



# **Industrial Data Implementors Forum**

Larry McKee/IBM

Martin Hardwick/ STEP Tools

October 18, 2000

Charleston, SC

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## **Agenda**

**Introductions**

**Open Issue Review**

**The BIG Issues**

**AP Interoperability**

**Unified PDM Schema**

**Modularity**

**Solid Model History**

**STEP and XML**

**Shipbuilding Implementors Report (EMSA)- U. Langbecker**

**CAX/PDM Implementors Forum- R. Barra**

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## Our Charter

Provide an open forum to discuss implementation concerns and lessons learned about all aspects of PDE (product data exchange) standards. Special emphasis is placed on implementation problems that are independent of specific product modeling/ description systems.

The committee evaluates technical problems that interfere with the implementation of the standards and proposes solutions via the approved change processes. In the event that a major problem is identified, this committee will propose temporary recommended practices, provide feedback to the appropriate technical committee or recommend the issue to appropriate technical committees for disposition.

The committee is concerned with the enhancement of data interchange standards to incorporate capabilities being added to current product modeling systems. It also serves as a body of experts when other committees need information on specific product modeling/ description systems and maintains relationships with all SC4 technical committees, industry consortia organizations and other standards committees as appropriate.

Further, while this committee encourages dissemination of information on appropriate products and toolkits, it shall not allow marketing and advertising of products or product comparisons.

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## The Exploder

- **The implementors forum exploder is hosted at NIST in the US**
- **Mail is sent to the exploder by addressing it to:**  
**step-imp@cme.nist.gov**
- **To join the exploder send a mail message to**  
**majordomo@cme.nist.gov**

**In the body of the message (NOT the Subject!) type:**

**subscribe step-imp**

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## The Web Site

- Can be found at: <http://impforum.aticorp.org>
- Has the charter, issue log, minutes of last meeting, and slides from last meeting
- STEP background material
- Forum FAQ
- Links to many STEP places

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### Welcome to the Industrial Data Implementors Forum Home Page

The Industrial Data Implementors Forum (IDIF) is an active and passive, virtual and meeting based discussion group which monitors the implementability of product data standards.

The forum is centered on the ISO TC184/SC4 product data standards but takes lessons learned from past and present activity in IGES, SET, VDA/FS and other product data standards. Most of the current discussions are on implementation of the ISO 10303 (STEP) data standard.

**[Charter](#)**

**[Issue Log](#)**

**[Minutes of Last Physical Meeting](#)**

**[Slides from the Last Meeting \(6 MB Zipped\)](#)**

**[Future Meetings](#)**

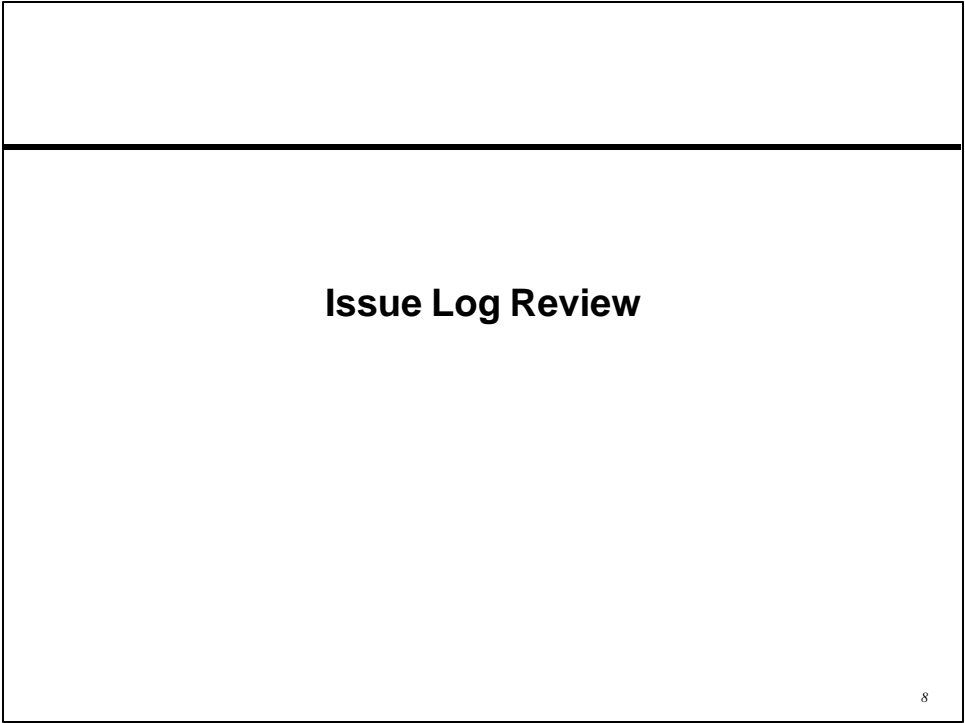
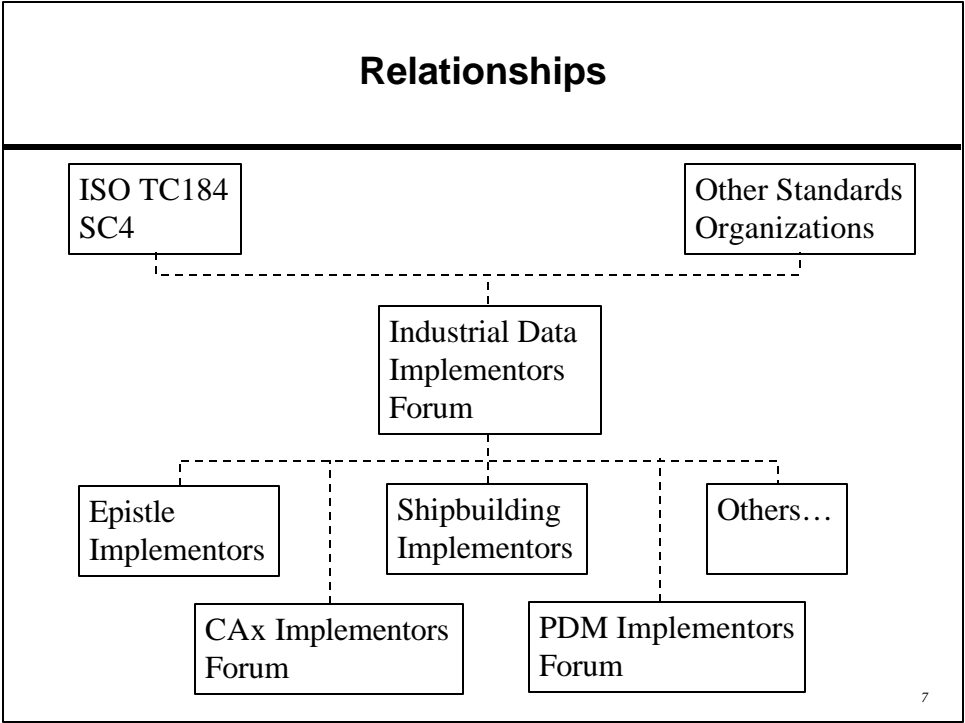
**[PDES/ STEP Information](#)**

**[FAQs](#)**

**[Information Links](#)**

For more information, please send an e-mail to [Larry McKee](#)

[ [IDIF Home](#) | [ISO TC184/SC4 Home Page](#) | [ISO Home Page](#) ]



## Issues

- **Summary- 47 Issues - 4 Open**
- **Issue: 036 AP Identities**
  - Open- Big Issue
- **Issue: 044 Solid Model Construction History**
  - Open- Big Issue
- **Issue: 046 STEP and XML**
  - Open- To be discussed this session
  - Will be added to Big Issues List
- **Issue: 047 Need for New Chair**
  - Martin Hardwick has been proposed by the US
  - Should be closed on Friday

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## New Issues???

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## The BIG Issues

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## The BIG Issues

- **AP Interoperability**
  - Unified PDM Schema
  - Modularity
- **Solid Model History**
- **STEP and XML**
- **New Chair**
  - Martin Hardwick is the proposed nominee!

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## **AP Interoperability**

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## **Agenda**

- **AP Interoperability**
- **Unified PDM Schema**
- **Modules**

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## AP Interoperability



- **The Process**
  - Identify Focus Areas of Overlap between APs
  - Identify specific issues
  - Resolve Issues
  - Test Resolutions
  - Standardize resolutions
- **Integrated Resource Changes for Interoperability**
- **AP Changes for Interoperability**
  - Some of the current techniques exhibited in AP 214
- **Focus areas**
  - Unified PDM schema
  - Modules/ Extensions
- **Part 21 extensions to support AP Interoperability**

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## *The Unified PDM Schema and Modules*

Larry McKee



## ***Unified PDM Schema Goal***

- ***What is the goal?***
  - Establish a core set of entities in STEP which support PDM
  - Introduce this core to Shipbuilding and PLCS AP projects
  - Harmonize with OMG, CALS, and MIL-STD2549
  - Test these entities via demos, pilots, and roundtables
  - Factor the resulting entities and supporting structures back into existing APs as core modules to enable interoperability



## ***Unified PDM Schema Plan***

- Develop the Unified PDM schema
  - version 1.1 established - anticipate maintenance release 1.2
- Review the schema with PDES, Inc., ProSTEP, JSTEP, STEP AP, and other SC4 requirements owners for buy-in consensus
  - review and resolution of AP214 DIS issues
  - resolution of issues on STEP IR Parts 41, 43, and 44
  - review within ISO 10303 SC4/WG3 technical forum
- Develop test versions of modules and AP schemas
  - Unified PDM schema to be several modules ...
- Test the schema in demos, pilots, and roundtables
  - PDM implementor forum, EuroFighter, STEPwise, STAMP, ...
- Work the schema into the APs within ISO through modules and resource part, AIC, and AP changes
  - Modules, AP extensions, AP revisions, new AP development





## **Module Development**

**Prespared by: Rogerio Barra/PDES, Inc./ATI  
Charleston, ISO**



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# Module Development

Prepared by: Rogerio Barra/PDES, Inc./ATI  
Charleston, ISO

## Module Development Recent Accomplishments

- First set of modules approved by ISO as Technical Specifications
  - 9 modules for shape appearance and layers
- Significant progress on PDM modules
  - Great team effort
- AP233 team acceptance of modularization approach
- Completed geometric validation properties module



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## Module Development Plans for the Next 6 Months

- Submit PDM modules as Technical Specifications
- Initiate CAX-IF testing on Construction History
- Continue influencing STEP System Engineering efforts
- Complete geometric tolerance modules
- Publish final release of PDM Schema Usage Guide



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## Module Development Challenges

- PDM modules ballot
  - Coordinate with ProSTEP and STEP Centers to ensure successful ballot
- Resource for Engineering Analysis modules
  - Rolls-Royce has expressed interest
  - Increase member companies' awareness of EA effort



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# Product Data Management

## PDM Recent Accomplishments

- Published release 4.1 of PDM Schema Usage Guide
  - Addressed issues raised against release 4.0
- Coordinated with AP214 team on resolution of interoperability issues related to rules
- Issued three updates to the PDM modules
- Drafted AP203 Amendment 1 and sent to ISO for a 2 month ballot
  - Fixes EXPRESS errors in AP203 and incorporates Express Technical Corrigenda fixes to Parts 41,42, 43, and 44



## PDM Plans for the Next 6 Months

- Publish maintenance release of PDM Schema Usage Guide by October 15
- Submit PDM suite of modules as Technical Specification
  - Product Identification- OK
  - Product Shape- OK
  - Product Structure- OK
  - Document- At Risk
  - Engineering Change- OK
  - Configuration/Effectivity- OK



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## PDM Challenges

- Balancing high priority near-term requirements
  - Have expanded resources
- Mapping Complexity
  - Team experience/knowledge of APs 203/214/232
- Interface/linkage points with other modules
  - Added module joint sub-team call



