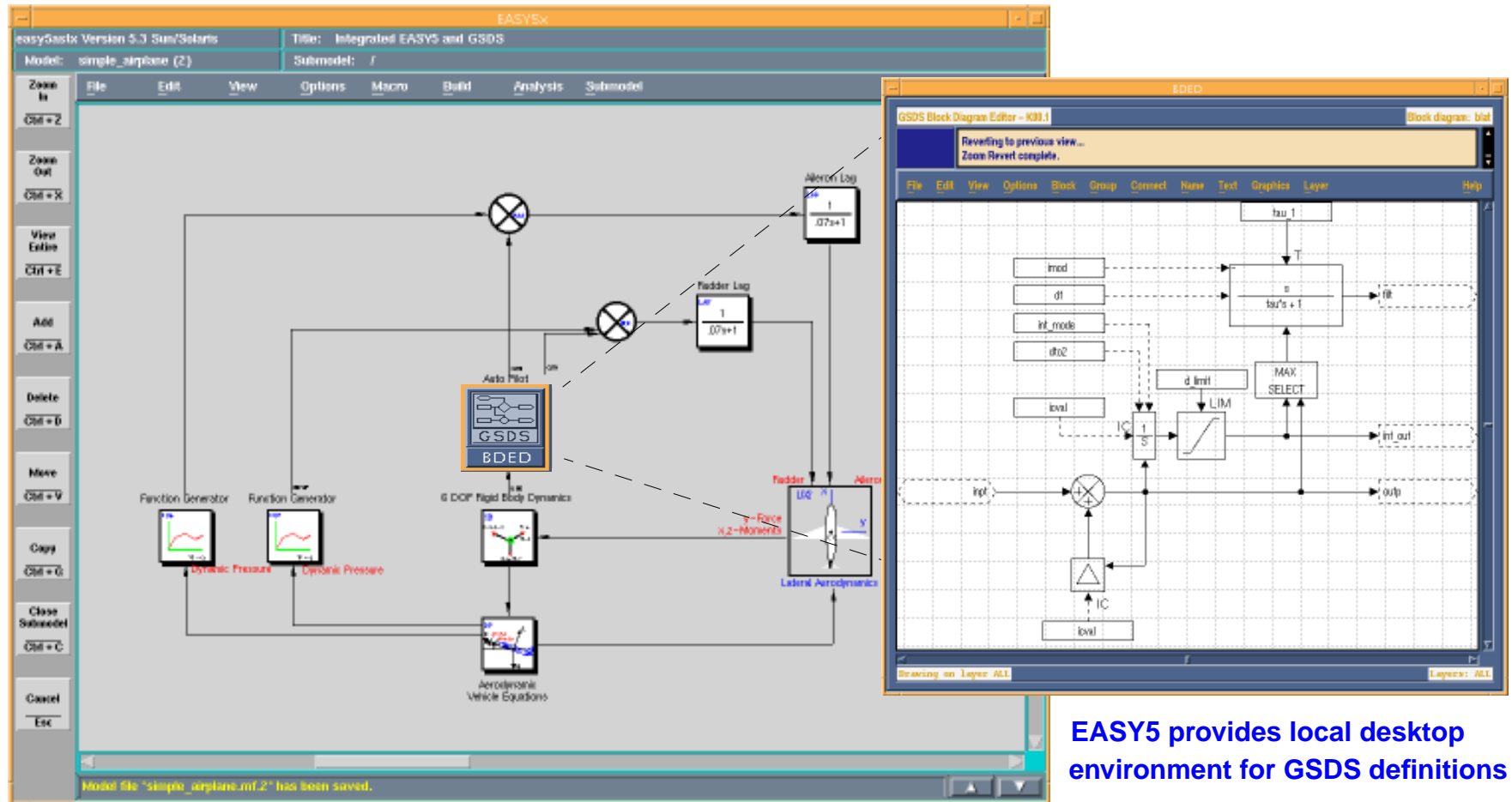
50% design cycle time reduction - solution phase flight loads analysis

Question - can we achieve similar benefits with our vendors ?

