

STEP and Intelligent Product Data Management

Stephen C. Waterbury
NASA/Goddard Space Flight Center



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ISE Team on May 3, 1999

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 - AP 209: “Composite and Metallic Analysis and Related Design” (CAE)
 - AP 210: “Electronic Assembly, Interconnect., and Packaging Design” (ECAD)
- **Without PDM, CAx Models are “Islands”**
- **Current COTS PDM: Association, not Integration**
- **“Intelligent PDM” (IPDM)**
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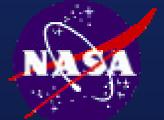
Key Acronyms and Definitions

- **CAX: CAD/CAM/CAE, etc.**

- Engineering software for the modeling of a product in any life cycle phase. E.g.: Mechanical Computer-Aided Design (MCAD), Electrical Computer-Aided Design (ECAD), Manufacturing (CAM), Analysis/Simulation (CAE), etc.

- **PDM: Product Data Management**

- Systematic maintenance, storage, tracking, and access to all information about a product throughout its lifecycle, including concepts, plans, documents, specifications, drawings, engineering and analysis models, manufacturing process information, testing information, etc. Configuration Management (CM) is a subset of PDM.



STEP AP 203: Configuration Controlled 3D Designs of Mechanical Parts and Assemblies

Configuration Management

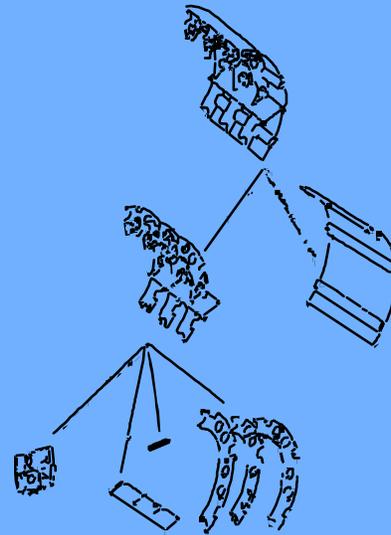
- Authorization
- Control (Version/Revision)
- Effectivity
- Release Status
- Security Classification
- Supplier

Geometric Shapes

- Advanced BREP Solids
- Faceted BREP Solids
- Manifold Surfaces with Topology
- Wireframe with Topology
- Surfaces and Wireframe without Topology

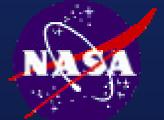
Product Structure

- Assemblies
- Bill of Materials
- Part
- Substitute Part
- Alternate Part



Specifications

- Surface Finish
- Material
- Design
- Process
- CAD Filename



STEP AP 209: Composite & Metallic Analysis & Related Design

Analysis Discipline Product Definitions

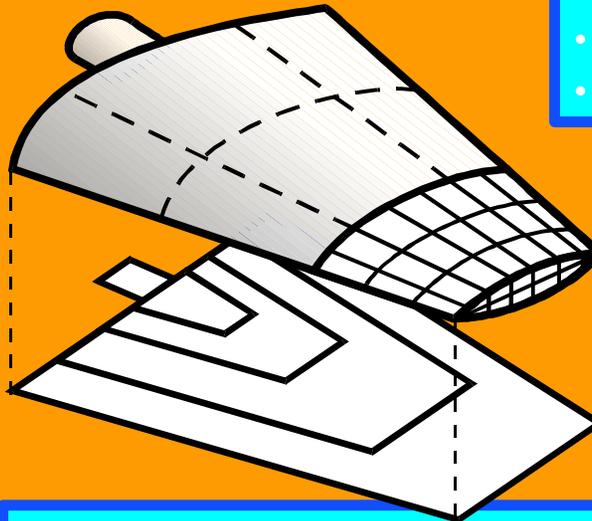
- **Finite Element Analysis**
 - Model (Nodes, Elements, Properties,...)
 - Controls (Loads, Boundary Constraints,...)
 - Results (Displacements, Stresses,...)
- **Analysis Report**

