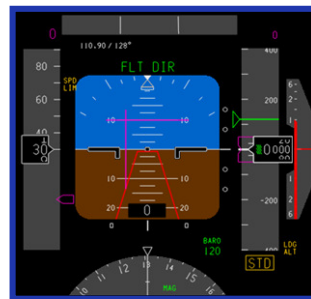
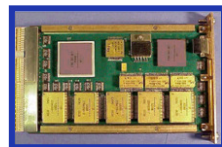




Aerospace Vehicle Systems Institute

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System Architecture Virtual Integration (SAVI)



Texas Engineering
Experiment Station



Project Overview

■ Overall Concept of Operations

- ◆ *Design and production based on early and continuous integration (virtual => physical)*
- ◆ *Integrate, then build*

■ Objective

- ◆ *Shift architecting, design, and production activities to explicitly address integration issues early, reducing program execution risks, cycle time and cost*

■ Approach

- ◆ *Adopt/develop “integration-based” software and system development processes with emphasis on integrating component-based, model-based and proof-based development*



Participants

■ Current

- ◆ *Active – Airbus, BAE, Boeing, DoD (Army), FAA, GE Aerospace (Smiths), Lockheed Martin, Rockwell Collins, SEI/Carnegie Mellon*
- ◆ *Joining – Dassault-Aviation, Honeywell, JPL/NASA*

■ Potential

- ◆ *Current AVSI members – DoD (Air Force), Goodrich, Hamilton Sundstrand (UTC) {Sikorsky, P&W}*
- ◆ *Potential new members – General Dynamics, Meggitt, Northrup Grumman, Raytheon, Thales, Woodward*



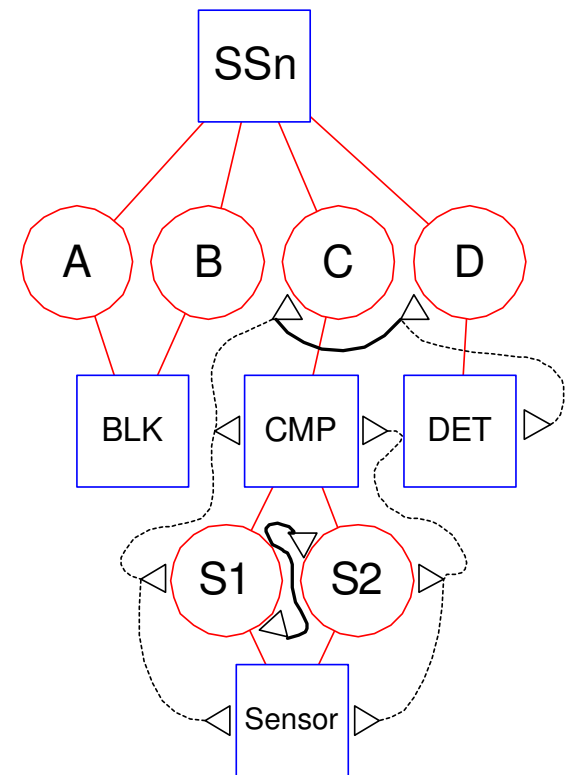
Expanded Objectives

- Integrate system, software, and hardware integration models in one framework
 - ◆ *Support component-based system assurance through analysis of functionality, performance, safety and security*
 - ◆ *Increase the degree of standardization and commonality for technical data exchanged between airframers, suppliers, and regulatory authorities*
- Integrate – then build
 - ◆ *Predict system behavior through analysis to ensure it is acceptable*
 - ◆ *Build to the requirements determined through the analysis*
- Reduce the cost of developing avionic systems
 - ◆ *Maintain or improve existing levels of safety and security*
- Start with the aerospace industry
 - ◆ *Leverage capabilities developed in related domains*
 - ◆ *Coordinate with related domains when advantageous*
- Foster U.S. Government and Aerospace industry Cooperation
 - ◆ *Complement the large, government/industry funded European R&D efforts*