# Integrating GSDS with EASY5

## BCA Requirements Capture - Detailed Definition - Autocode

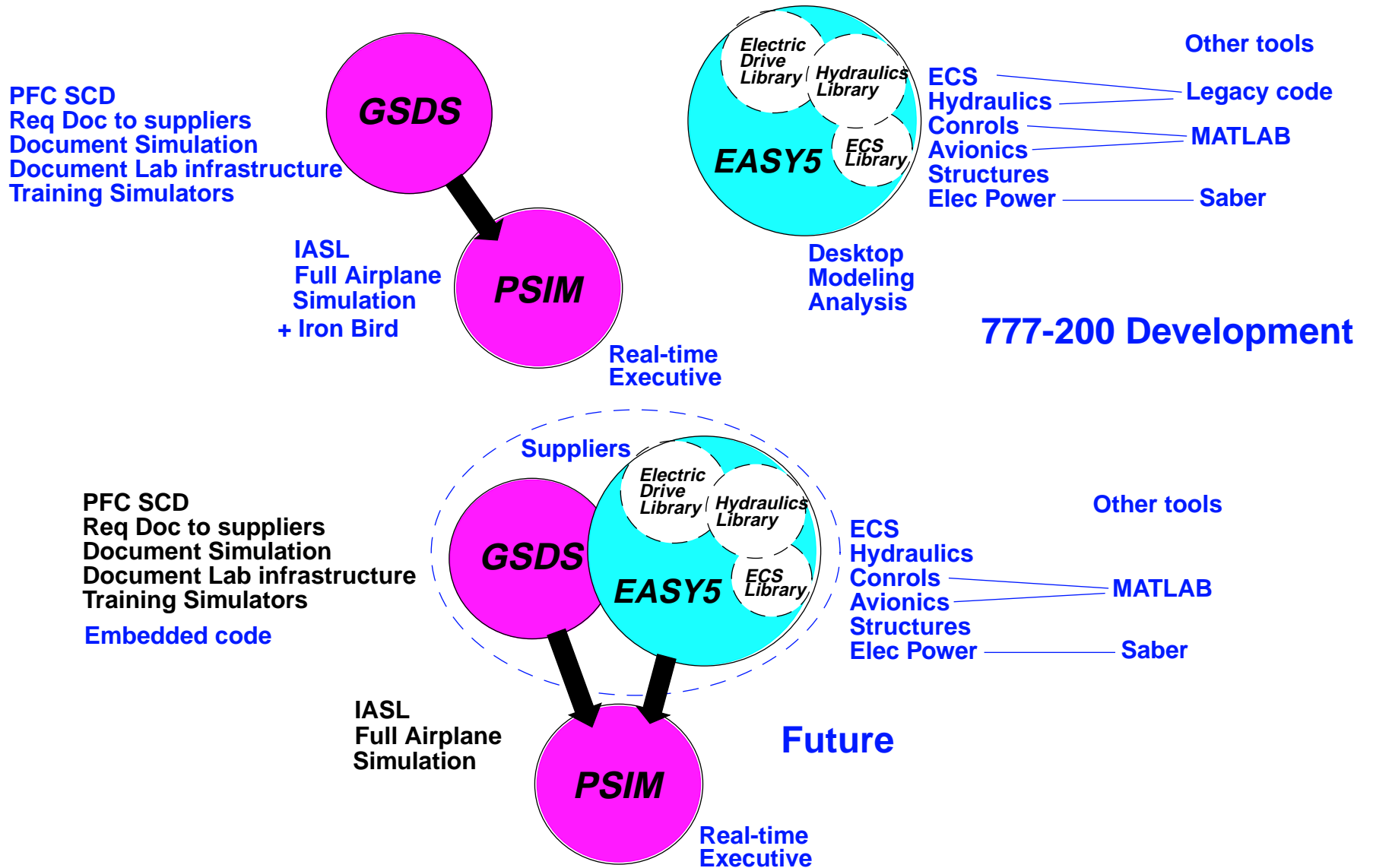
GSDS Auto-code modules may be added as components in EASY5



