

Toward a Standardized Architecture for CAx Model Integration and Synthesis

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Benefits of Standards for CAx Models

- Exchange of models among CAx tools from different vendors
- Exchange of models between CAx tools of different disciplines (electrical/mechanical/analysis/simulation)
- Standards-based format for data sharing
 - Avoids requiring contractors to buy new CAx tools (cuts costs of contracts; avoids new learning curves)
 - Major OEM's are using STEP in this way
- Standard library and archive format, enabling:
 - Model re-use by later projects, independent of tools
 - Long-term storage of models, engineering knowledgebase



The NASA STEP Testbed

Product Master Model

- The concept of the **Product Master Model** is the synthesis (“intelligent union”) of all engineering discipline view-models of the product
- STEP and OMG standards provide the foundation for:
 - A **Product Master Model Schema** (STEP)
 - A **Product Master Model API** (OMG CORBA and PDME)
 - A **Tool Interface Backplane Specification** (STEP, OMG, and others)
- The **Product Master Model Schema** and **API** will support
 - Intelligent Product Data Management (IPDM)
 - Integrated Model-based Systems Engineering
 - A Global Product Model Knowledgebase
- A **Tool Interface Backplane Specification** to provide
 - Standardized interfaces between tools and model object services
 - Plug-and-play interactions between arbitrary combinations of COTS and in-house-developed software



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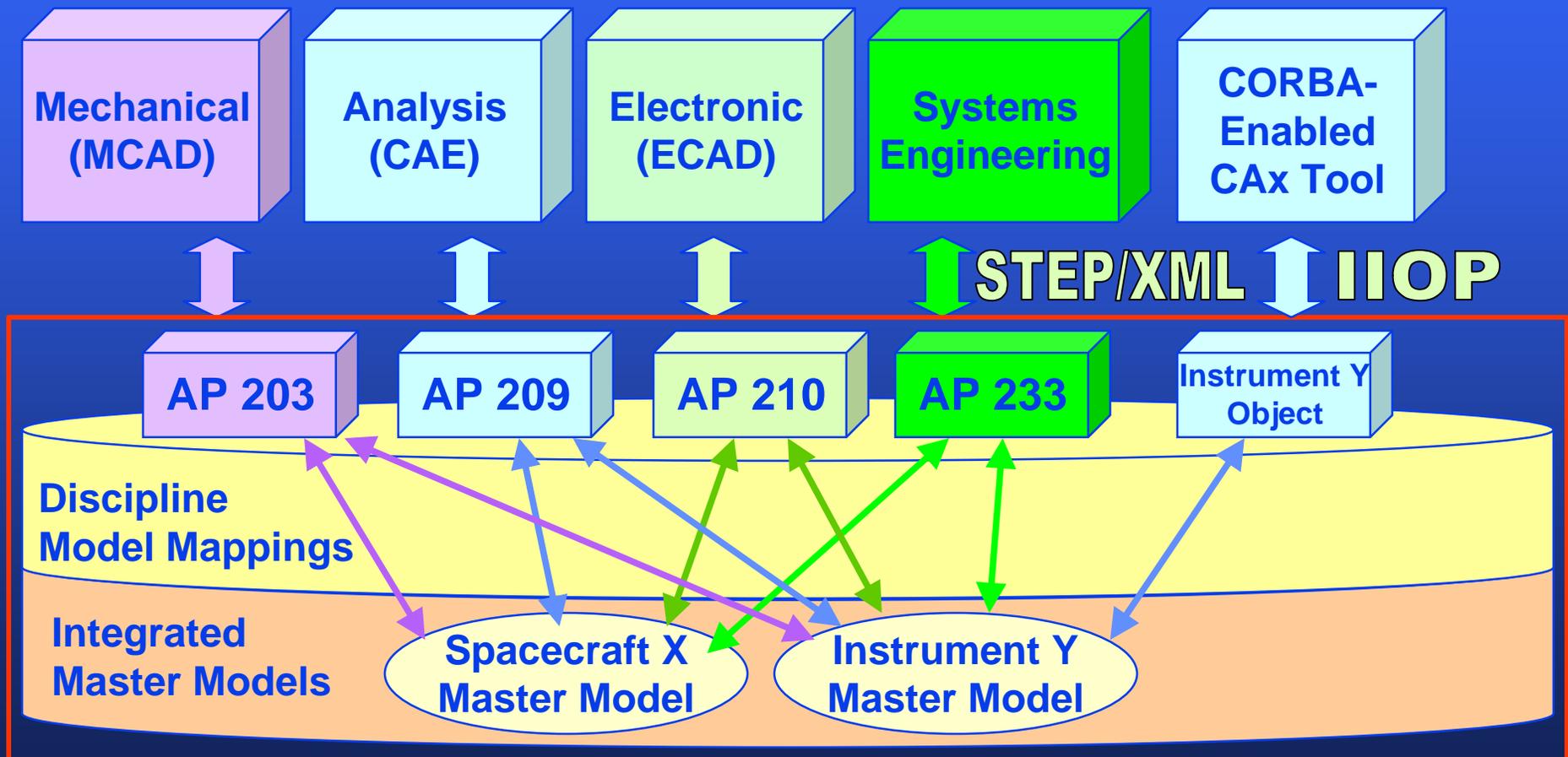
Key Technology Targets