Design Discipline Product Definition

- **Shape Representations**
- **Assemblies**

Configuration Control, Approvals

- **Part, product definitions**
- **Finite element analysis model, controls, and results**



Information Shared Between Analysis & Design

- **3D Shape Representations**
- **Composite Constituents**
- **Material Specifications & Properties**
- **Part Definitions**

Composite Constituents

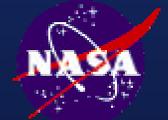
- **Ply Boundaries, Surfaces**
- **Laminate Stacking Tables**
- **Reinforcement Orientation**

Material Specifications & Properties

- **Composites**
- **Homogeneous (metallics)**

3D Shape Representation

- **AP202/203 Commonality Plus Composite Specific 3D Shapes**
 - Advanced B-Representation
 - Facetted B-Representation
 - Manifold Surfaces With Topology
 - Wireframe & Surface without Topology
 - Wireframe Geometry with Topology
 - Composite Constituent Shape Representation



STEP AP 210: Electronic Assembly, Interconnect, and Packaging Design

Physical

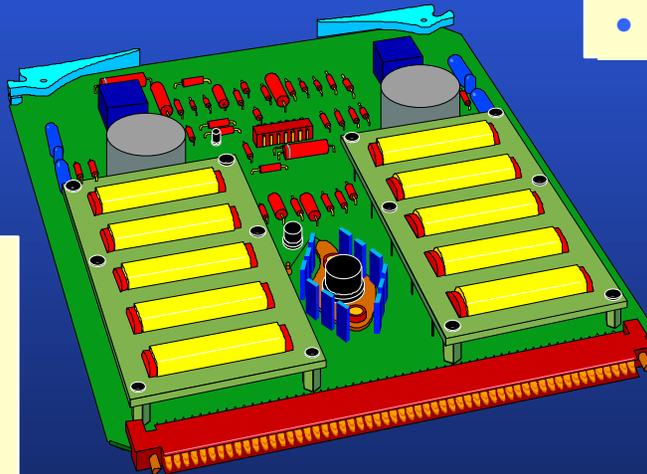
- Component Placement
- Bare Board Geometry
- Layout items
- Layers non-planar, conductive & non-conductive
- Material product

Geometry

- Geometrically Bounded 2-D Shape
- Wireframe with Topology
- Advanced BREP Solids
- Constructive Solid Geometry

Product Structure/Connectivity

- Functional
- Packaged



Part

- Functionality
- Termination
- Shape 2D, 3D
- Single Level Decomposition
- Material Product
- Characteristics

Configuration Mgmt

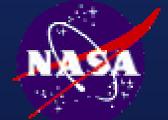
- Identification
- Authority
- Effectivity
- Control
- Requirement Traceability
- Analytical Model
- Document References