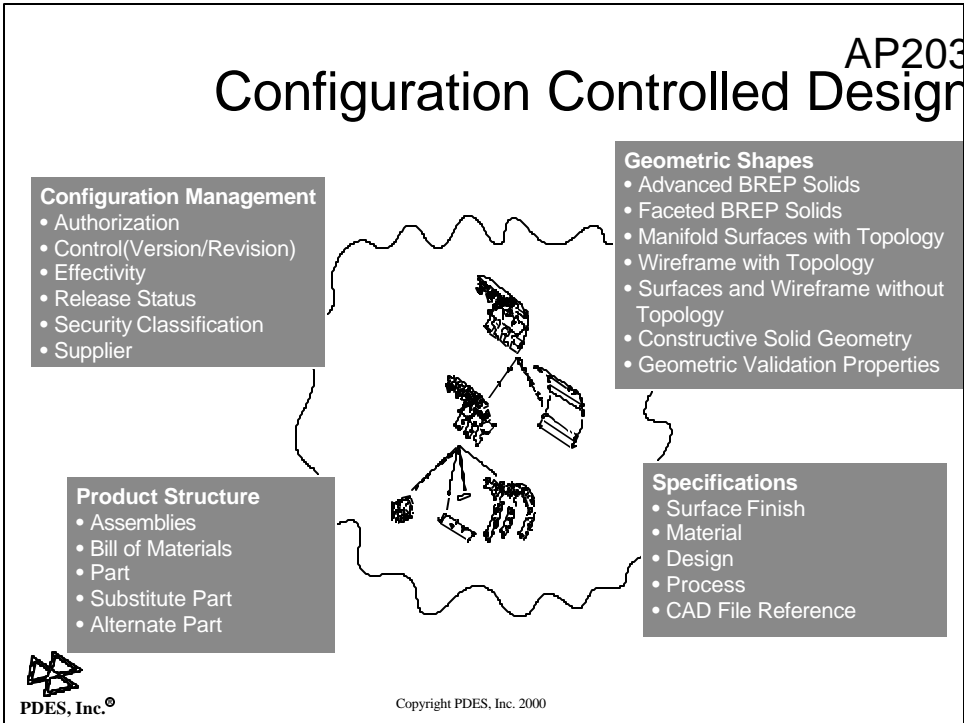
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# AP203 Edition 2

## Configuration Controlled Design



## AP203 Edition 2 Basic Concepts

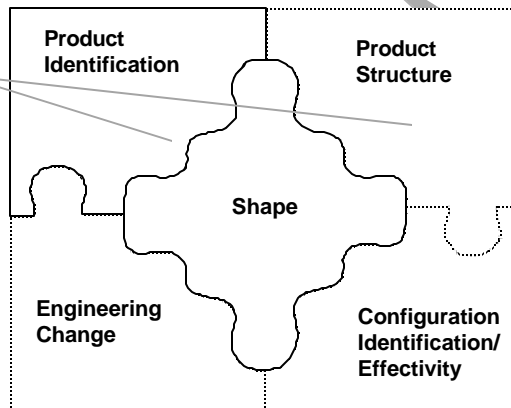
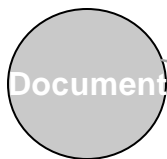
# AP203- The Module



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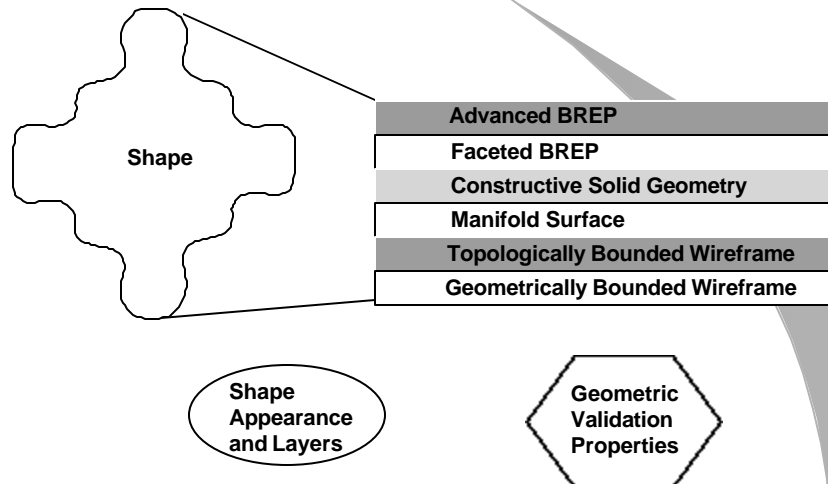
## AP203 Edition 2 Basic Functions



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## AP203 Edition 2 Shape/Extended Functions



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## AP203 E2 Conformance Classes

- Currently 203:1994 has 12 classes (2-PDM and 5 Shape)
- AP203:2000 will also have 12:
  - Product Identification (~ 203 CC1a)
  - Product Structure
  - Engineering Change
  - Configuration Identification/Effectivity
  - Shape
    - Advanced BREP Solids
    - Faceted BREP Solids
    - Manifold Surfaces with Topology



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## Conformance Classes (cont.)

- Shape (continued)
  - Wireframe with Topology
  - Surfaces and Wireframe without Topology
  - Constructive Solid Geometry
- Color/Layer
- Geometric Validation Properties
- New ones are based on functionality



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## AP203 E2 Challenges

- Resources
  - .25 person effort is barely enough
- Post ballot support
  - Work through modules team



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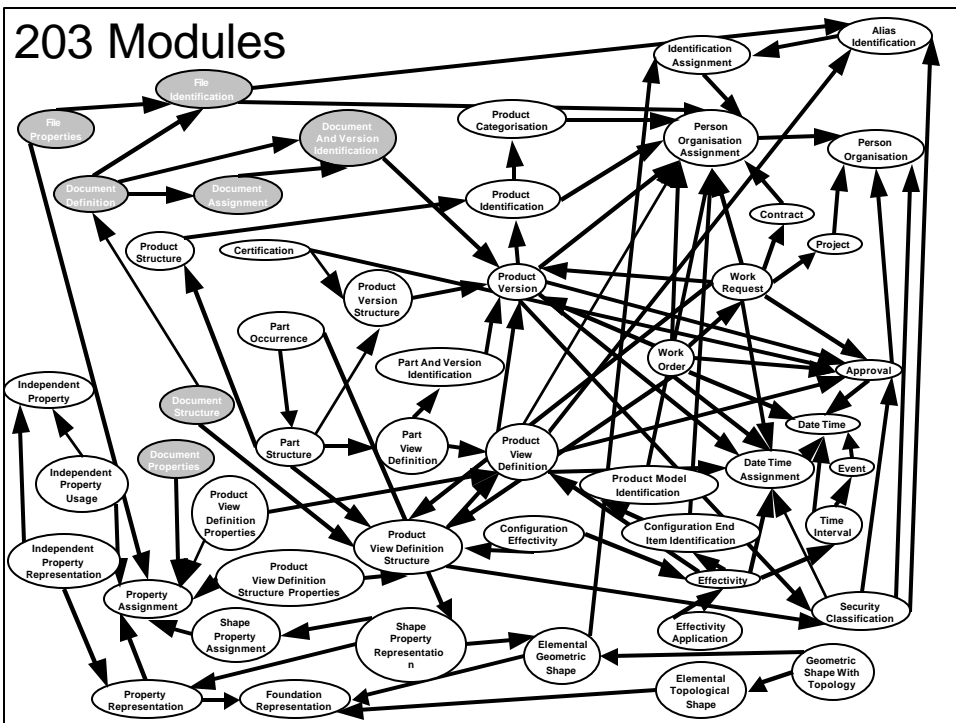
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203 Edition 2

## Back-Up Slides



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# 203 Modules (cont.)

The diagram illustrates the relationships between 203 modules, organized into several layers. The modules are represented as ovals, and the arrows indicate dependencies or relationships between them.

**Top Layer (Input/Source Modules):**

- Constructive Solid Geometry
- Manifold Surface
- Shell Based Wireframe
- Edge Based Wireframe
- Faceted Boundary Representation
- Advanced Boundary Representation
- Geometrically Bounded Wireframe
- Geometrically Bounded Surface
- Geometric Validation Property Representation

**Intermediate Layer (Processing/Transformation Modules):**

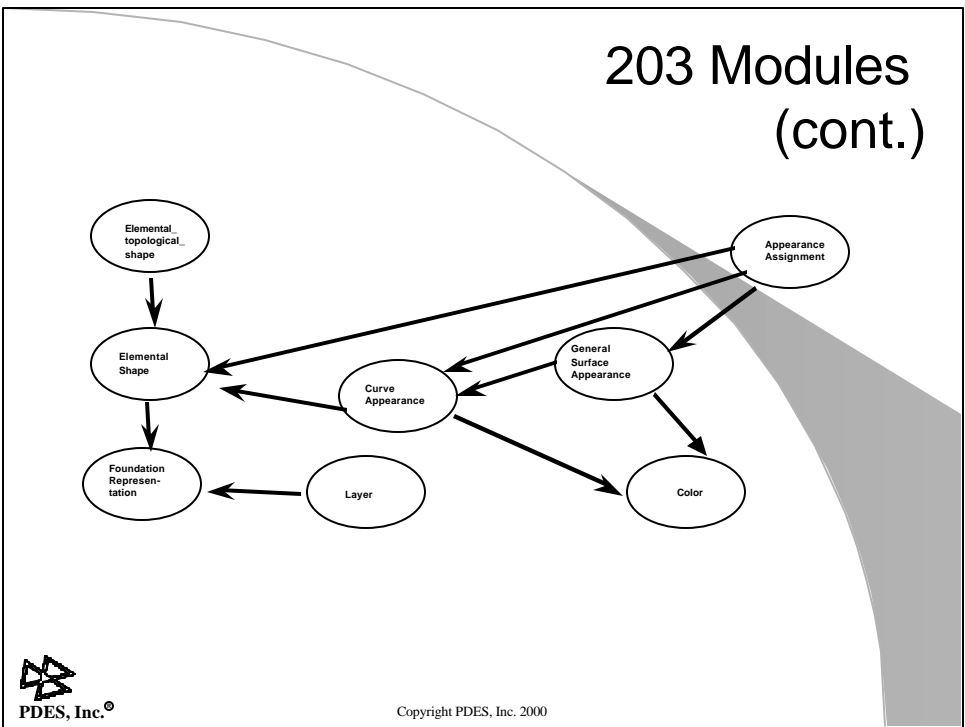
- Topologically Bounded Surface
- Geometric Shape With Topology
- Identification Assignment
- Elemental Topological Shape
- Shape Property Representation
- Property Representation
- General Surface Appearance
- Curve Appearance
- Appearance Assignment

**Bottom Layer (Output/Assignment Modules):**

- Elemental Geometric Shape
- Foundation Representation
- Shape Property Assignment
- Layer
- Property assignment
- Color

**Key Relationships:**

- Constructive Solid Geometry** and **Manifold Surface** lead to **Topologically Bounded Surface**.
- Topologically Bounded Surface** leads to **Geometric Shape With Topology**.
- Geometric Shape With Topology** leads to **Elemental Geometric Shape** and **Elemental Topological Shape**.
- Elemental Geometric Shape** leads to **Identification Assignment**, **Foundation Representation**, and **Shape Property Assignment**.
- Elemental Topological Shape** leads to **Curve Appearance** and **Foundation Representation**.
- Curve Appearance** leads to **Color**.
- General Surface Appearance** leads to **Color**.
- Foundation Representation** leads to **Property assignment**.
- Shape Property Assignment** leads to **Property assignment**.
- Property Representation** leads to **Property assignment**.