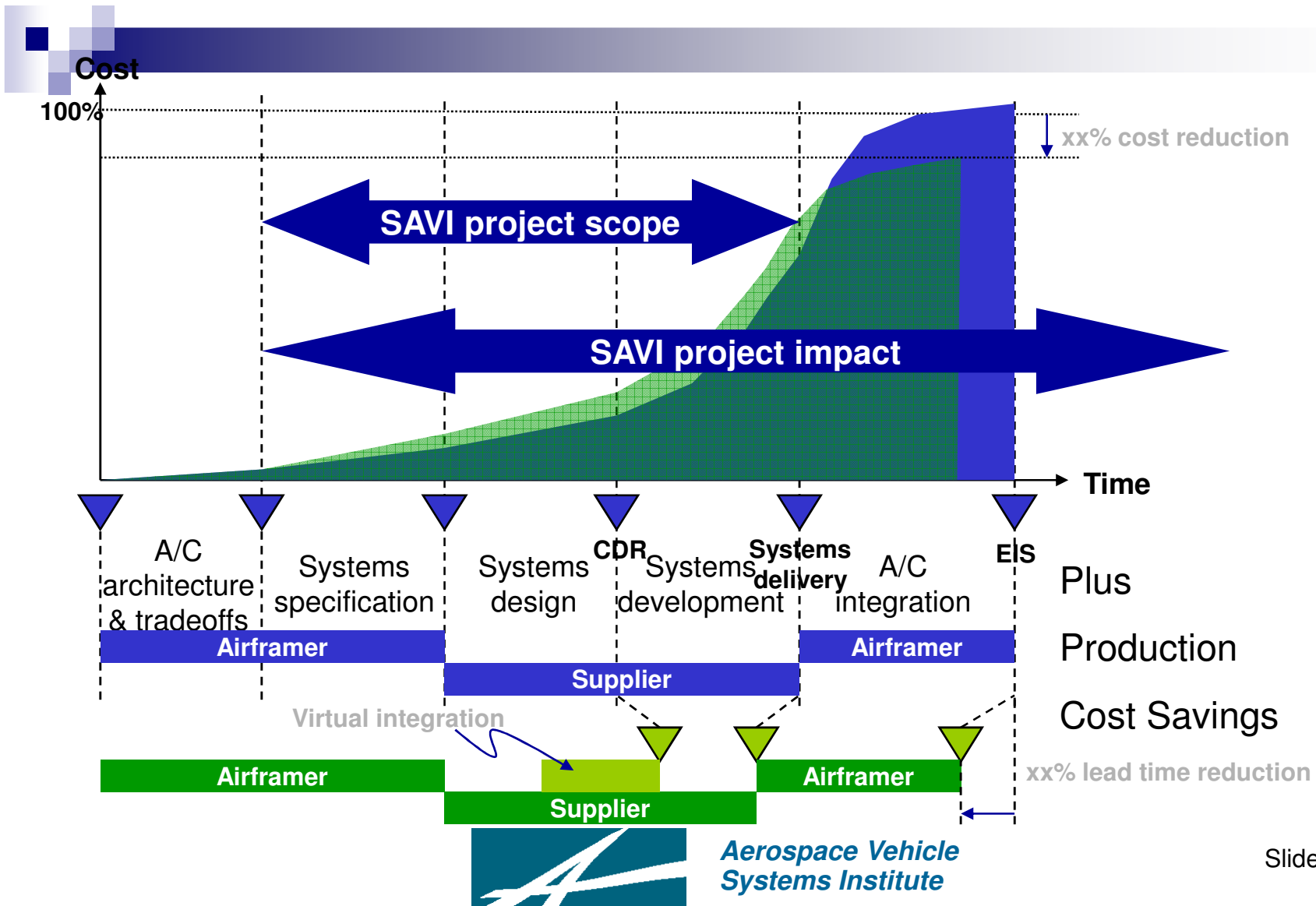


Transition to System and SW Engineering Integration Based on Component-Based Architectures

- SoS and Systems are Composed Primarily of Components
 - ◆ *Modules that Encapsulate Both Data and Functionality, and Are Configurable at Run-Time*
 - ◆ *Requires accurate Modeling and Analysis of Properties, Relationships, Attributes, Associations, Interactions and Dependencies between Components*
 - ❖ Control, Data, Timing, Sequencing, Synchronization, Interrupts, Performance, Latency, Jitter, Safety, Security, Reliability, Resources, Fault Tolerance, and other Quality Factors
 - ❖ Composable, Reusable Software Modules
 - ◆ *Requires Two Perspectives*
 - ❖ Independent of the context in which they are used
 - ❖ Dependent on the context in which they are used
 - ◆ *Requires Component-Based Model Framework*

