PDES, Inc. Board Meeting

October 28, 1998

Engineering Analysis: A Vendor’s Perspective

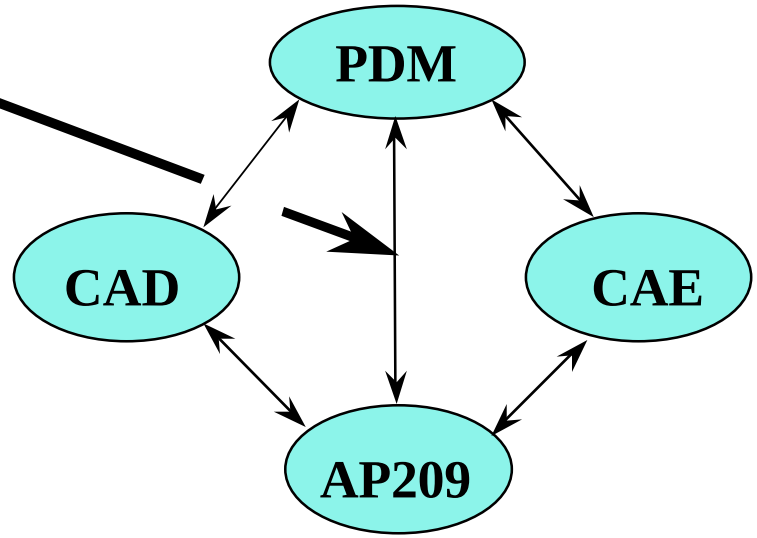
Tom Mack

Presentation Topics

- **Why AP209?**
- **STEP Opportunity And Issues**
- **Customer Expectations**
- **Harmonization/Interoperability/Modularization**
  - **AP203/AP214/AP209**
  - **Part 107 - "Evolution Versus Creation"**
- **CAD/CAE Or CAE/CAD - "Who's On 1st"**
  - **Function Define Form Or Visa Versa**
  - **Either Way What Needs To Be Communicated ?**
  - **Data Model Issues Between CAD (AP203) And CAE (AP209)**
- **CAE/AP209 And Its Role In PDM**
- **AP209 Status And Planned Milestones**

Why AP209?

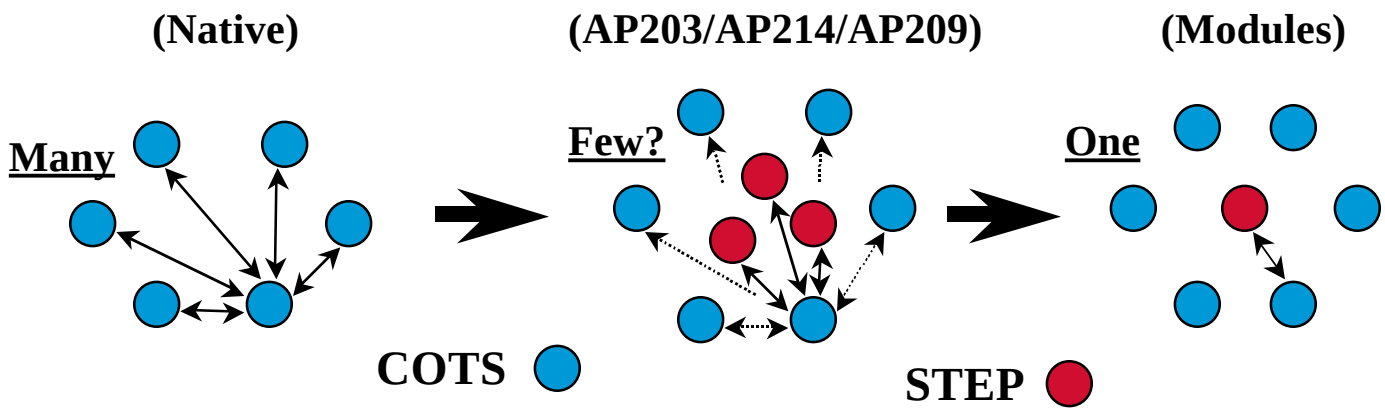
Significantly Extended Source Of Enterprise Wide Data



- **Vendor Product Neutral File**
- **Industry Standard Data Model For Corporate Wide Simulation Process Integration**
- **Single Design *AND* Analysis Data Source Within The Enterprise PDM**
- **Platform To Extend Engineering Analysis STEP Coverage Into All Analysis Disciplines**
- **Long Term Repository Critical To Aircraft Industry**