Requirements

- Design
- Allocation
- Constraints
- Interface

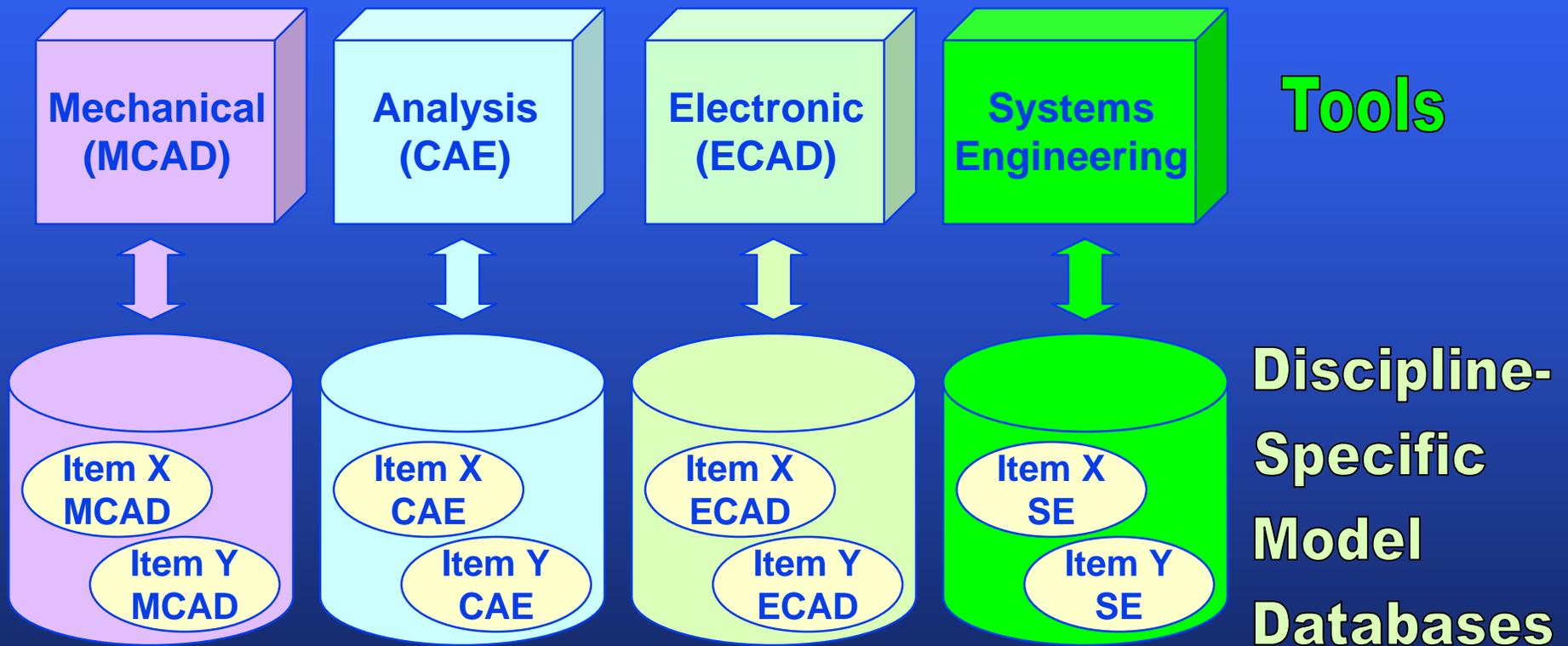
Technology