# Geometric Dimensioning and Tolerancing (GDT)

## GDT Objectives

- Develop and validate modules for geometric and dimensional tolerances
- Support CAD vendors implementing the modules

## GDT Participants

- Tom Hendrix - Boeing
- Rogerio Barra - ATI
- Much assistance from
  - Larry McKee
  - Mark Lobo
  - Chris Vaughan



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## GDT Recent Accomplishments

- Developed two drafts of PDM Properties
- Developed draft GDT suite in PDES, Inc. html format
  - Harmonized with ISO
- Developed experimental scripts for data-driven module authoring
  - “one click” html authoring



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## GDT Plans for the Next 6 Months

- Develop GT usage guide for vendors
- Develop annotation/presentation module suite
  - Based on AP214
  - Harmonized with Model Viewing
- Pursue validation of GDT modules
- Harmonize DT modules with FDIS AP214
- Republish GDT modules as html
- Prepare PDM Properties modules for ISO ballot



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## GDT Challenges

- Suppliers interest in GDT and drafting is soft
  - Will continue to promote
- HTML environment and guidelines are still evolving
  - Getting some attention, will get more
- HTML authoring takes time
  - But can be at least partly automated



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# Engineering Analysis



## Engineering Analysis Recent Accomplishments

- Draft Part 5x 'Mathematical Description'
  - Links Part 50 to the rest of STEP
  - Reviewed in Bordeaux
  - Harmonised with Parts 43 and 108
  - Issued as WG12 N605
- EACM (Engineering Analysis Core Model) module progress
  - Concept of state harmonized with AP233
  - Interpreted on to Part 50 DIS and draft Part 5x

## Engineering Analysis Plans for the Next 6 Months

- Submit first batch of EACM modules for TS ballot
- Conduct simultaneous NWI/CD ballot for Part 5x



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## Engineering Analysis Challenges

- Ensure that Part 5x supports Part 104/EACM integration
  - On-going technical work with Keith Hunten and Tom Thurman
- 'Finite element definition' module in EACM
  - Documents the Myrtle Beach proposal, with revisions if necessary, as a module

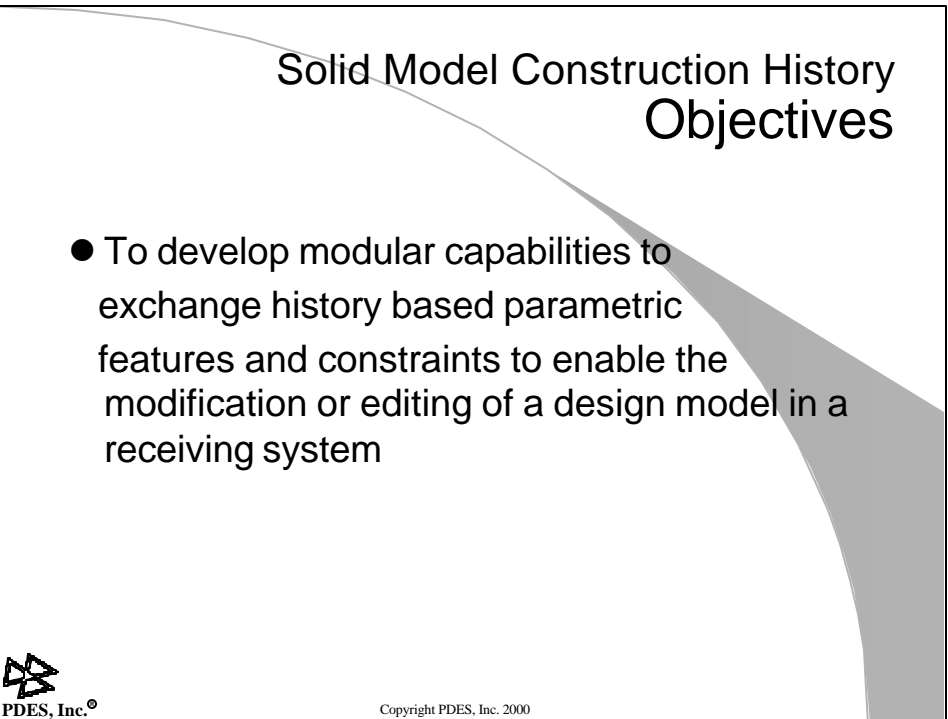


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# Solid Model Construction History



## Solid Model Construction History Objectives

- To develop modular capabilities to exchange history based parametric features and constraints to enable the modification or editing of a design model in a receiving system

## Solid Model Construction History Participants

- Bill Anderson - ATI
- Mike Pratt - NIST
- Vijay Srinivasan - IBM
- Noel Christensen - Honeywell Federal



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## Solid Model Construction History Recent Accomplishments

- Spring Offsite Meeting
  - Productive meetings with CAD vendors and team members
  - Vendors in attendance represented Dassault, SDRC, UG, Autodesk, Spatial, and Theorem Solutions
    - Discussed vendor responses to questions of access to history information
    - Modeling approach was presented and discussed for vendor feedback
    - Dassault and SDRC representatives expressed belief that construction history exchange is feasible with current modeling approach



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## Solid Model Construction History Recent Accomplishments

- Participated in successful ISO Parametrics Workshop at NIST May 15-17
  - Decided on scope of initial implementation
  - Part 21 file creation progress for test part
- Published Feature-Based Construction Operations document addressing Priority 1 list through Blends (see next slide)
- Developed draft Implementors' guide that includes integrated model, test part, and Part 21 file



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## Solid Model Construction History Recent Accomplishments

- Priority 1 List
  - Linear sweeps of sketch (extrusion)
  - Rotational sweep of sketch
  - Boolean operations (union, diff., intersect.)
  - Blending (including rounding, filleting, etc.)
  - Rigid body transformation (translate, rotate)
  - Generation of feature patterns
  - Use of system defined features from a library



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## Solid Model Construction History Recent Accomplishments

- Construction history model is an integrated model using these resource structures
  - Part 108 - Parameterization and constraints for explicit geometric product models (SC4/WG12 N526)
  - Parametric framework for exchange of geometric product models (SC4/WG12 N441)
  - Feature-Based Construction Operations (SC4/WG12 N 589)



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## Solid Model Construction History Recent Accomplishments

- Held successful workshop at ISO Meeting in Bordeaux (June 29-30)
  - Published draft Implementors' Guide as key workshop material
  - About 15 participants at workshop (vendors included Dassault, Spatial, Unisys, GSSI)
- Work underway to incorporate workshop feedback



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## Solid Model Construction History Plans for the Next 6 Months

- Continue to work with ProSTEP on joint work plan and implementation effort
- Publish Implementors' Guide in September incorporating workshop decisions
- Conduct workshop at October ISO Meeting in Charleston
- Obtain vendor commitments to begin implementations as part of CAX-IF Round 5J



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## Solid Model Construction History Challenges

- Finalize model for October ISO Workshop
  - Freeze changes to 'resource' models
- Vendor commitments to begin implementations
  - Work through user companies
- Resource shortage
  - Obtain additional support



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## STEP for the World Wide Web

Prepared by: David Price/IBM/PDES, Inc.

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## STEP for the Web Objectives

- **Accelerate efforts to map STEP onto the Web**
- **Pursue Web Content Standardization**
  - Understand, influence and utilize Web Standards organizations, in addition to using ISO to standardize APs and modules
- **Conduct Demos, Prototypes and Pilots that validate and show that STEP and the Web work well together**

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## **STEP for the Web Objectives (cont.)**

- **Anticipated Deliverables**
  - An ISO standard for making STEP schemas available in Web format and for exchanging data in Web format using those schemas
  - A process and web site PDES, Inc. can use to standardize STEP schemas for the Web
    - Put at least one schema through that process
      - The PDM schema is a likely candidate

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## **STEP for the Web Objectives (cont.)**

- **Anticipated Deliverables (cont.)**
  - **For Demos, Prototypes, Pilots**
    - Software that implements the STEP for the Web standard
    - A proof-of-concept application based on that software
    - A web site for publishing, discussing and implementing STEP on the Web

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## Quick Tutorial on XML - the eXtensible Markup Language

- **A Document Type Definition (DTD) defines the structure of XML documents**
  - Similar to a schema
- **XML documents contain the data marked with the tags defined in the DTD**
  - For STEP/XML -the DTD exists and is derived from the EXPRESS schema
- **Part 28 is an ISO project standardizing mappings from EXPRESS to XML**

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## Part 28 and Bindings

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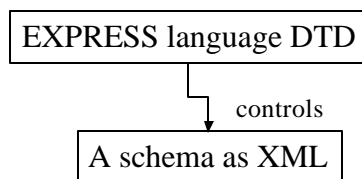
## Part 28

- Part 28 is an ISO project standardizing mappings from EXPRESS to XML
  - EXPRESS DTD for schema exchange
  - EXPRESS/UML/XMI for schema exchange
  - Late Binding DTD for data exchange
  - EXPRESS-Typed Early Binding
  - Object Serialization Early Binding
  - Containment Early Binding (maybe)

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## The EXPRESS DTD

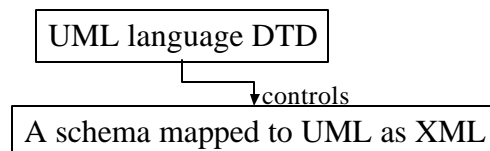
- Maps *all* of EXPRESS *syntax* into XML



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## EXPRESS to UML for XMI

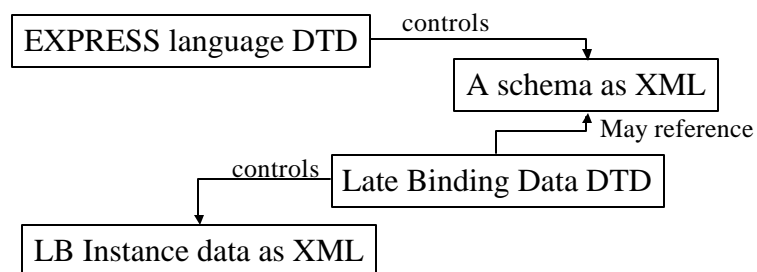
- Maps subset of EXPRESS concepts to OMG UML Meta-model Class Diagram concepts for OMG XMI use
- Requires Part 28, OMG XMI spec and OMG UML



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## Late Binding DTD for Data Exchange

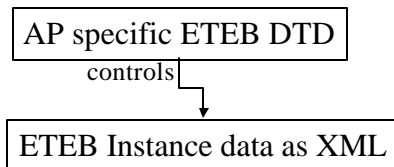
- Maps EXPRESS simple, defined and entity type instances into XML document
- Is SGML "architecture DTD" for ETEB



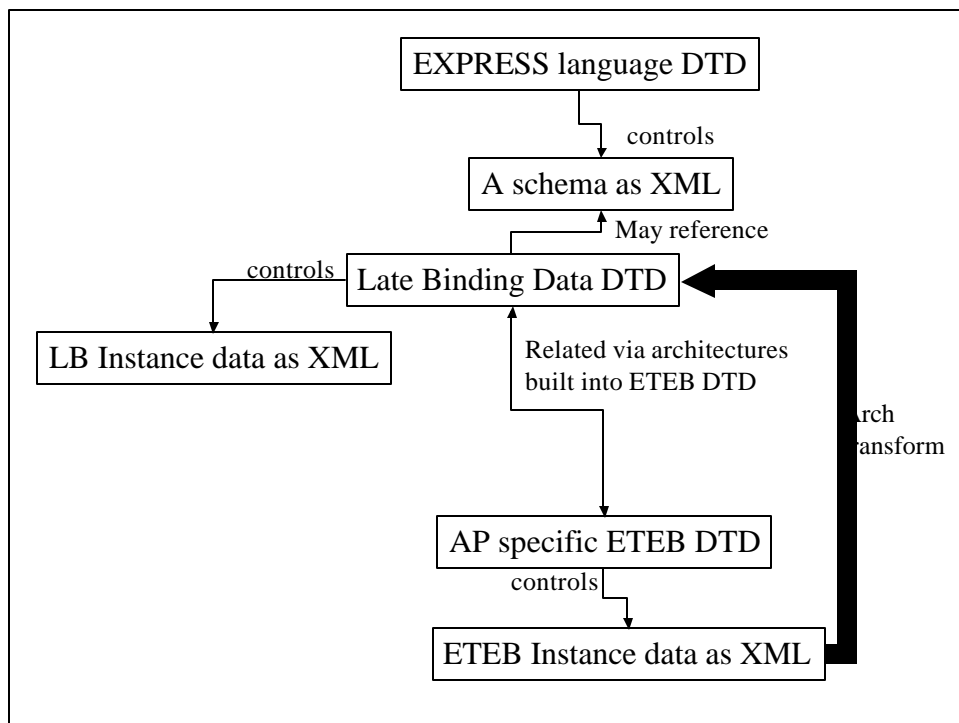
30

## EXPRESS-Typed Early Binding

- Maps as much of EXPRESS typing into DTD as possible
- Is architecturally related to Late Binding
  - See next page