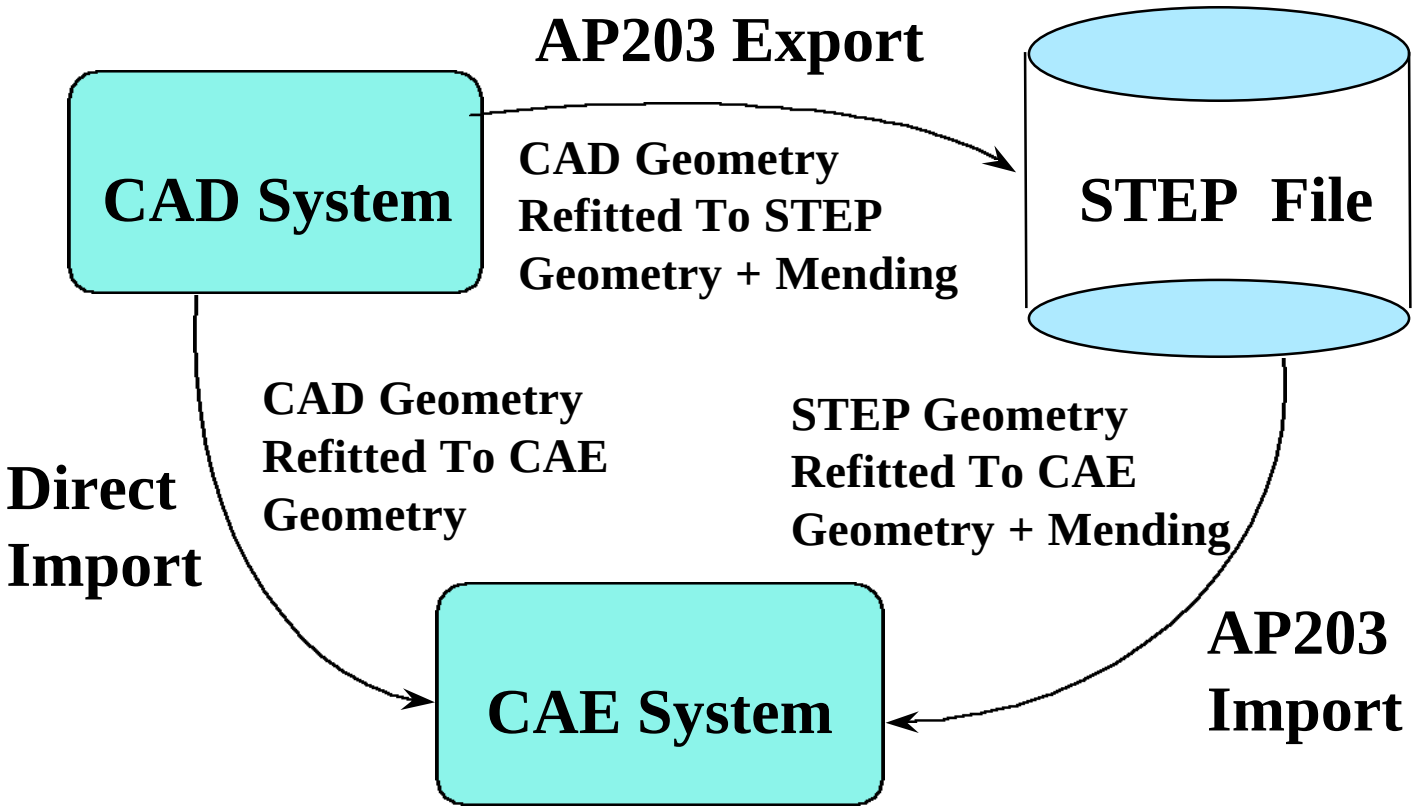
STEP Opportunity And Issues

- **Opportunity: Many-To-Few-To-One**



- **Issues**
  - Expectations Set By COTS Native Functionality
  - Accuracy/Tolerances/Features/Constraints
  - Significant Duplication Within Existing APs
  - Need For Harmonization/Interoperability/Modularization
  - Key To Design/Analysis AP209 Extensions
  - Vendor Interfaces Are Cost Drain, Not Revenue Source

Customer Expectations



MSC Customer Expectations Set By Current Direct CAD To CAE Geometry Import Processes