- Fabrication Design Rules
- Product Design Rules

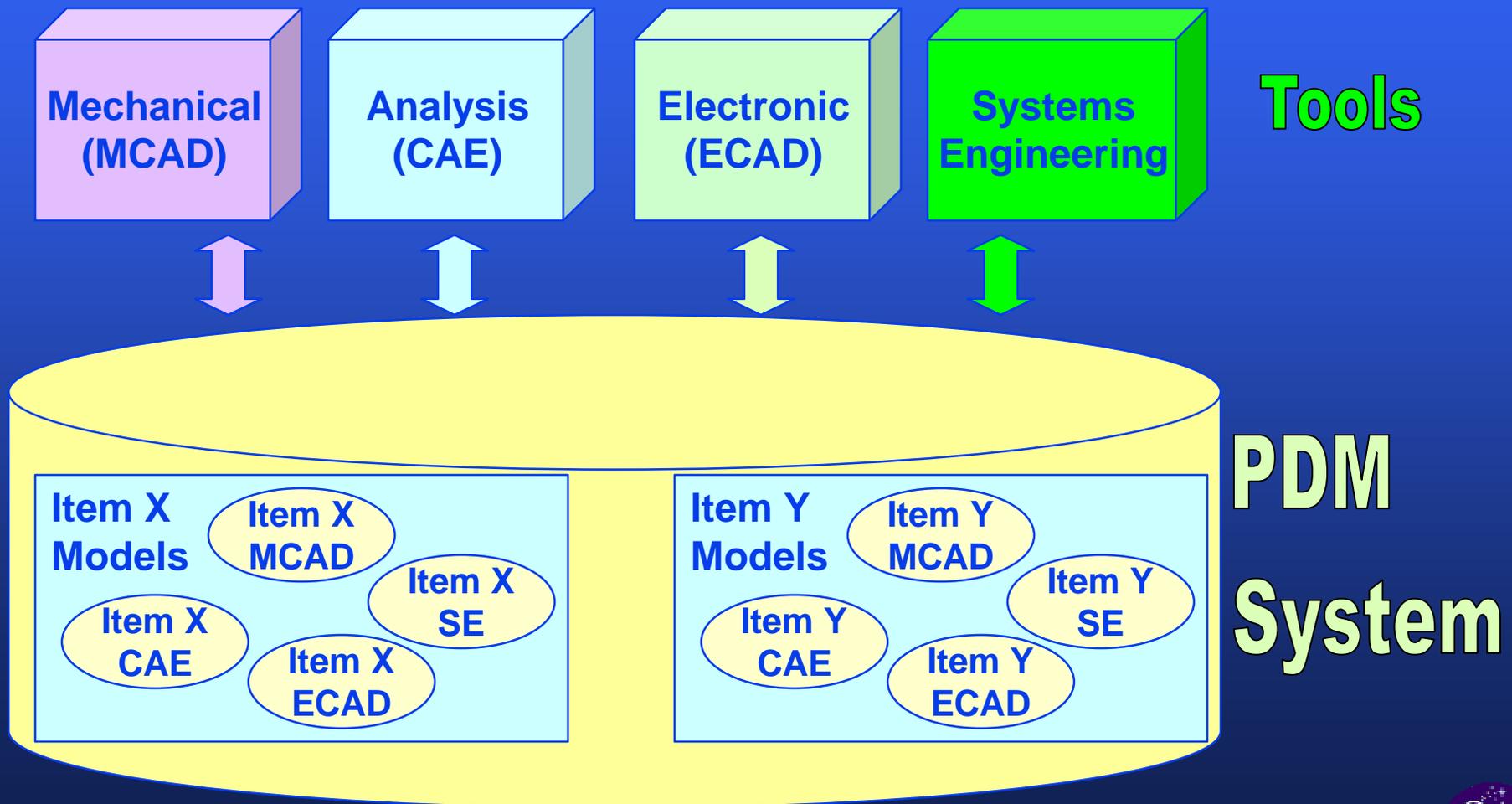


Without PDM, CAx Models are "Islands"