EASY5 provides local desktop environment for GSDS definitions



# BCA IASL Integrated Development Environment EASY5/GSDS/PSIM



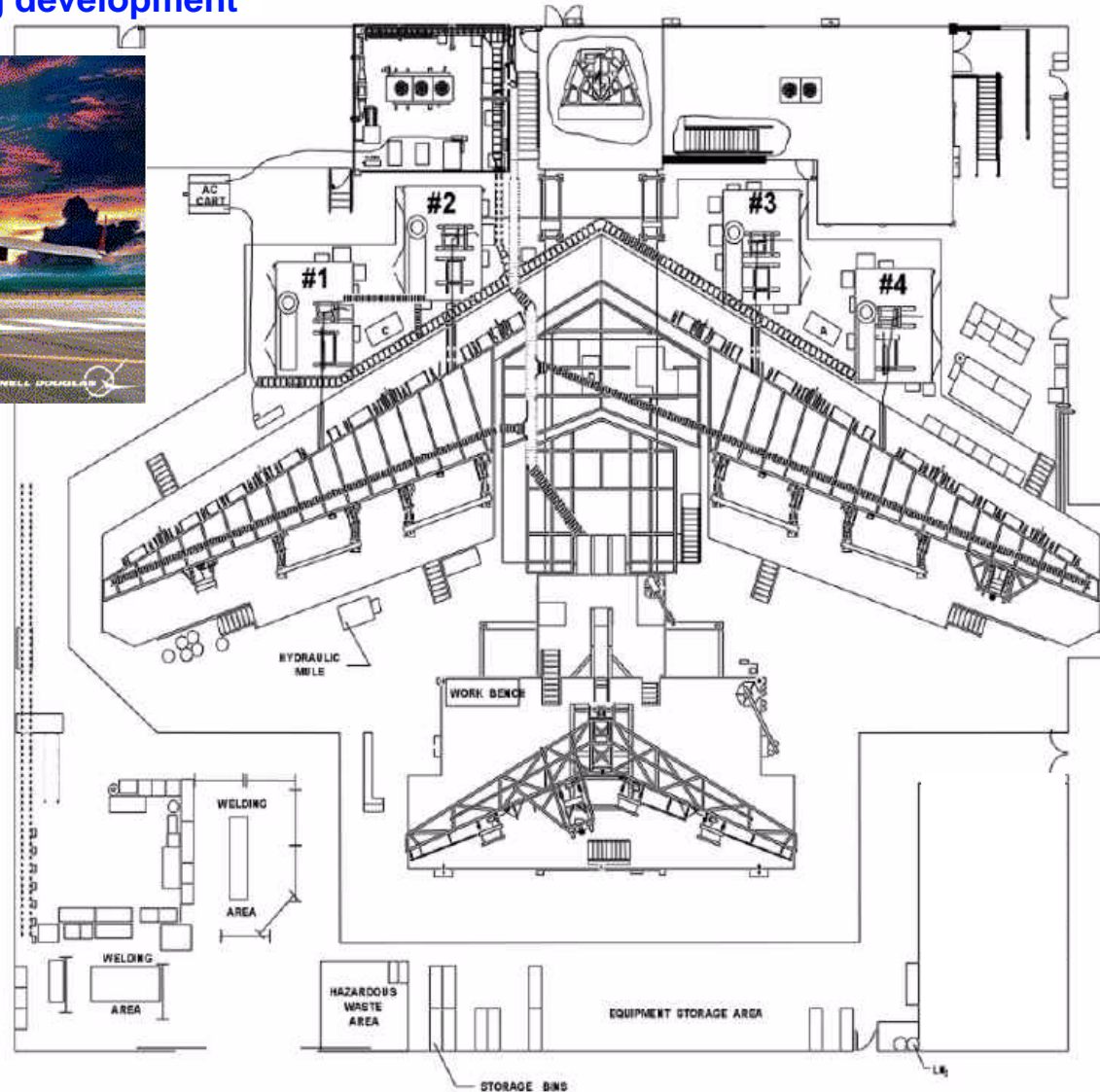
# C-17 Iron-Bird

## 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

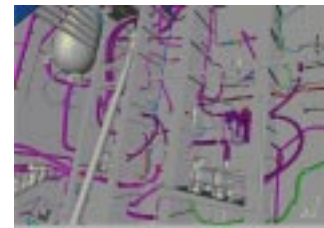


# Integrating EASY5 with CAD

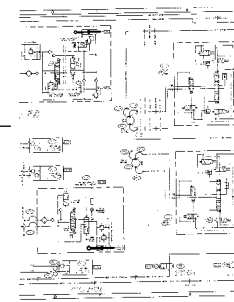
## Goal:

Use **Generative Design** infrastructure to automatically relate fluid system **EASY5** functional models to **CAD** definition

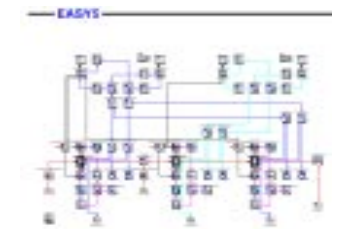
**Aerospace**  
- hydraulics  
- environmental  
- fuels