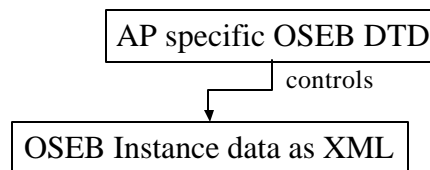


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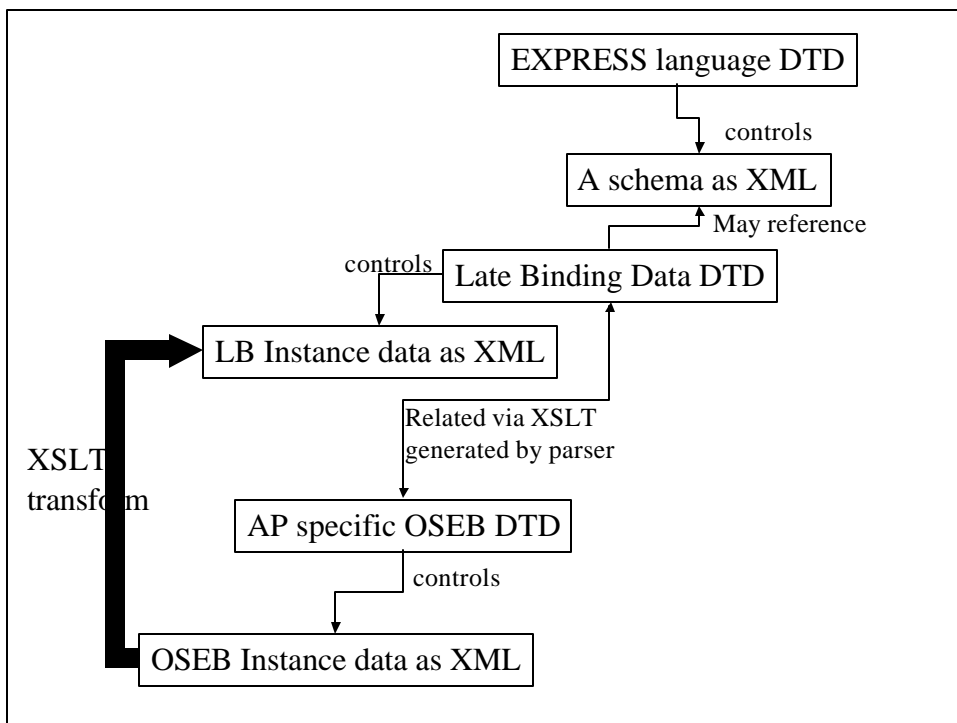


## Object Serialization Early Binding

- Maps EXPRESS into XML that is parallel to programming language constructs
- EXPRESS not visible in the DTD
- Mapped to Late Binding via XSLT
  - See next page



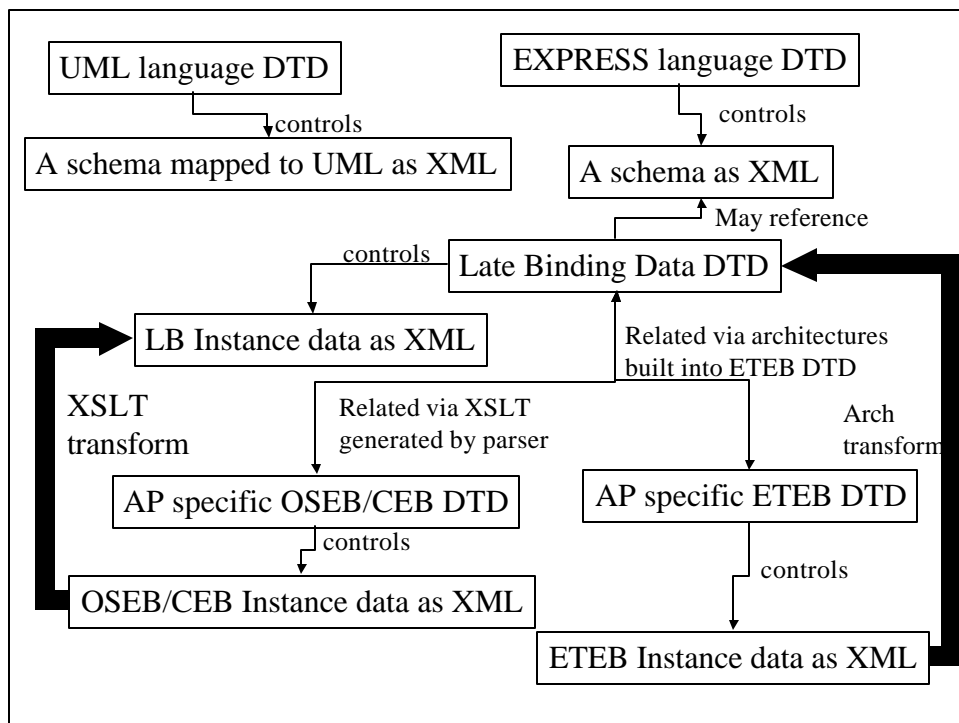
33



## Containment Early Binding

- Map subset of EXPRESS to simple XML using containment
- Human readability is considered
- Making “STEP” (I.e. APs) simple is considered
- See the OSEB diagrams as CEB fits into the architecture in the same manner

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## **STEP for the Web Recent Accomplishments**

- **Part 28 EXPRESS/XML Development Workshops**
  - February (ISO), March (PDES, Inc. offsite), April (ISO), May (joint with Nat'l. Shipbuilding Research Program), June (PDES, Inc.)
  - Significant progress in developing Part 28 Technical Specification
- **Web site for STEP/Web standardization**
  - Produced public STEPml web site
    - <http://www.stepml.org>
  - Product identification for a parts catalogue set as scope for the first schema

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## **STEP for the Web Near Term Goals**

- **Complete Part 28 EXPRESS/XML for initial ballot as a Technical Specification**
  - WG11 Convener signed off last week
- **Publish at least one STEP schema using the STEPml website**
- **Produce more functional STEP/XML demo**
  - Including use of more XML related tools

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## **STEP for the Web Challenges**

- **Keeping focus and momentum**
  - Weekly calls with team
- **Learning curve**
  - Conducting workshops
  - Using XML experts from industry

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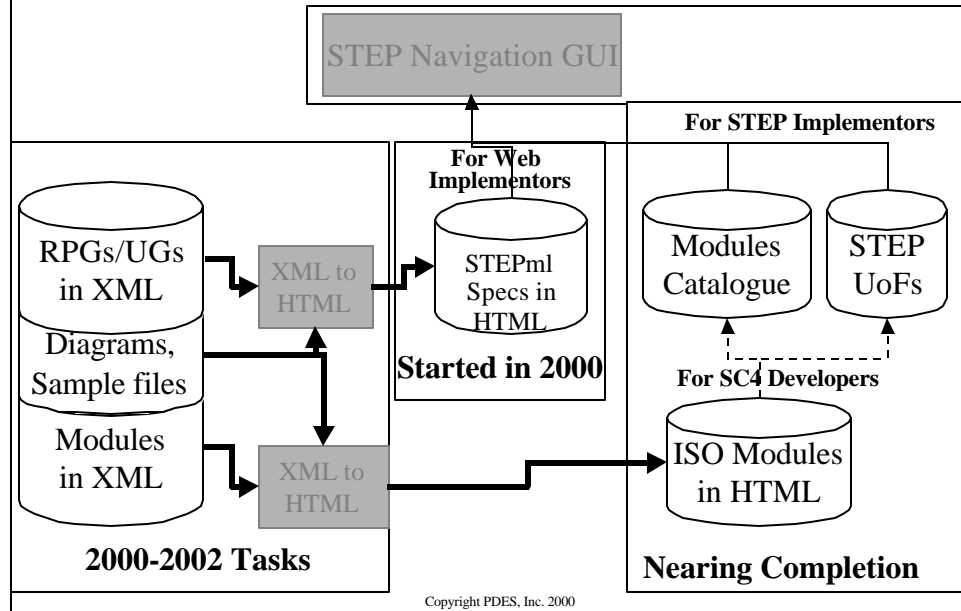


## **STEP for the Web In the Longer Term**

- **Develop an infrastructure for publishing STEP on the Web, including maintenance of STEP modular repository**
- **Publish selected STEP data models in XML form for Web implementors**
- **Complete an ISO standard for mapping EXPRESS into XML (ISO 10303-28)**
- **Provide demonstrations and proof-of-concept software**

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## STEP/Web Infrastructure Approach



## STEP and XML Activities

- PDML
  - <http://www.pdml.org/>
- STEPml
  - <http://www.stepml.org/>
- STEP Modules XML Repository Demo
  - <http://www.mel.nist.gov/apde/stepmod/demo/>
- PDMi2 EXSE
  - [http://public.prostep.de/pdmi2/app\\_exse.html](http://public.prostep.de/pdmi2/app_exse.html)
- STEP Tools CEB
  - <http://www.steptools.com/projects/xml/>
- Creating Early Bound XML representations from EXPRESS models
  - <http://www.cs.man.ac.uk/ugrad/projects/info.html#A28>
- Developing an XML representation to be used in the Construction Industry
  - <http://www.cs.man.ac.uk/ugrad/projects/info.html#A30>

## STEP and XML Activities...

- Related efforts
  - aecXML
  - <http://www.aecxml.org/technical/index.htm>
  - SWEDCALs
  - <http://info.admin.kth.se/SGML/Bibliotek/Litteratur/whitep/wp.html>
  - KNOW
  - <http://www.stepcom.ncl.ac.uk/intrch/newsletters/pdf/nlet20.pdf>
- There are undoubtedly others...

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## EMSA STEP Shipbuilding Activities

Uwe Langbecker  
Germanischer Lloyd

PROVIDED SEPARATELY



## CAX and PDM IF Testing

Dr. Rogerio Barra  
PDES, Inc.