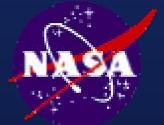
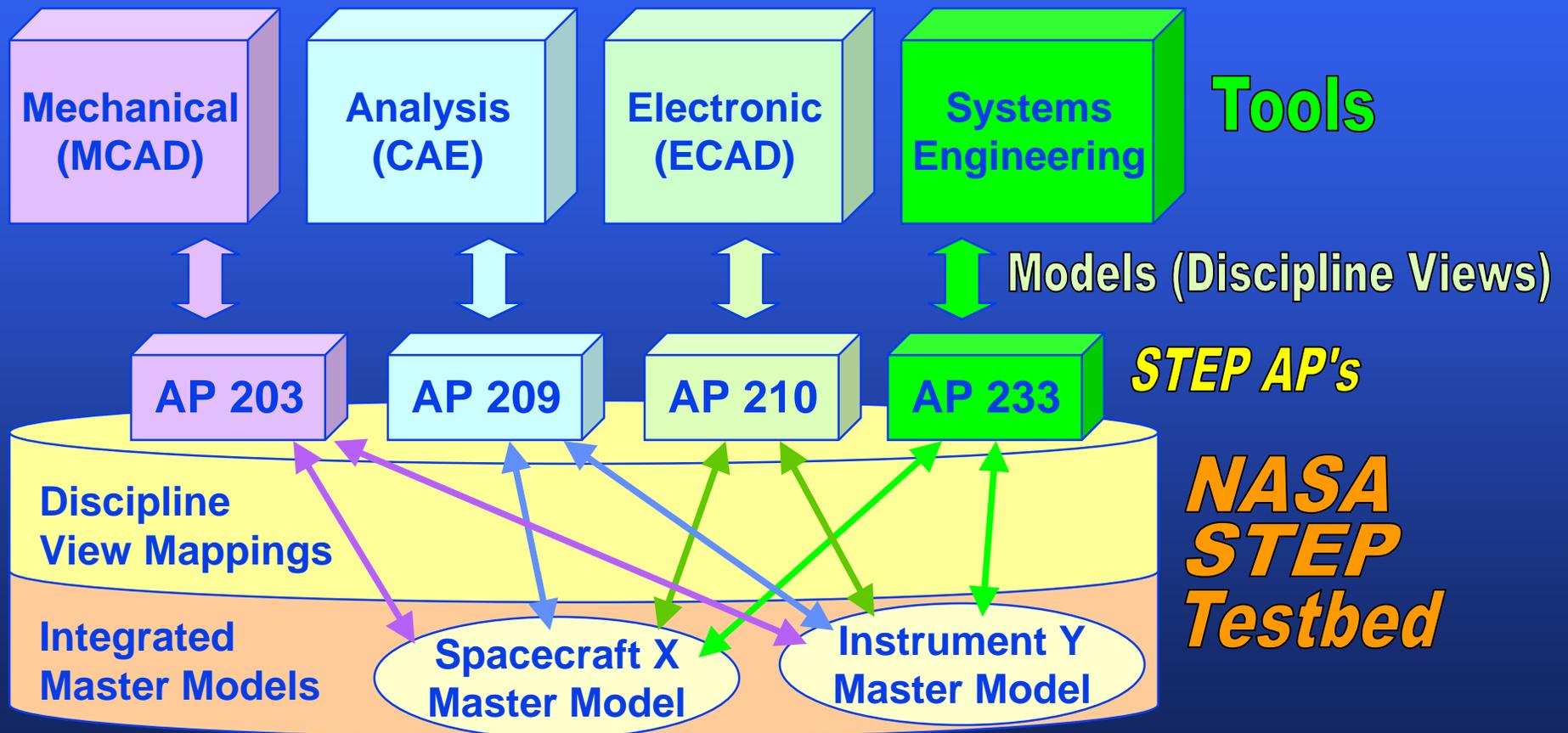
Models Are Isolated Within Disciplines