**Mechanical CAD Definition**

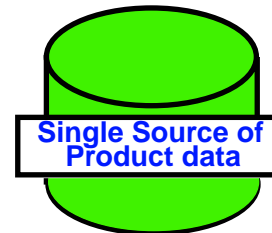


**Functional Schematic**



**Analysis Model**

**Boeing**

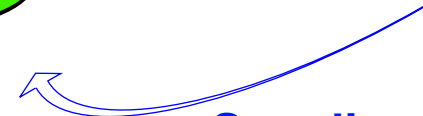


**Single Source of Product data**

Develop framework for **central library** of **vendor-supplied component models** to be plugged in

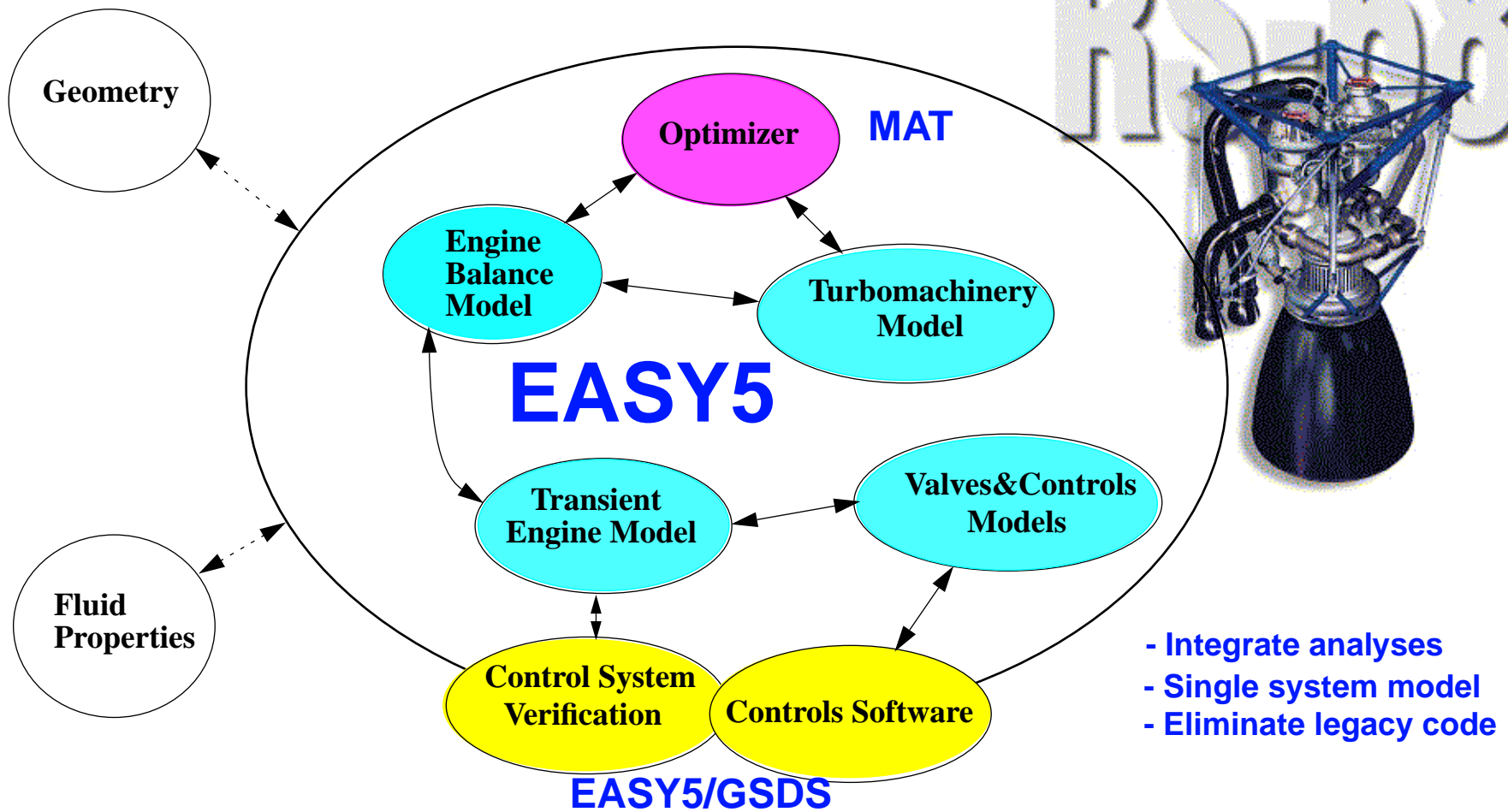
- pumps
- valves
- actuators

**Suppliers**

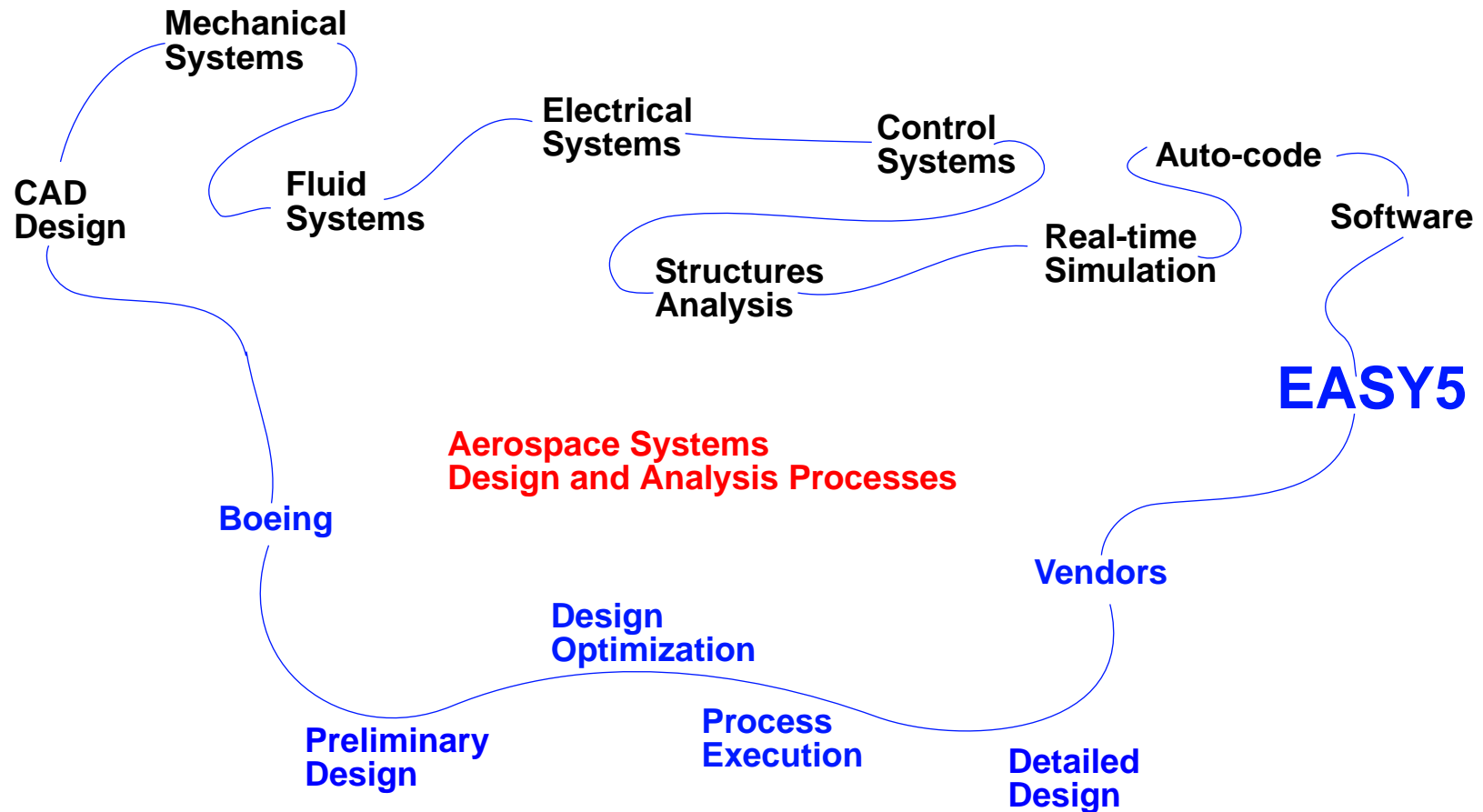


# Rocketdyne RAPID Project

## Rocket engine design optimization process



# 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**