- **Intelligent-PDM or “IPDM”** (*PDM = Product Data Management*)
 - Integrates heterogeneous, multi-disciplinary models into a Product Master Model based upon STEP and OMG standards
 - Provides interactive repository for CAx models (native and standard)
 - Provides Web-accessible services via STEP, XML, and CORBA
 - Client application supporting standard interfaces, tool integration
- **Integrated Model-based Systems Engineering**
 - Builds upon IPDM and the Product Master Model
 - Incremental system model definition, validation, and verification
 - Systems Meta-Model containing discipline model interdependencies
 - Linkage of system model parameters to discipline-specific models
 - Immediate feedback on change impacts
 - Cross-disciplinary view of functions and requirements allocation
 - Client for all discipline engineers to communicate with systems view



The NASA STEP Testbed Architecture

Integrating STEP and CORBA technologies



NASA STEP Testbed



The Product Master Model Evolution: Incremental Population 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



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Intelligent-PDM Pilot

- **Objective:**

- To provide a plug-and-play IPDM service for the management, integration, and synthesis of CAx models in a multi-disciplinary, distributed collaborative environment

- **Technologies:**

- **NIST Espresso** is the “model integration and view synthesis” engine (integrating discipline-specific models into the Product Master Model and synthesizing discipline-specific models out of the Product Master Model)
- **EXPRESS-X** mappings define the transformations between the **STEP AP** data (application-specific models created by tools) and the STEP-based **Product Master Model**



The NASA STEP Testbed Implementation Plan

- **Identify NASA requirements for Intelligent-PDM (IPDM) and Integrated Model-based Systems Engineering (IMSE)**
 - Document Use-Cases (Scenarios)
 - Identify all tools and services to be integrated and supported
 - Prototype an initial NASA Tool Interface Backplane Specification (based upon the OMG PDM Enablers, with extensions as reqd.)
 - Prototype the Product Master Model and mappings to discipline CAx models (as represented in STEP)
- **Begin implementation of an IPDM / IMSE Pilot**
 - Work has begun on pilot capabilities
 - Will seek to collaborate with NASA, ESA, PDES, Inc., and ProSTEP aerospace partners



The NASA STEP Testbed

IPDM / IMSE Development Plans for FY00

- Prototyping of MCAD <-> ECAD model integration and sharing
 - The NASA STEP Testbed is collaborating with Boeing, IBM, and others in the PDES, Inc. Electromechanical Pilot*
- Standardization of a NASA Systems Engineering Information Model
 - Harmonization of Mission Design Parameters among NASA's Integrated Design Centers
 - Implementation of a Systems Engineering client tool
- Pilot PDM system for NASA ISE/CEE Infrastructure
 - Initial **PDM Enablers (PDME)** interfaces (CORBA/IIOP access)
 - LDAP interfaces for
 - X.500 personnel directory, user roles, project directory
 - Security services
- **Collaboration with NASA and ESA STEP development projects**

* The PDES, Inc. Electromechanical Pilot Project is implementing MCAD/ECAD model exchange using STEP AP 203 and AP 210.