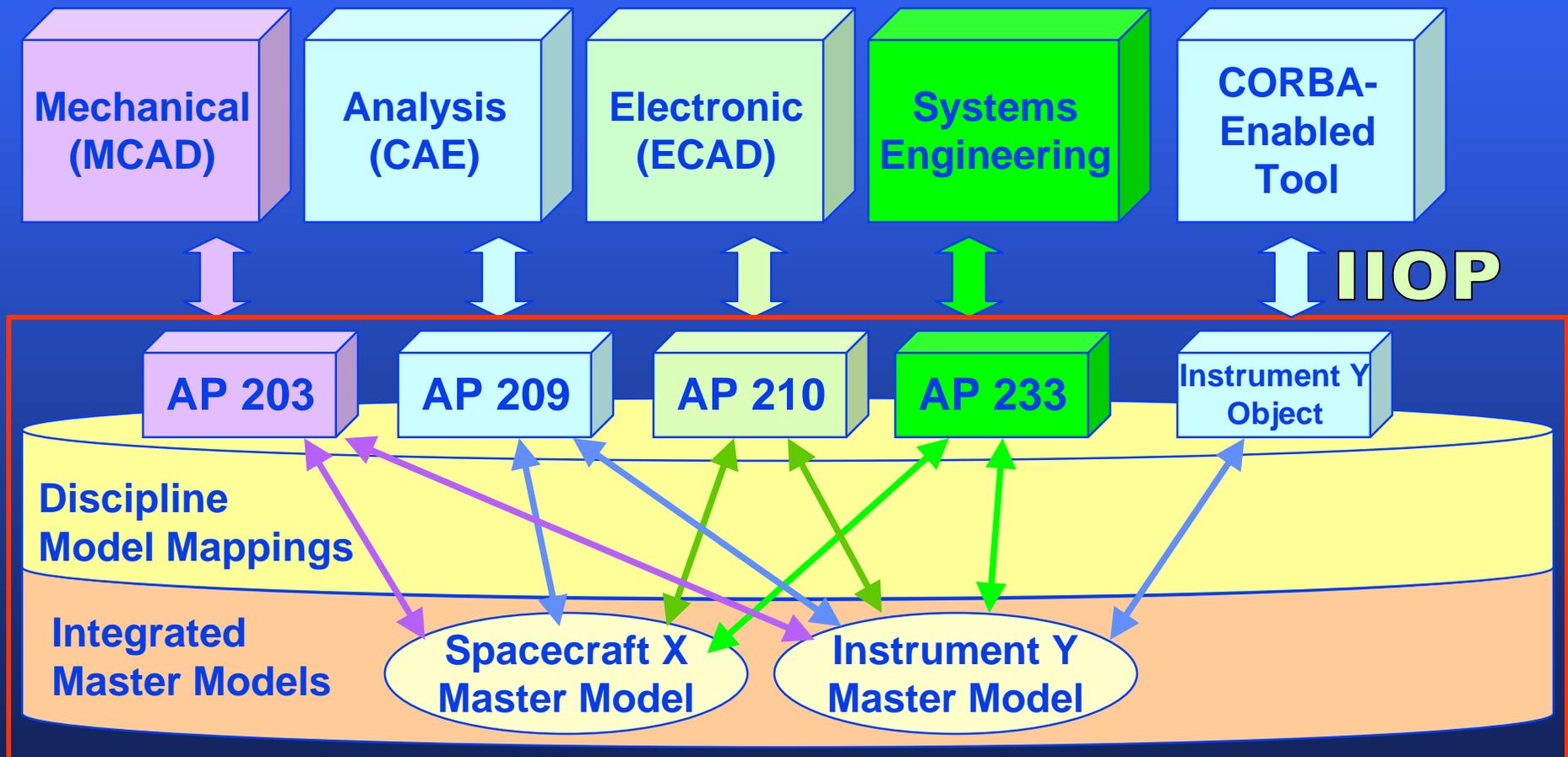
Current Product Data Management (PDM): Models Can Be *Associated* But Not *Integrated*



“Intelligent PDM” (IPDM): Master Models Integrate Discipline Models



Plug-and-Play IPDM: CORBA PDM Enablers Object Interfaces



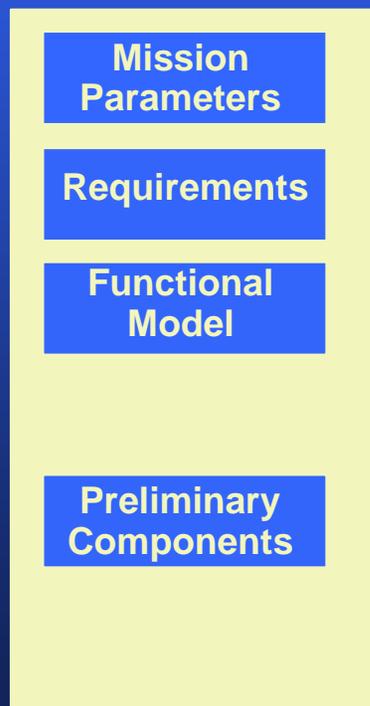
NASA STEP Testbed



The Product Master Model Evolution: Population of Model Contents Over the Mission Life Cycle