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## Vendor Translator Information

- Information on the latest releases of vendors STEP translators can be found at:
  - <http://pdesinc.aticorp.org/vendor.html>
- CAD Best practice information can be found at:
  - <http://www.cax-if.org/bestprac/practice.html>
  - <http://public.prostep.de/BP/>



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# CAX - IF



Dr. Rogerio Barra  
CAX Implementor Forum

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WWW: <http://www.cax-if.de/>  
<http://www.cax-if.org/>

## CAX-IF

### Round 4J Scope (ended in July)

- External References (joint with PDM-IF)
- Geometric Validation Properties
- Surfaces
  - *Geometrically bounded*
  - *Topologically bounded*
- Draughting
  - *Views*
  - *Dimensions*
- Production Models



## CAX-IF

### Who did what in Round 4J?

Vendor	Ext. Ref.	Prod. Models	Val. Props	Surf. Model	Drafting
Spatial		x		x	
MDT		x	x	x	
Inventor		x			
Bentley		x	x	x	
CATIA		x		x	
I-DEAS	x	x		x	
PTC	x	x	x	x	x
STI	l	l	l	l	
Theorem-CADDS	x	x	l	x	x
Theorem-UG	x	x	x	x	x
Alias	l	x	l	l	
UG		x	x	x	
debis	x	x		x	x
Matra	x	x	x	x	
ISD CAD	x	x		x	x
Alibre		x	l	x	x

#### Legend of Terms

x -- Participation / l -- Import only / E -- Export only/Red - Signed up, didn't do