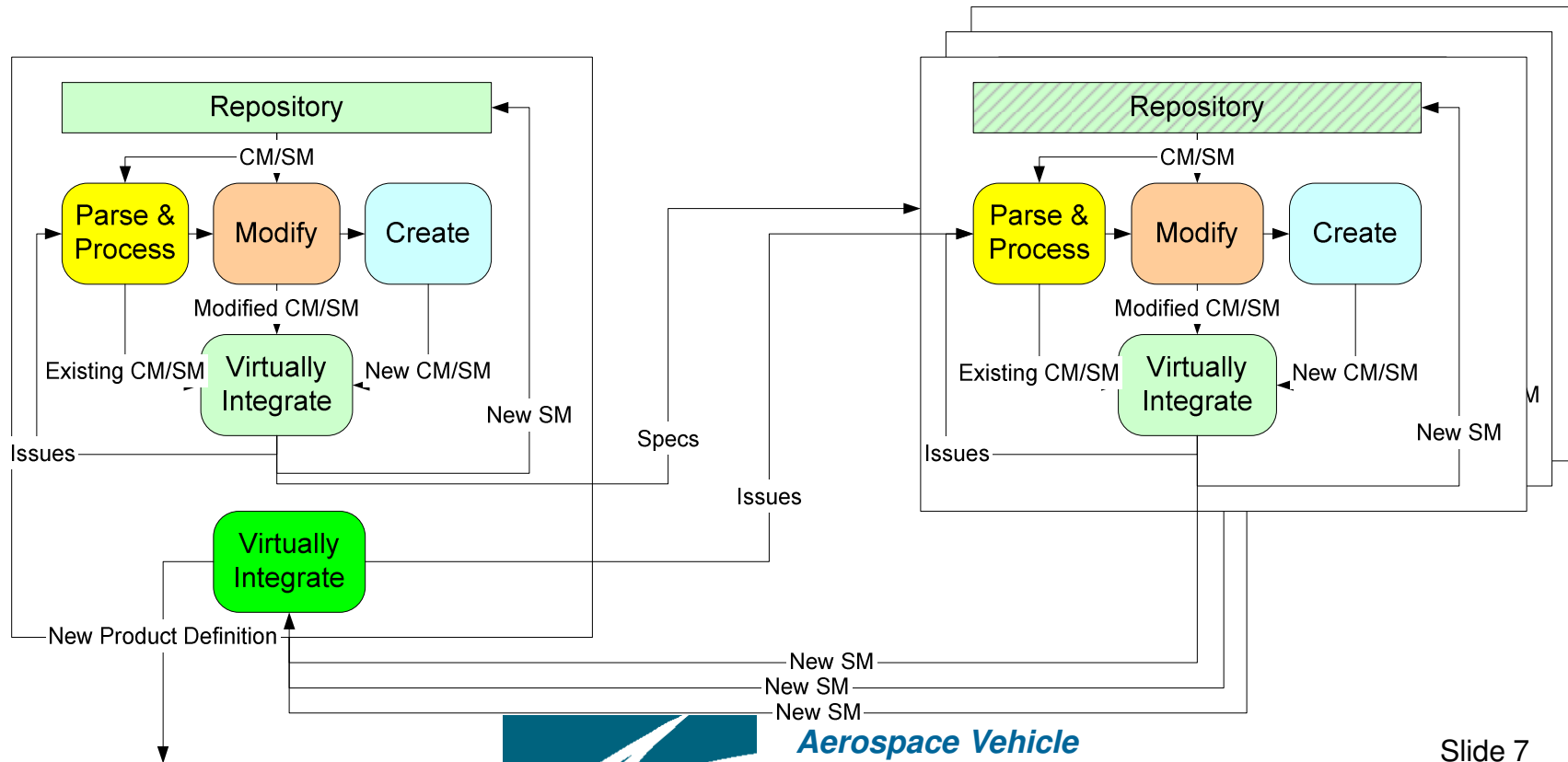


Expected Cost / Schedule Impacts



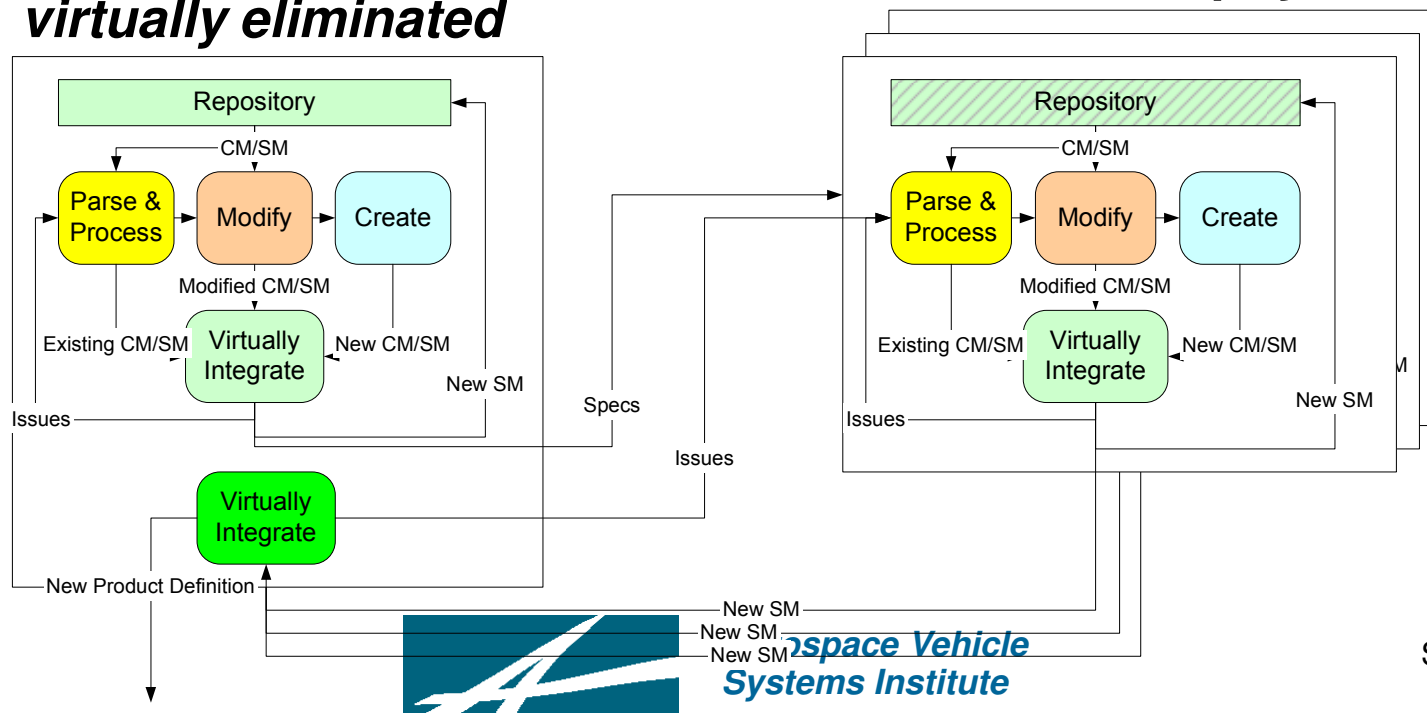
Modified Business Model

- System Integrator defines a new product using internal repository of virtual “parts”
- Specifications for virtual subcomponents sent to suppliers



Modified Business Model (continued)