Questions To Be Answered By Customer

- **CAD Geometry Import Evaluation**
  - **Degree of Difficulty - Can Customer Import the Design Geometry and Mend It?**
  - **Accuracy - Can Customer Get the Volume, CG, Area, Etc. Right?**
- **CAE Geometry Evaluation**
  - **Can Customer Mesh the Geometry and Create a FE Model?**
- **CAE Analysis Evaluation**
  - **Can Customer Get an FEA Solution?**
  - **Can Customer Get the Right Answers?**
- **CAD/CAE Export Evaluation**
  - **Can Customer Export the CAD/CAE Geometry to STEP (AP203/AP209)?**
  - **Can Customer Export the CAE FE Model and FEA Results to STEP (AP209)?**

1998 NAFEMS Ltd Challenge

STEP Geometry For Analysis Modeling Challenge

AP203 B-Rep
Solid Of Piston

MSC/PATRAN Initial Geometry Import

Import Geometry Verify Plot

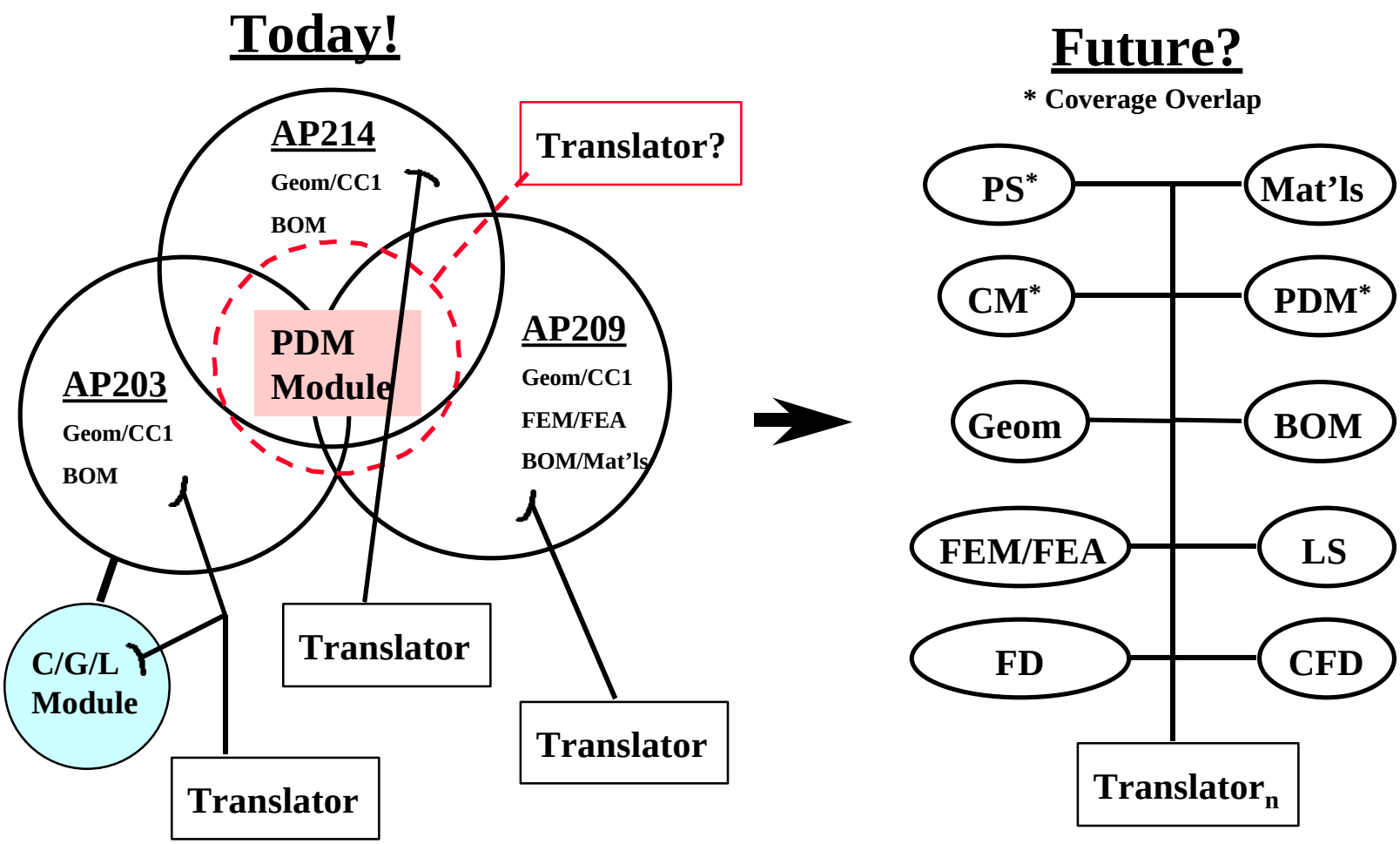
Untrimmed Surfaces

Missing Fillet

Ultimate CAE Measure Of STEP's Readiness

FEM/FEA Results

AP203/AP214/AP209/PDM/?