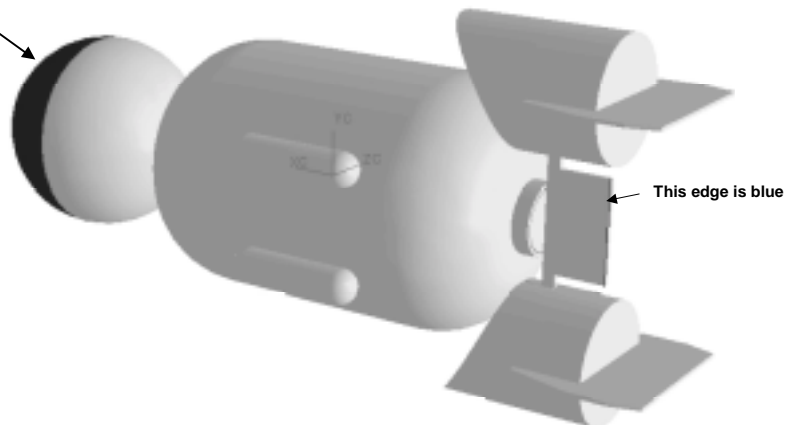
3



## CAX-IF

### Geometric Validation Properties and 3D Text Annotation Test Case

Outer face of Head\_Front is coloured red

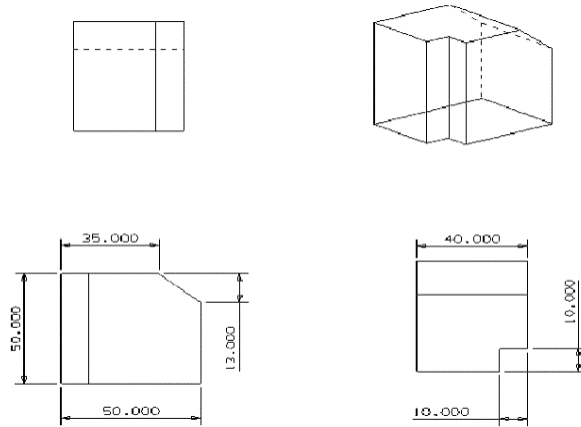


4



## CAX-IF

### Draughting Test Case

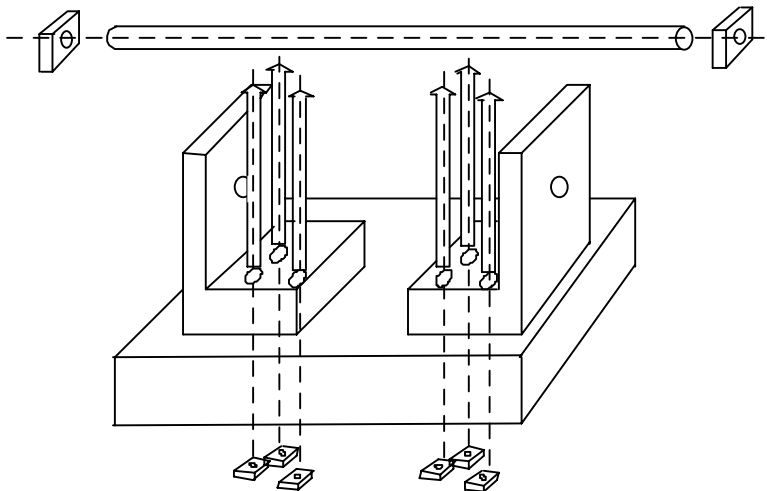


5



## CAX-IF

### Solid Assembly for External References Test Case



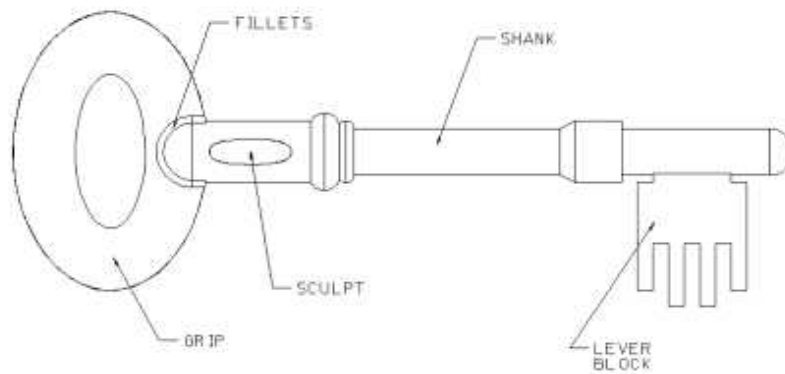
6





## CAX-IF

### Surface Model Test Case

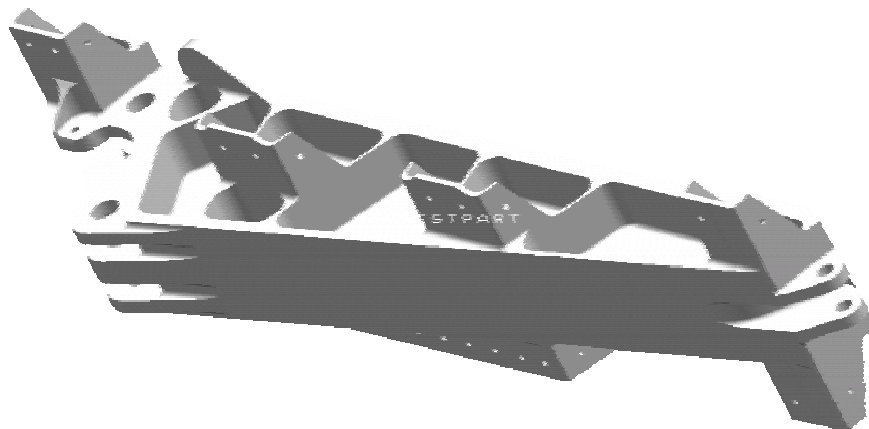


7



## CAX-IF

### Production Test Case CATIA -- from Lockheed Martin

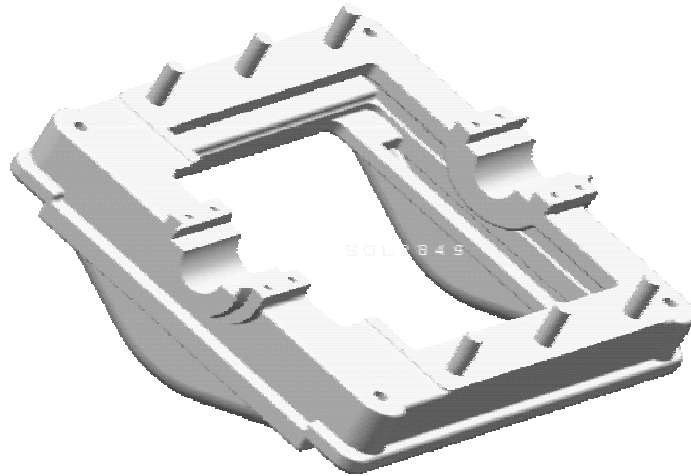


8



## CAX-IF

### Production Test Case CATIA -- from Electric Boat

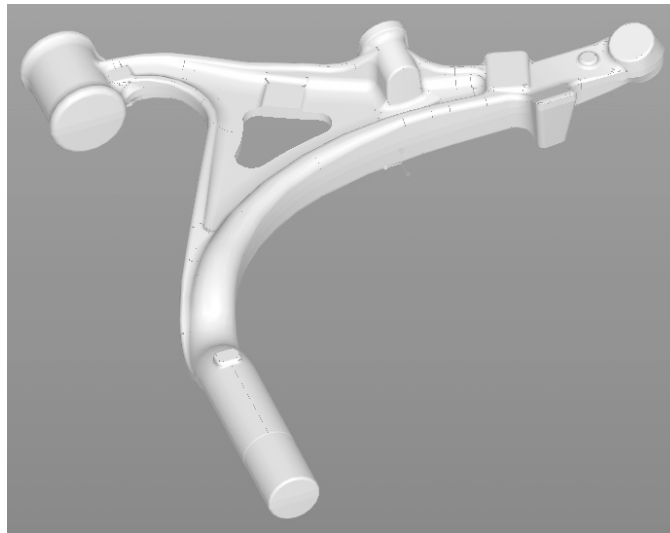


9



## CAX-IF

### Production Test Case ProE (Suspension Arm) -- from Peddinghaus

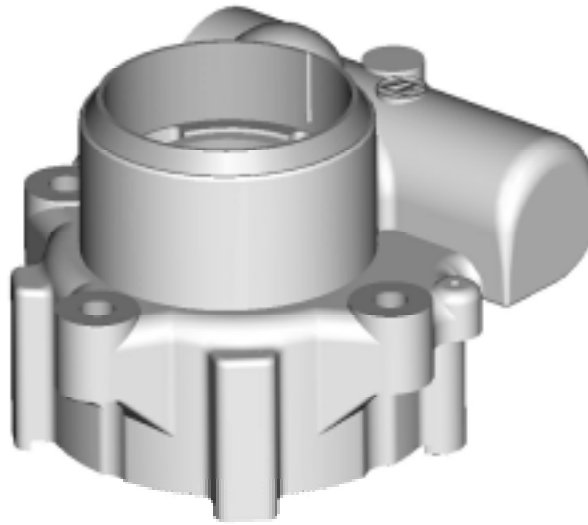


10



## CAX-IF

### Production Test Case Pro/E -- from ZF

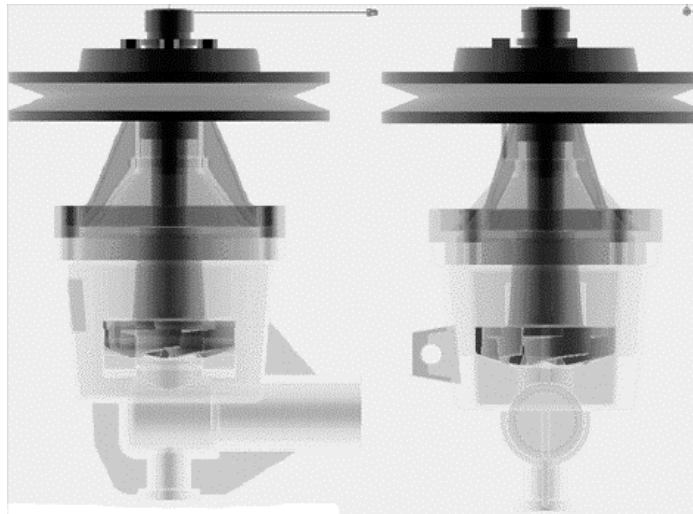


11



## CAX-IF

### Production Test Case CASCADE (Pump Rotor) -- from Matra

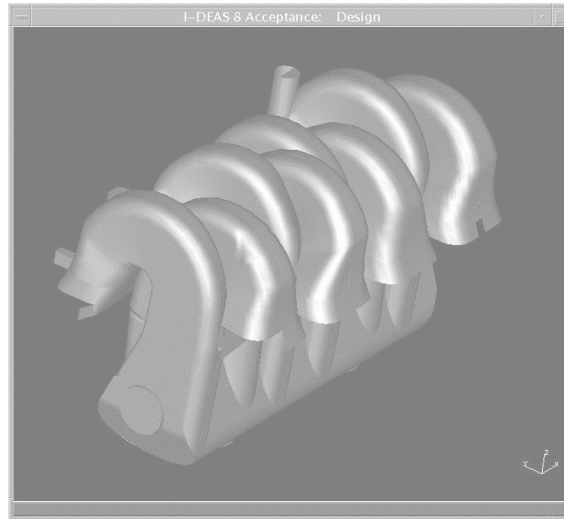


12



## CAX-IF

### Production Test Case I-DEAS (Manifold) -- from Ford



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## CAX-IF

### Production Test Case Inventor (Mountain Bike) -- from AutoDesk

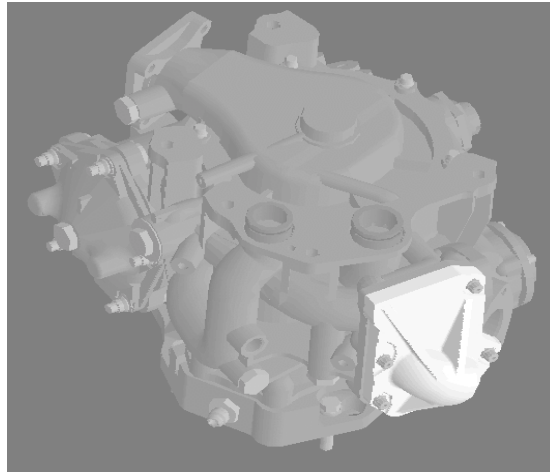


14



## CAX-IF

### Production Test Case UGSolutions/UG -- from P&W Compressor Assembly

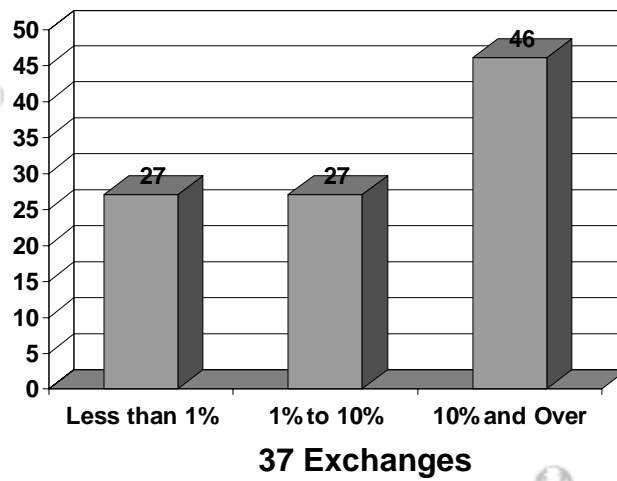
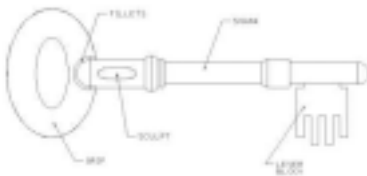


15



## CAX-IF

### Results for Geometrically Bounded Surface Model

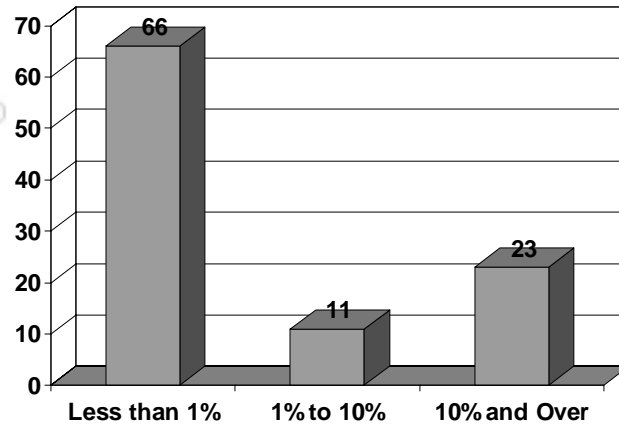
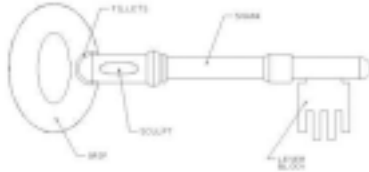


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## CAX-IF

### Results for Topologically Bounded Surface Model



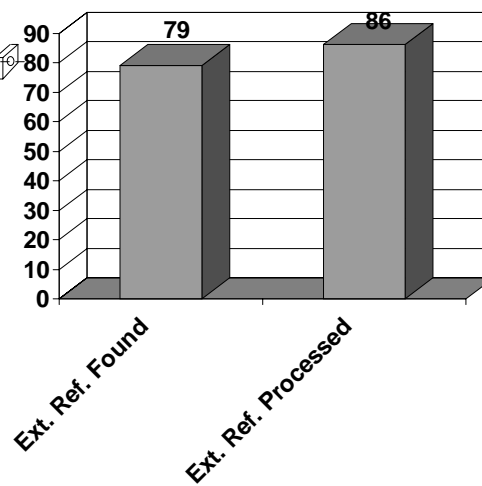
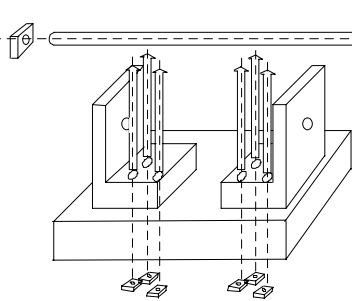
79 Exchanges

17



## CAX-IF

### Results for External References



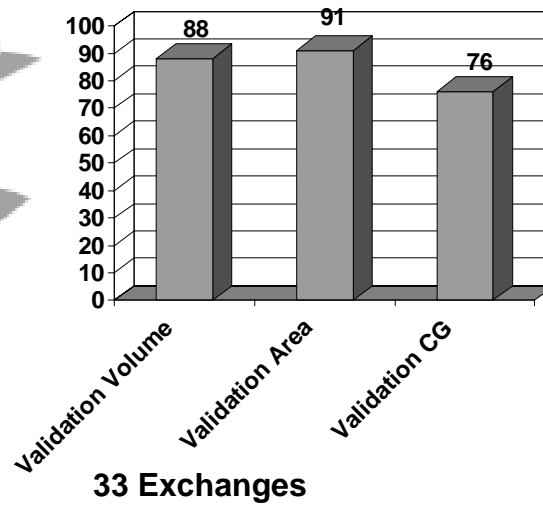
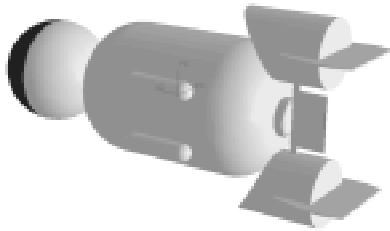
29 Exchanges

18



## CAX-IF

### Results for Validation Properties

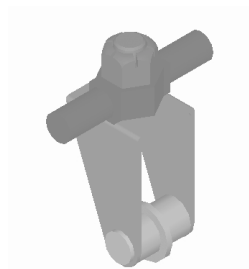


19

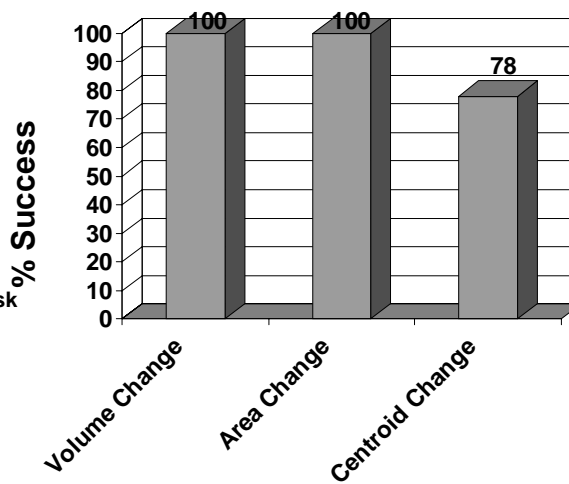


## CAX-IF

### Results for Production Model



From AutoCAD/Autodesk

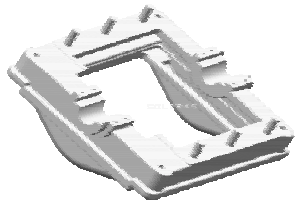


20

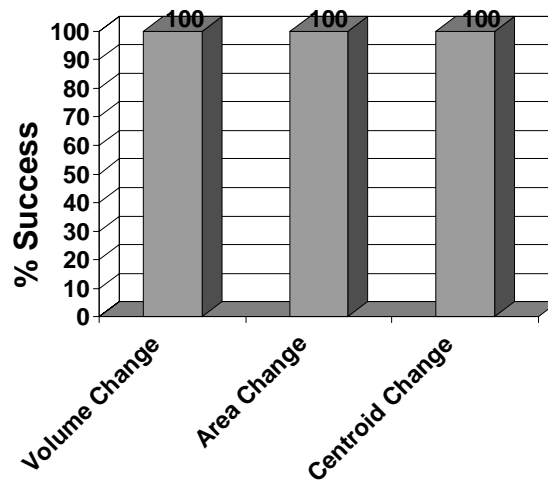


## CAX-IF

### Results for Production Model



From CATIA/Electric Boat

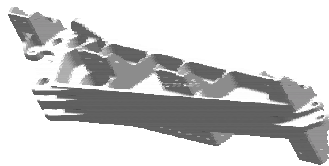


21

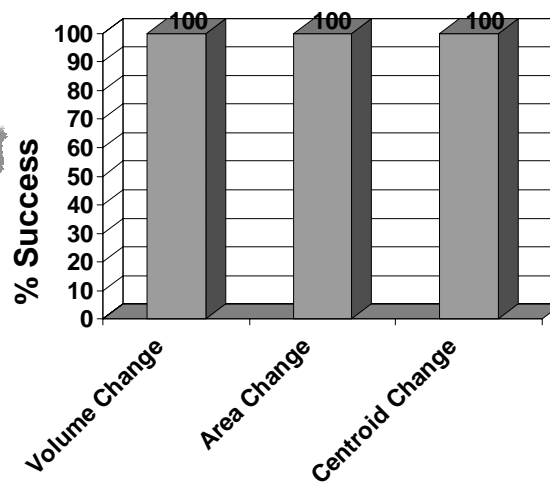


## CAX-IF

### Results for Production Model



From CATIA/Lockheed Martin



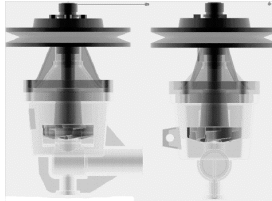
22



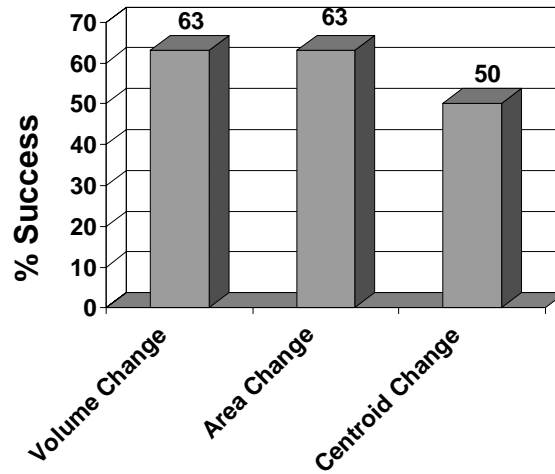


## CAX-IF

### Results for Production Model



From CASCADE/Matra

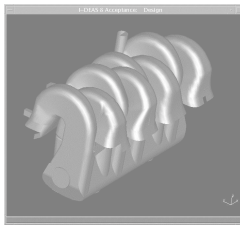


23

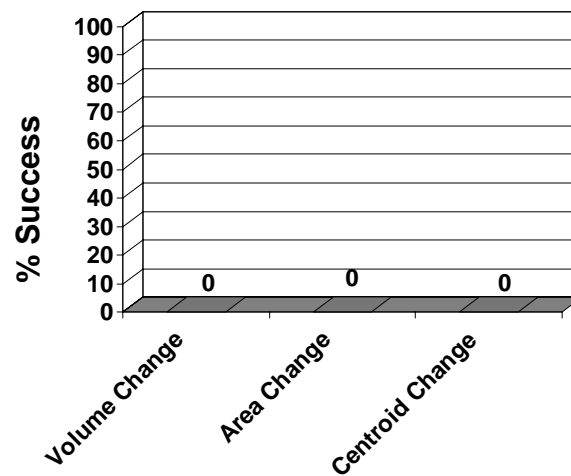


## CAX-IF

### Results for Production Model



From IDEAS/Ford



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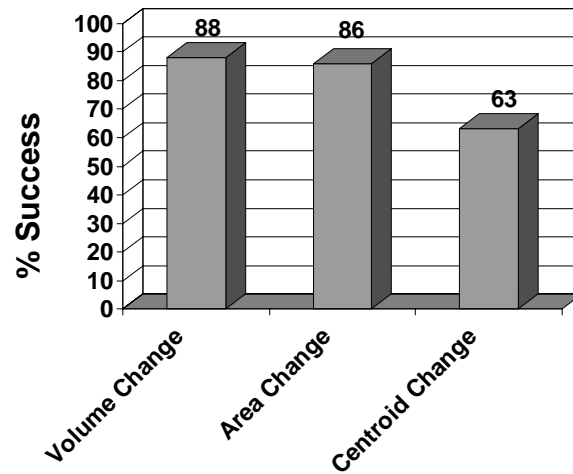