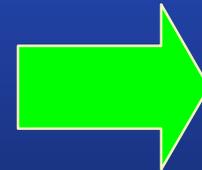
Pre-Phase A

Integrated
Mission Proposal



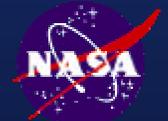
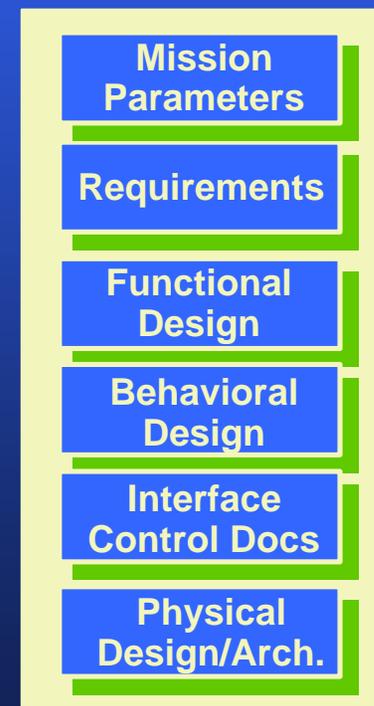
Phase A/B

Prototyping
and Analysis



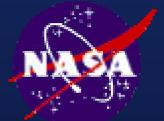
Phase C/D

Detailed Design,
Build, and Test



Benefits of a STEP-based IPDM Service

- Exchange of models among CAx tools from different vendors
- Exchange of models between CAx tools from different disciplines (electrical/mechanical/analysis/simulation)
- Cross-discipline model integrity (common information is shared), enabling a robust Systems Engineering view
- Tracking of all mission/model parameters throughout the life cycle
- Standard library format for product model/design re-use
- Standard, STEP-based PDM format for NASA/contractor data sharing
 - **Avoids requiring contractors to buy the same tools (expensive for the contract; additional learning curve)**
 - **Major OEM's are using STEP in this way**



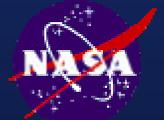
The NASA STEP Testbed IPDM Pilot

- **Objective:**

- To provide a plug-and-play service for the management, integration, and synthesis of multi-disciplinary product models for heterogeneous tools and applications

- **Implementation:**

- **Espresso** will provide the “model integration and view synthesis” engine (integrating application-specific models into the Product Master Model and synthesizing other application-specific view models out of the Product Master Model)
- **EXPRESS-X** mappings will define the transformations between the **STEP AP** data (application-specific models created by tools) and the STEP-based **Product Master Model**
- **OMG PDM Enablers and CAD Services** interfaces will be implemented using CORBA and Python to provide plug-and-play access for tools and applications



For More Info: STEP/OMG URL's!

- **STEP On-Line Information Service (SOLIS)** -- <http://www.nist.gov/sc4>
- **Expresso** (*free download*) -- <http://step.nasa.gov/testbed#expresso>
 - *Note: available as source (lisp) or binaries for Windows or Linux.*
- **STEP On A Page** (a capsule summary and current status of STEP) -- http://pdesinc.aticorp.org/step_on_a_page.ppt
- **PDES, Inc.**: a government-industry consortium implementing STEP -- <http://pdesinc.scra.org>
- **USPRO** (U.S. Product Data Association), distributor for STEP documents -- <http://www.uspro.org>
- **NASA STEP Central**: the main NASA site for STEP information -- <http://step.nasa.gov>
- **The NASA STEP Testbed**: STEP/OMG infrastructure pilot project -- <http://step.nasa.gov/testbed>
- **The OMG Manufacturing Domain Task Force (MfgDTF)**: PDM Enablers, etc. -- <http://www.omg.org/homepages/mfg>