Modules/Building Blocks?

- **ISO New Work Item (NWI) Initiated In The STEP Engineering Analysis Committee**
  - **Work to leverage STEP AP209 and GEM work to date**
  - **Must Conform With Existing STEP Implementaions (Part 40 Series)**

CAD/CAE Or CAE/CAD "Who's On 1st

- **Funtion Defines Form**
  - **Conceptual Phases Of Design Definition And Assessment**
  - **Typical Within Industries Where Performance Is "King"**
  - **Results Serve As Requirements For Form**
- **Form Defines Function**
  - **Design To Build Phases Of Product Development**
  - **Typical Within Industries Using Part Reuse And Part Libraries**
  - **Tier 1 Supplier Support/Exchanges**
  - **Results Serve As Starting Point For Design Assessment**
- **Data Model Issues**
  - **AP203 (Unattributed Design Geometry, No Engineering Constraints Or Features, BOM Mat'l Id But No Properties)**
  - **AP209 (Attributed Idealized Geometry, Design Version Performance Levels, BOM Mat'l Id And Properties)**

Idealized Design Geometry For FEA

Implicit Thickness “t” Issue

Solid/Surface Geometry
FEM/FEA Shell Elements

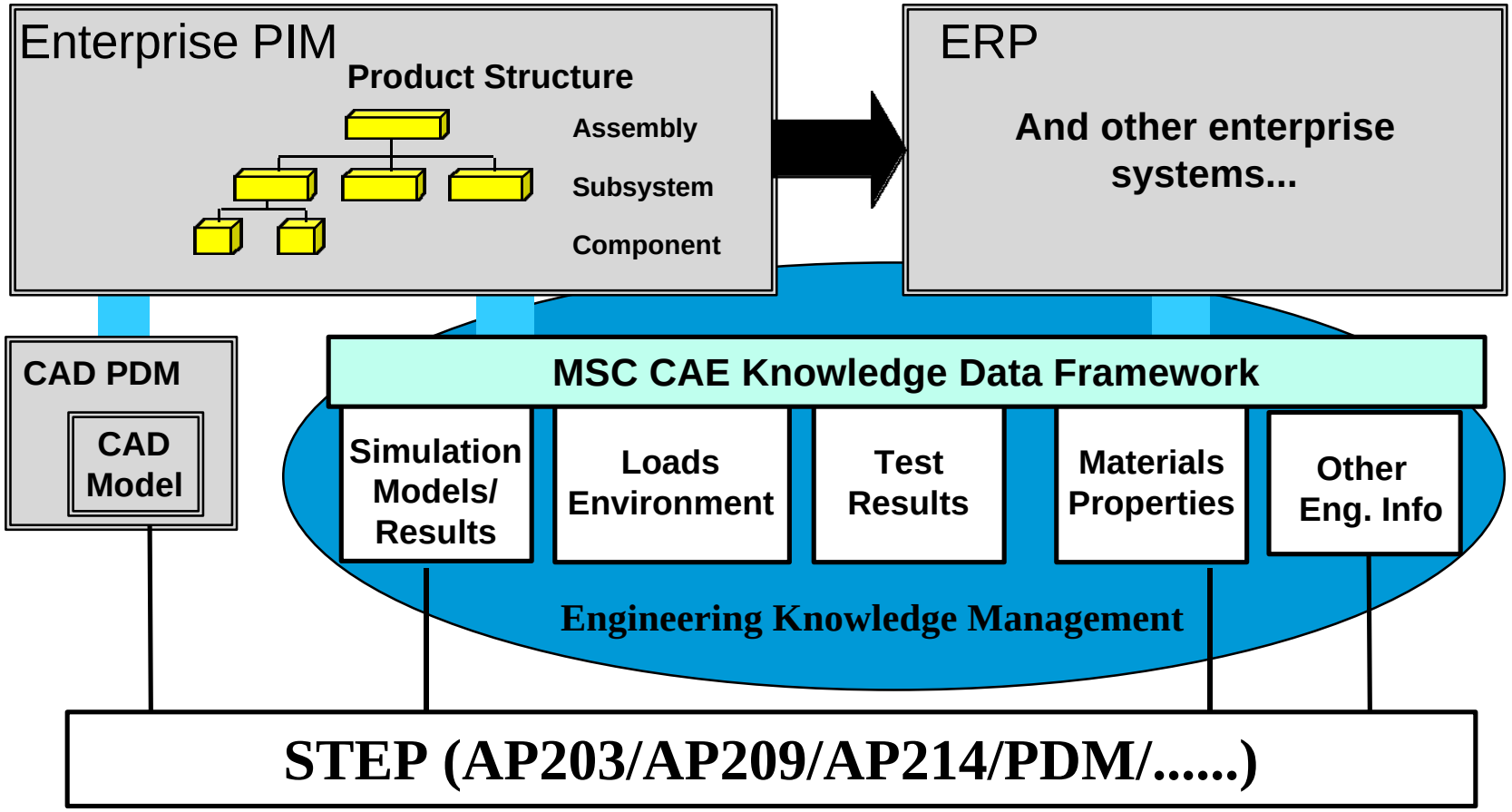
Rib Stiffener Cross-Section Shape Issues