## CAX-IF

### Results for Production Model



From Inventor/Autodesk

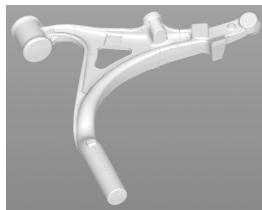


25

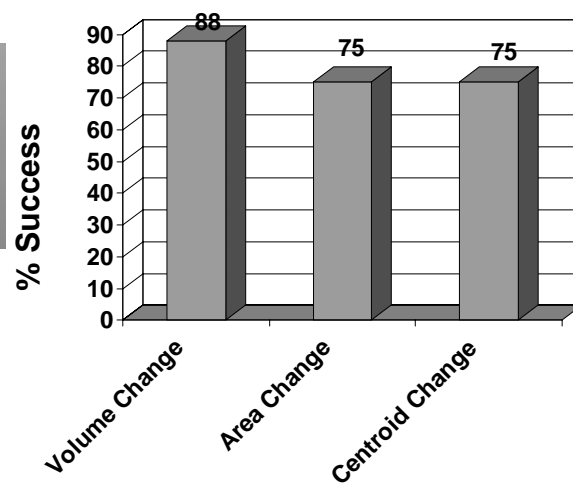


## CAX-IF

### Results for Production Model



From Pro/E/Peddinghaus

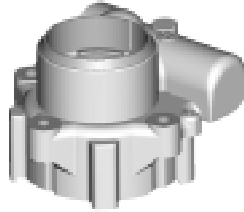


26

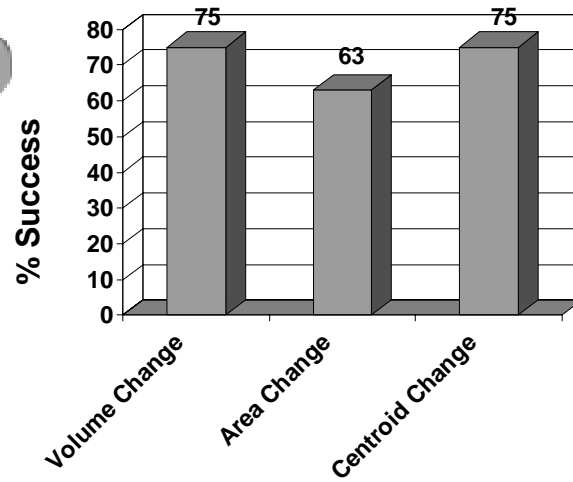


## CAX-IF

### Results for Production Model



From Pro/E/ZF

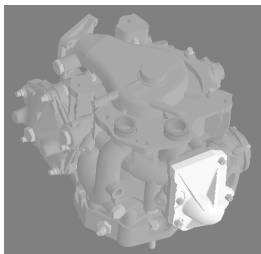


27

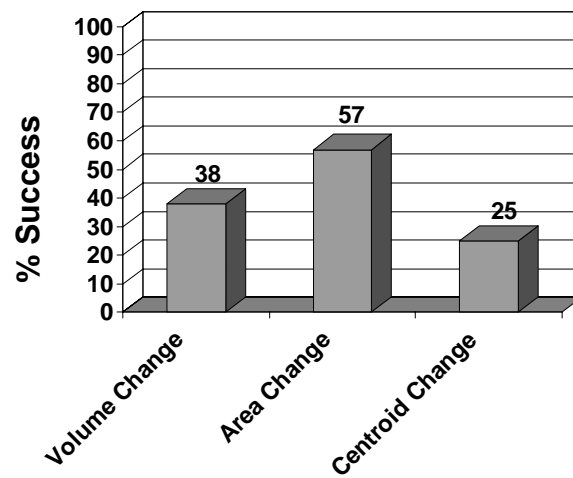


## CAX-IF

### Results for Production Model



From UG/Pratt & Whitney



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## CAX-IF

### Production Model Testing

- **Keep re-testing problematic models to work on improvement**
  - *Check model quality and analyze problems*
  - *Sound explanation for failures is needed*
  - *CAD versioning influences transfer results*



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## CAX-IF

### Round 4J Summary: Validation Properties and Text

- **Geometric Validation Properties ready for prime time now!**
  - *Post-processor shall compute deviation of Geometric Validation Properties and show in a log file*
  - *Usage of capability left to user/business process*
- **Significant increase in robustness of geometry transfer**
- **Lack of interest/implementation for associative text?**
  - *No successful exchange this time (out of one)*



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## CAX-IF

### Round 4J Summary: Draughting

- Where is the pace going?
- Is there any pace?
- What are the problems:
  - *Poor coverage/participation of draughting experts in meetings?*
- View placement issue almost solved



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## CAX-IF

### Round 4J Summary: Surface Models

- Topologically bounded variant has much better results than geometrically bounded model - reasonable
- Results for topologically bounded surface model improved compared to round 2J
- High degree of failures - for K1\_Geo approximately 25%
- Recommendation: do not use the geometrically-bounded capability



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## CAX-IF

### Round 4J Summary: External References

- **Excellent results**
  - *Correct structure and geometry processing*
- **Future directions**
  - *Handling of incomplete assemblies (net change)*
  - *How about the PDM Schema and any types of CAD data?*
- **Significant problem with one processor**
  - *Issues identified, will be solved by vendor*



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## CAX-IF

### Round 5J Scope (ends December)

- **Associative text - Spaceship**
- **Drafting - add angular\_dimension, title block**
- **Colors / Layers (each vendor provides own model w screenshot and layer list)**
- **Validation Properties - Spaceship**
- **External References - Spaceship -- document properties (format)**
- **Surface model, topologically bounded only - Key**
- **Production models**



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## CAX-IF Who's going to do what in Round 5J?

Vendor	External Ref.	Production Models	Validation Property	Surface Model	Drafting	Assoc. Text	Colors Layers
Spatial							
MDT		X	X	I		X	X
Inventor		X					C
Bentley		X	X	X		?	?
CATIA	?	X		X			
I-DEAS	X	X	X	X		?	X
PTC	X	X	X	X	X	X	X
STI	I	I	I	I			C
Theorem-CADDS	X	X	X	X		X	X
Theorem-UG	X	X	X	X		X	X
Alias		I	X				
UG		X		X			
debis	X	X		X	X		
Matra	X		X	X			
HiCAD	X	X		X	X		
Alibre		X	X				?

### Legend of Terms

x -- Participation / I -- Import only / E -- Export only / C - Colors



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## CAX-IF Production Model -- Differential From AutoDesk Inventor

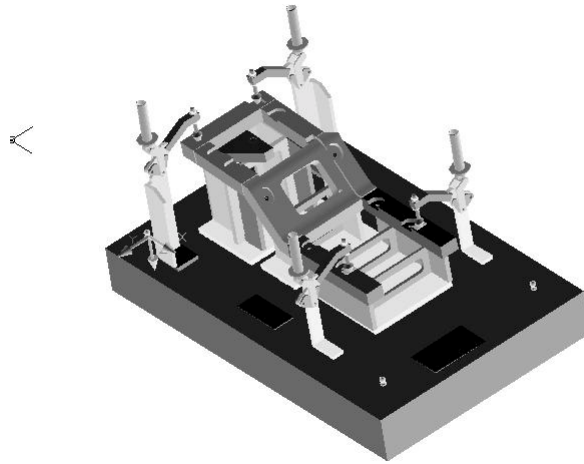


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**CAX-IF**

**Production Model -- Fixture  
From AutoDesk Mechanical Desktop**



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**CAX-IF**

**Production Model -- Rear Engine  
Mount Beam  
From P&W/UGS**



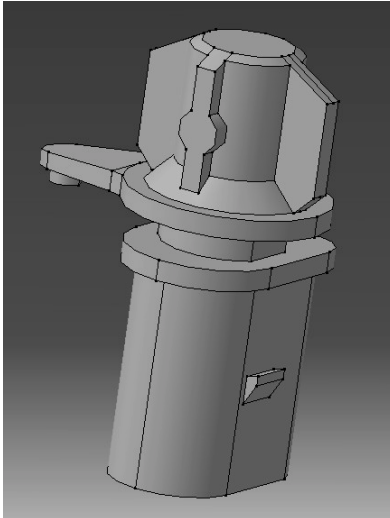
38





**CAX-IF**

## **Production Model -- Torsion Protector From ProSTEP/debis**

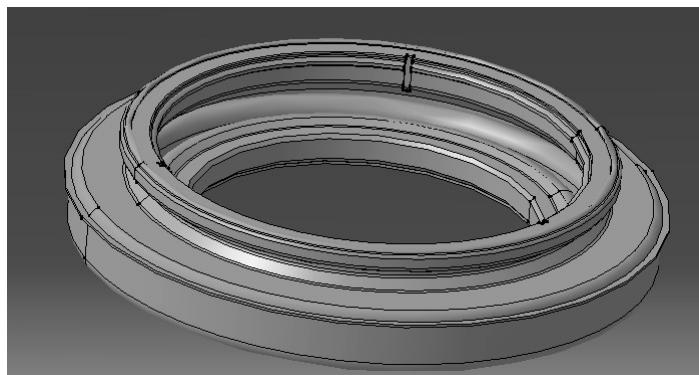


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**CAX-IF**

## **Production Model -- Gasket Ring From ProSTEP/Dassault**

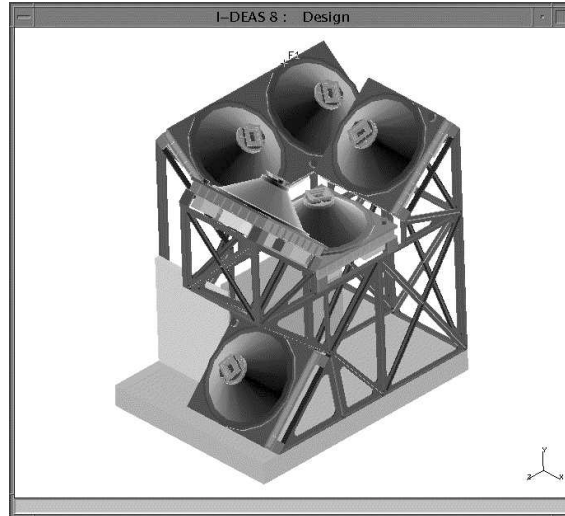


40



## CAX-IF

### Production Model -- Receiver?? From NASA/Ideas



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## CAX-IF

### Production Model -- Transmission Control Unit Casing From ZF/Pro/E



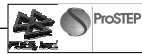
42



## CAX-IF

### Round 6J+

- **Candidates**
  - *Tolerances*
  - *Construction history/parametrics*
  - *Draughting*