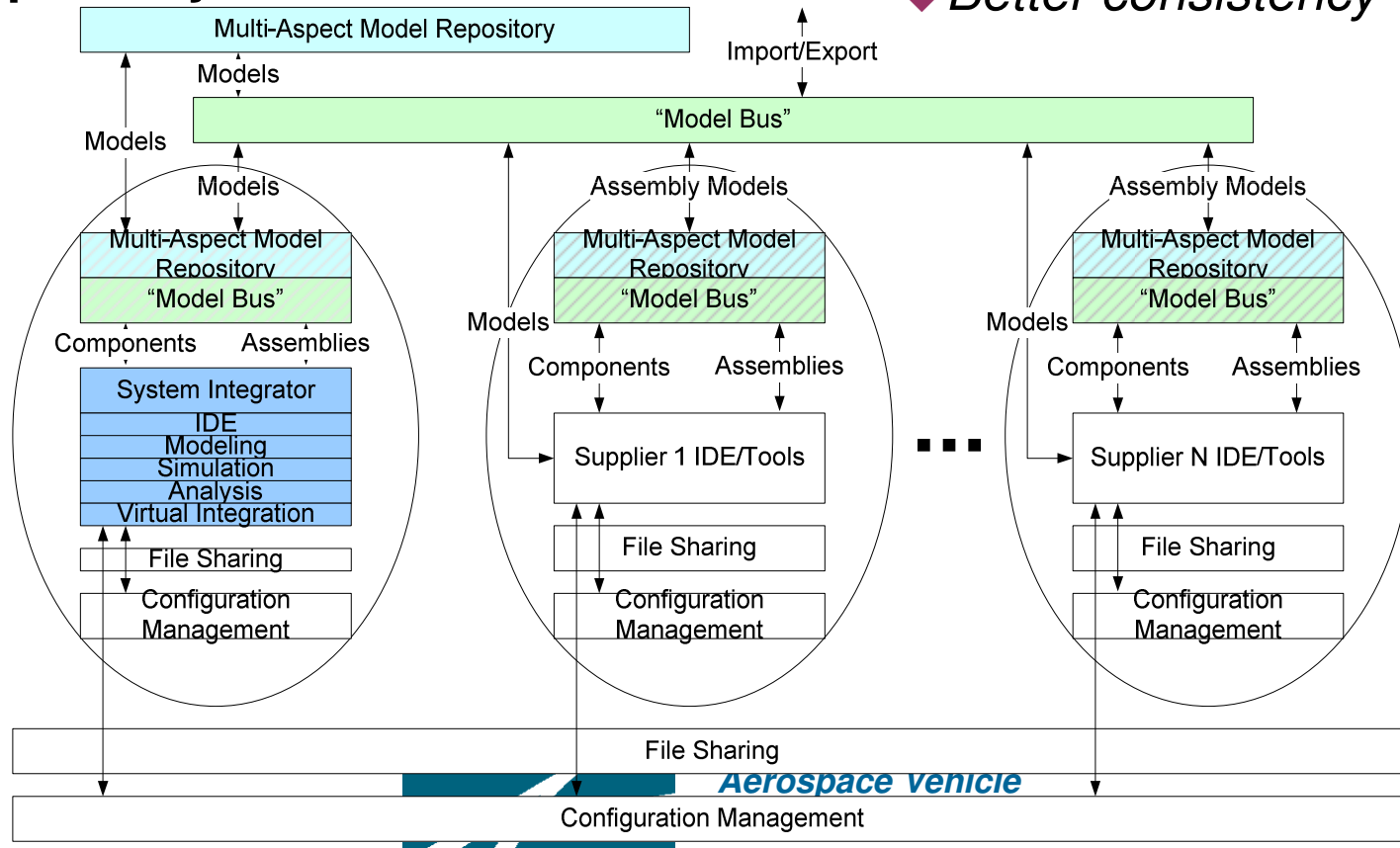
- Virtual parts returned for virtual integration into a virtual product
 - ◆ *Cost savings realized by finding problems early on virtual parts*
- Once the virtual product is satisfactory, the actual product is developed
 - ◆ *Cycle-time reduction realized since re-work on physical parts virtually eliminated*



Single Information and Relationships Repository

Integrate information and relationships in a single repository with a "model bus"