<u>AP209 Possible Representations</u>

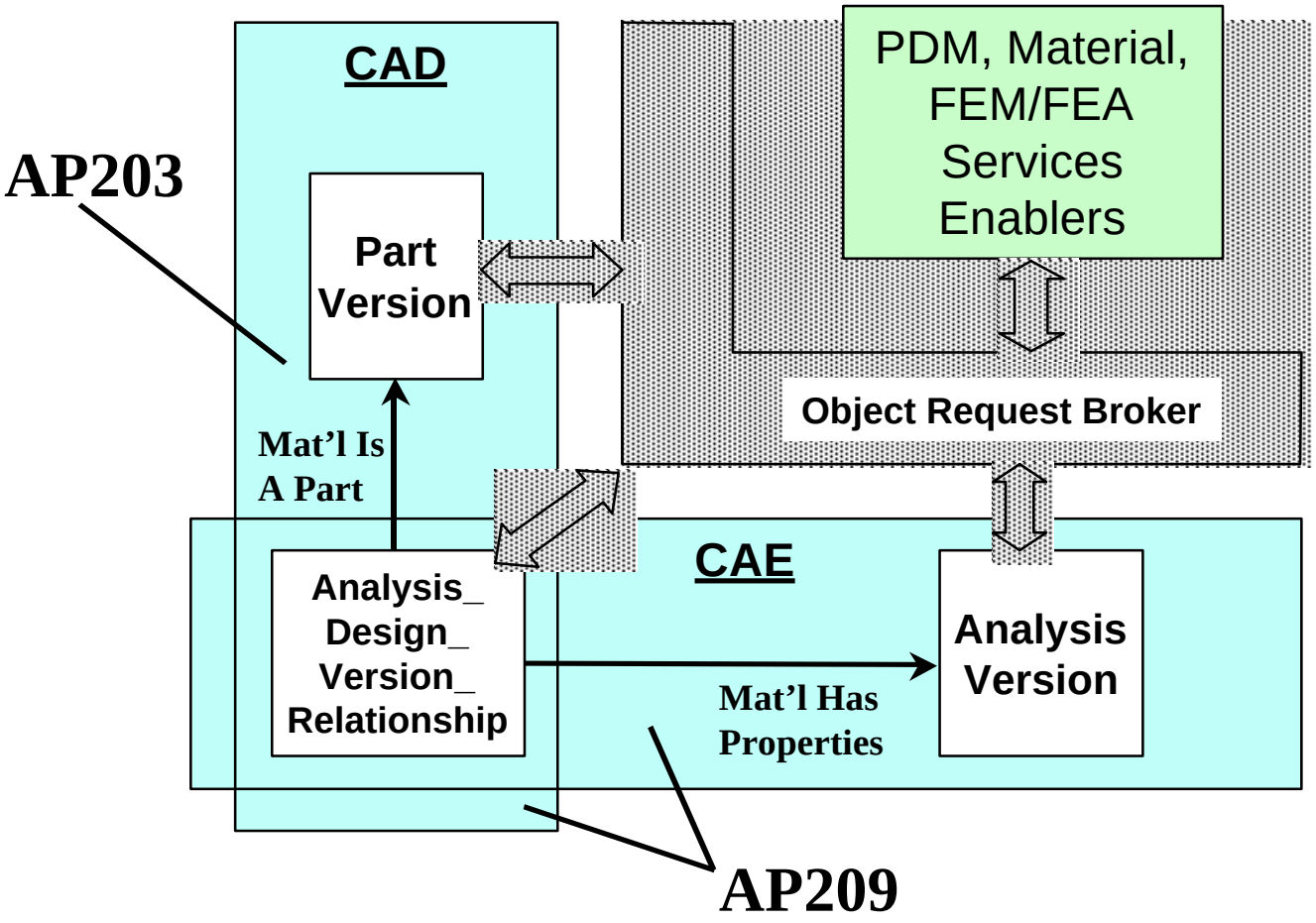
- **Idealized Shape (Trim Surface)**
- **FEM Properties (A, I, etc.)**