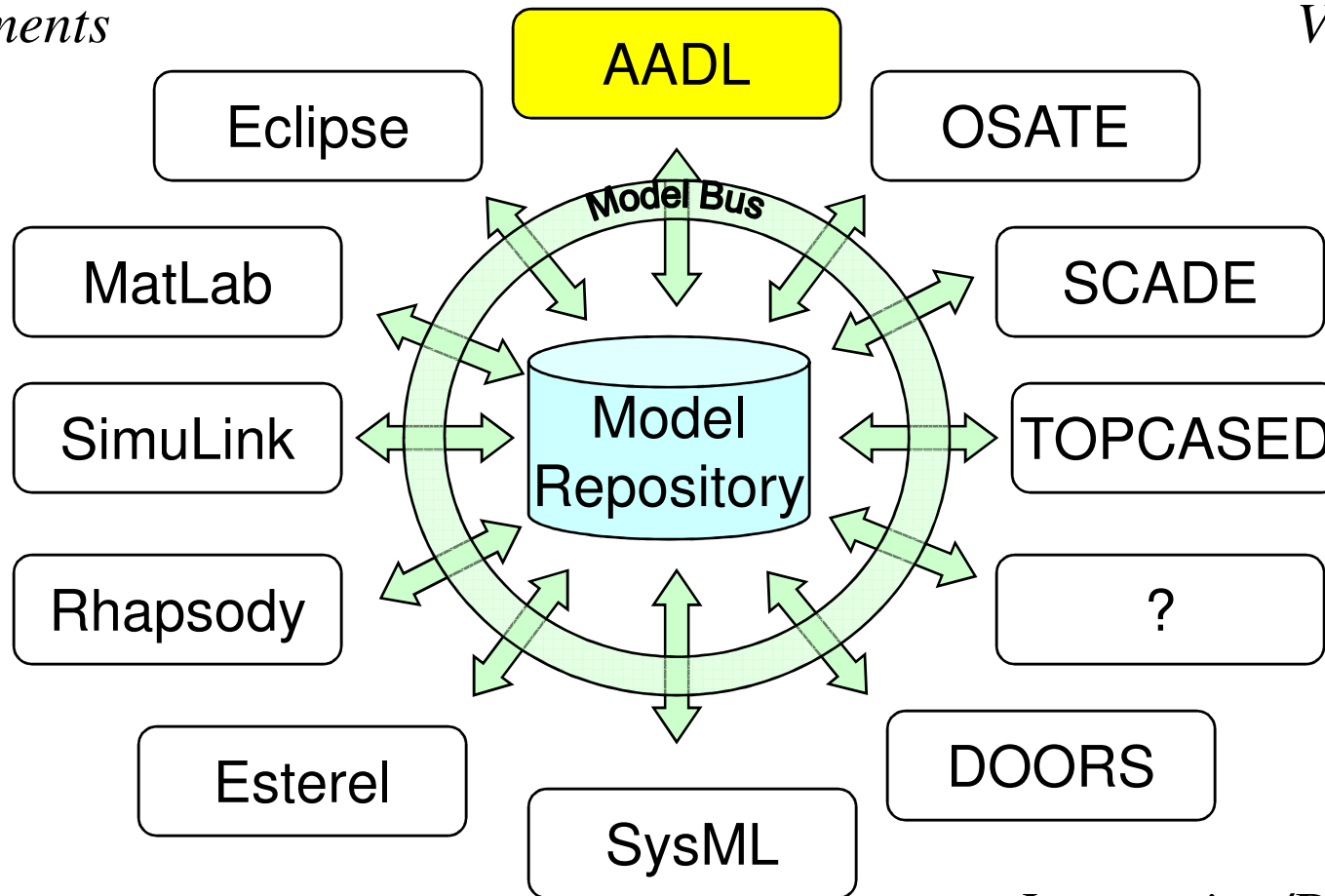
- ◆ Better requirements
- ◆ Better integration
- ◆ Better communication
- ◆ Better consistency



Overview of Multi-Aspect Model Repository & Model Bus

Requirements

Verification



Design

Integration/Deployment

Slide 10



Aerospace Vehicle
Systems Institute

Deliverables

- **Component-Based Model Framework**
 - ◆ ***Multi-Aspect Model Repository Definition***
 - ❖ Framework for Description of Components
 - ***Rules for constructing and interconnecting components***
 - ***Rules for property definitions supporting required (integration) analyses***
 - ◆ ***Model Bus Definition for Consistent Model to Model Information Interchange***
- **Virtual Integration Analyses Definitions Catalog**
- **Parametric Process Definition for achieving Virtual Integration**
 - ◆ ***Integrating Component-Based, Model-Based and Proof-Based Development***
- **Pilot Project(s) Results and Lessons Learned**



Why AVSI?

- Rapid technological advancement and obsolescence combined with increasingly complex hardware and software evolution present integration problems affecting all of us
 - ◆ *It's not going to get better, it's only going to get worse*
 - ❖ Boeing and Airbus have published data showing doubling of size and complexity every two years
 - ◆ *We can't afford to solve it alone*
 - ◆ *We can't afford to solve it multiple times*
 - ◆ *We can't afford not to solve it*



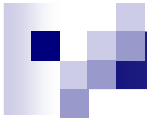
Why AVSI?

- We need industry-wide, reusable solutions to be developed, maintained, evolved, and cost-effectively applied to multiple projects by a variety of users
 - ◆ *Solutions require a combination of research and pragmatic experience (Industry & Academia)*
 - ◆ *Solutions require a balance between development and regulation (Industry & Government)*
 - ◆ *Solutions require broad buy-in (Industry & Standards)*

- Partnership Is Only Viable Approach to the Common Problem

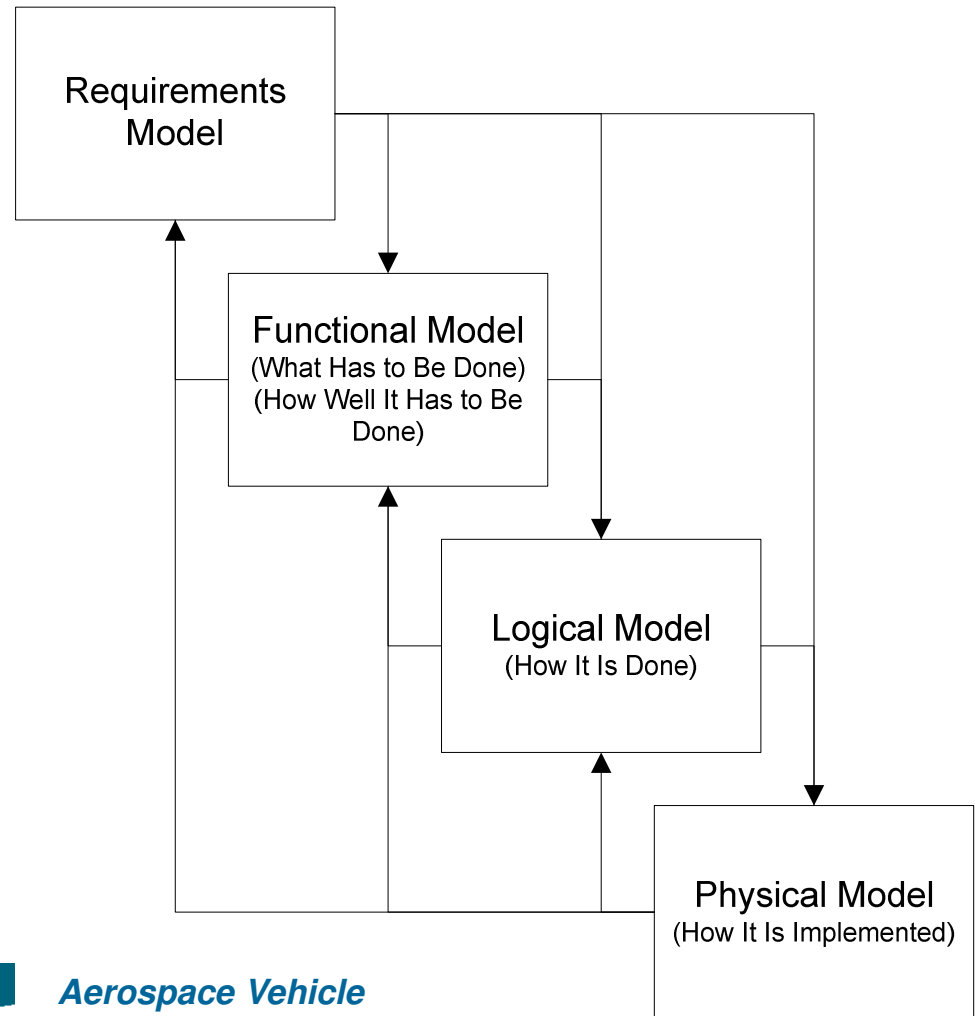


Backup Slides

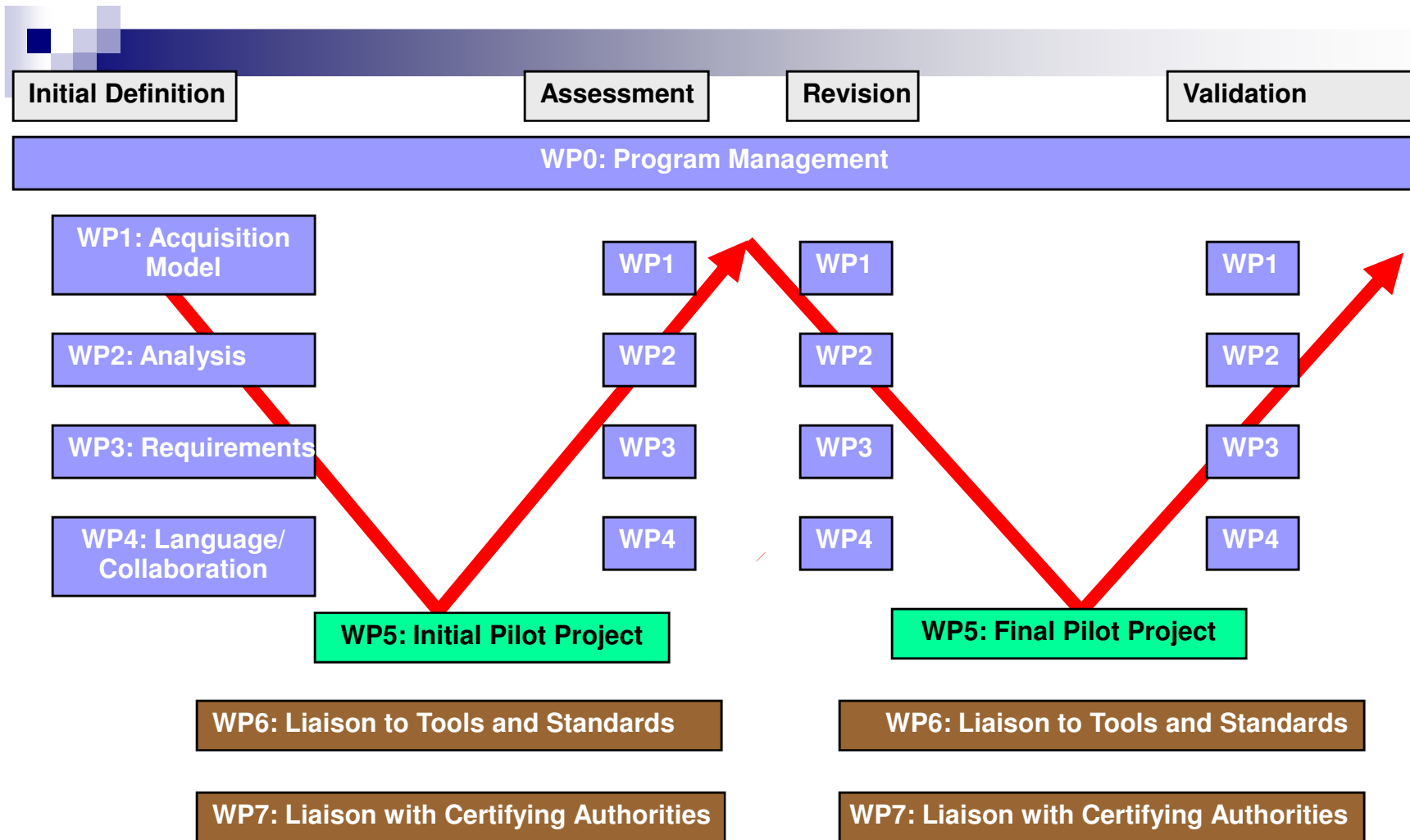


Multi-Aspect Models for Model-Centric Development

- Different models, modeling, simulation and analysis tools may be necessary for
 - ◆ *Different properties*
 - ◆ *Different users*
- Compatible modelling tools (open source or commercially available)
 - ◆ *TOPCASED*
 - ◆ *AADL*
 - ◆ *MATLAB/Simulink*



Work Packages (Notional)



Preliminary Work Products