CAE/AP209 And Its Role In PDM

MSC's Integration Strategy



PDM Integration And STEP Coverage



AP209 Status And Planned Milestones

- **AP209 To Be Out For DIS Ballot By The End Of 1998**
  - **Part 104 Finite Element Resource On Track**
  - **AP203, AP214, and PDM Schemas Harmonizations Completed**
- **Two AP209 Demonstrations Scheduled For Near Term:**
  - **11/98 TAC: Highlighting Sharing Shape/Analysis Data In a PDM Controlled Environment (Shipbuilding Industry) With Emphasis On Analysis Extensions And CAE To CAD Communication Of Design Changes Required To Meet Performance**
  - **6/99 TAC: Highlighting Sharing Of Composite And Analysis Data In The PDM Controlled Iterative Design/Analysis/Fabrication Of Composite Structures**
- **AP209 Modularization Project Initiated At Last Offsite**
  - **Basic Goal Is To Enable Future Inclusion Of CFD, Thermal, And Nonlinear Dynamic/Transient Analysis Modules**
  - **Continue Work On Harmonizing Part 107 with AP209 and STEP Core**

AP209 Recommendation

AP209 Is Ready For Full-Scale Commercial Implementation

- **Many Successful Pilots/Demonstrations To Date**
- **Current Pilot Is Implementing DIS Schema**
- **AP209 Provides a Solid Basis For Multi-Physics Design And Analysis Integration**

Backup Slides

AP209 Awareness Through Demonstrations

(Completed/AP209 CD)

- **PDES, Inc. Design-To-Analysis Phase 1 (1994)**
  - **Ford, Boeing, Lockheed, ITI, MSC**
  - **Auto And Composite Tank Structures**
  - **CAD-To-CAE-To-CAE**
  - **COTS CAD/CAE (ARIES, PATRAN, NASTRAN, ITI/STRESSLAB)**
  - **Linear Static FEA**
  - **Video Generated, PDES, Inc. TAC Demo**
- **DARPA MADE/IPDE Program Phase 1 (1996)**
  - **Boeing, ASU, MSC**
  - **Aircraft Structures**
  - **CAD-To-CAE(CFD)-To-CAE(Structures)-To-CAE(CFD)**
  - **COTS CAD/CAE (CATIA, PATRAN, NASTRAN)**
  - **Boeing Proprietary CFD (AGPS/A502)**
  - **Iterative 1st Order CFD And Linear Static FEA**
  - **In-House Boeing Demo, PDES, Inc. Offsite Presentation**

AP209 Awareness Through Demonstrations (Cont.)

(Planned/AP209 DIS) - Lockheed, Electric Boat, MSC

- **Electric Boat Design-To-Analysis Process (1998)**
  - **Ship Structures**
  - **CAD-To-CAE-To-CAE-To-CAD**
  - **COTS CAD/CAE (PRO/E, PATRAN, NASTRAN)**
  - **Electric Boat Proprietary (COMMANDS)**
  - **Multiple Idealized Geometric Shapes And FEM/FEA Models**
  - **Linear Static And Dynamic FEA**
  - **PDES, Inc. TAC Demo (November 1998)**
- **Lockheed Design/Manufacture/Analysis Composites Process (1999)**
  - **Composite Aircraft Structures**
  - **CAD/CAM-To-CAE-To-CAD/CAM**
  - **COTS CAD/CAE (CATIA, FiberSIM, PATRAN, NASTRAN)**
  - **Lockheed Proprietary (ASSS, PICASSO)**
  - **Composite Structure Geometric Shapes (Ply/Zone) And FEM/FEA Models**
  - **Linear Static And Dynamic FEA**
  - **PDES, Inc. TAC Demo (June 1999)**