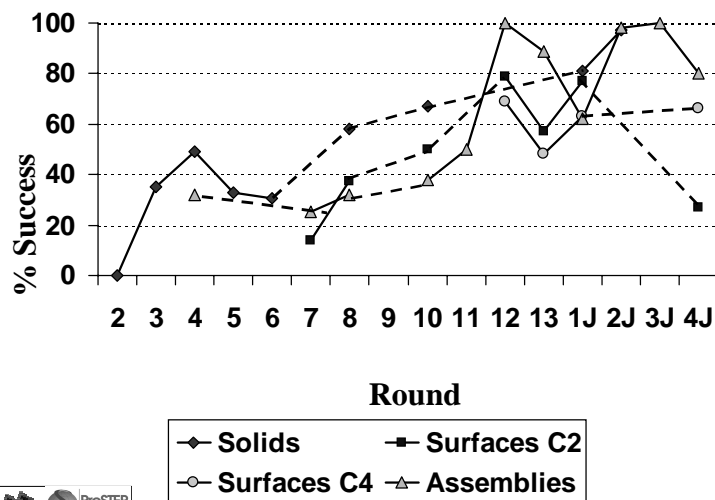


43



## CAX-IF

### STEPnet/CAX-IF Testing Results Summary



Please note:

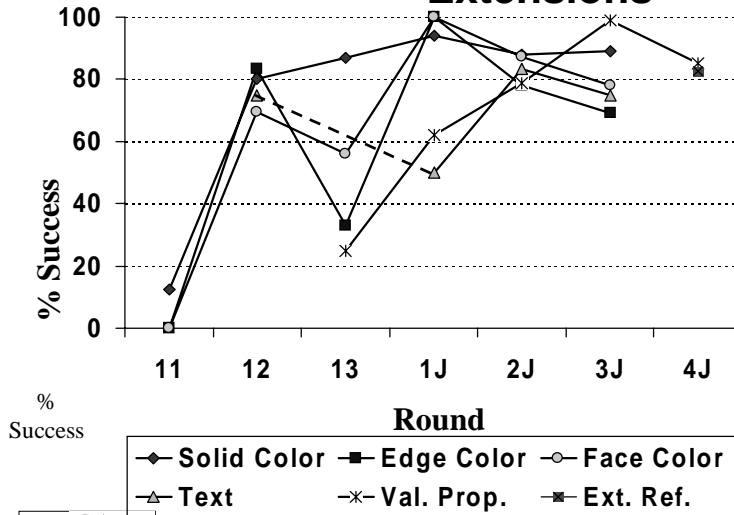
- Statistics do not take into account model complexity, which may vary from round to round
- Statistics reflect the "state" of the group of CAX vendors, the participants of which change over time
- Dotted lines signify interpolation where data is unavailable



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# CAX-IF STEPnet/CAX-IF Testing Results Summary -- Extensions



Please note:

- Statistics do not take into account model complexity, which may vary from round to round
- Statistics reflect the "state" of the group of CAX vendors, the participants of which change over time
- Dotted lines signify interpolation where data is unavailable



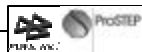
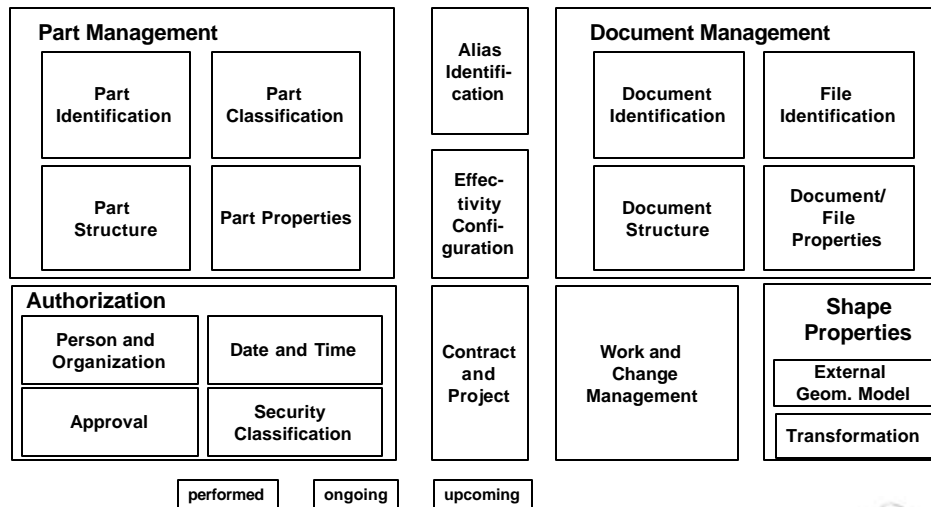
# PDM-IF



Dr. Rogerio Barra  
PDM Implementor Forum

E-Mail: Barra@aticorp.org  
WWW: <http://www.cax-if.de/>  
<http://www.cax-if.org/>

## PDM-IF Scope of the STEP PDM Schema and Test Campaigns (Status: Sept. 2000)



## **PDM-IF**

### **Round 4C Participants (ended July)**

- **BMW PRISMA 4.7\_3**
- **DaimlerChrysler/debis - GIS V1100.8**
- **Eigner & Partner/CADIM/EDB V2.3**
- **ISS/InSync V2.7.5**
- **ProSTEP (PDM Editor V0.9)**
- **SAP 4.6C**



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## **PDM-IF**

### **Round 4C Scope**

- **Supplied Item Identification -- Alias Relationship -- AR1**
- **Document and File Relationship -- DR1**
- **Part Structure with External References -- ER1**
- **Part Structure with External Shape, Geometric Model Structure and CAD File Reference -- ER2**



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## PDM-IF Activity by participant (totals across all test cases)

participant counts	pre-processing export	post-processing import					
Participant		bw	db	ep	is	ps	sp
bw - BMW	1						
db - Debis	2		2		2		1
ep - Eigner & Partner	2		2		2		2
is - ISS							
ps - ProSTEP	4		3		3		2
sp - SAP	2		2		2		2
synthetic test case	4	1	4		4	4	2
<b>total</b>	<b>15</b>	<b>1</b>	<b>13</b>		<b>13</b>	<b>4</b>	<b>9</b>

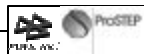


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## PDM-IF Activity by test case (totals across all participants)

test case counts	pre-processing export	post-processing import					
Test Case		bw	db	ep	is	ps	sp
ar1	4	1	4		4	1	4
dr1	6		5		5	1	5
er1	2		1		1	1	
er2	3		3		3	1	
<b>total</b>	<b>15</b>	<b>1</b>	<b>13</b>		<b>13</b>	<b>4</b>	<b>9</b>

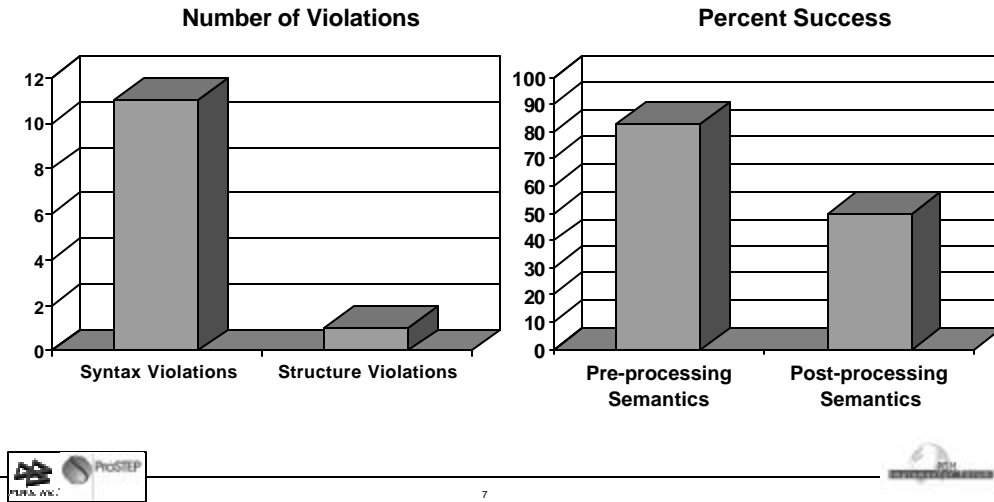


6



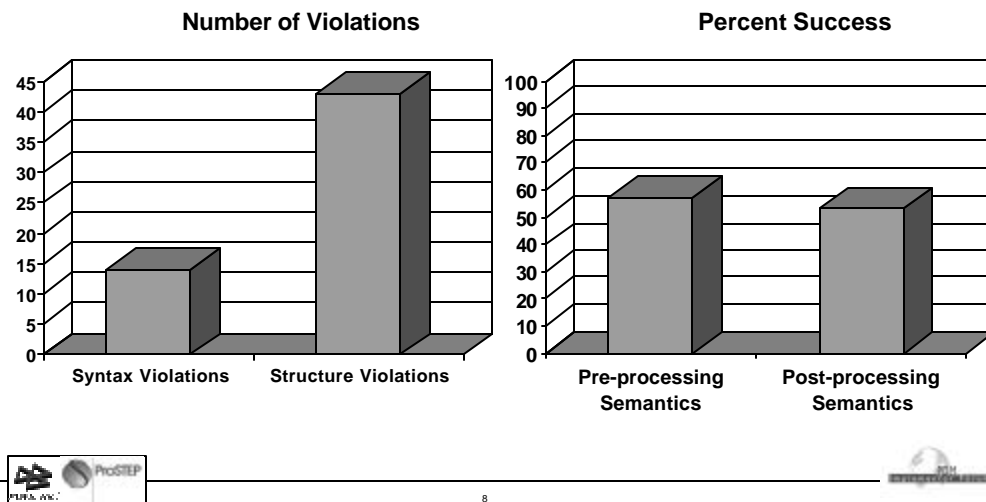
## PDM-IF

### Results Supplied Item Identification -- Alias Relationship



## PDM-IF

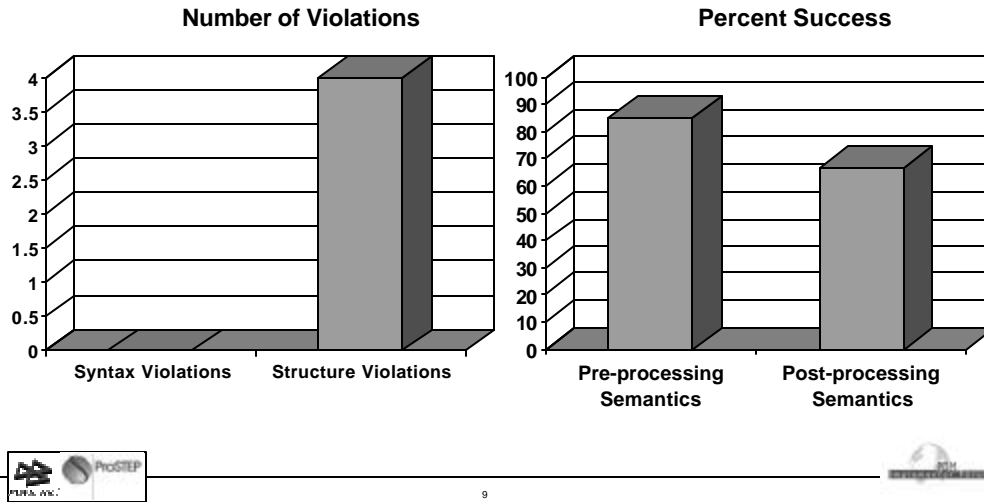
### Results Document and File Relationship





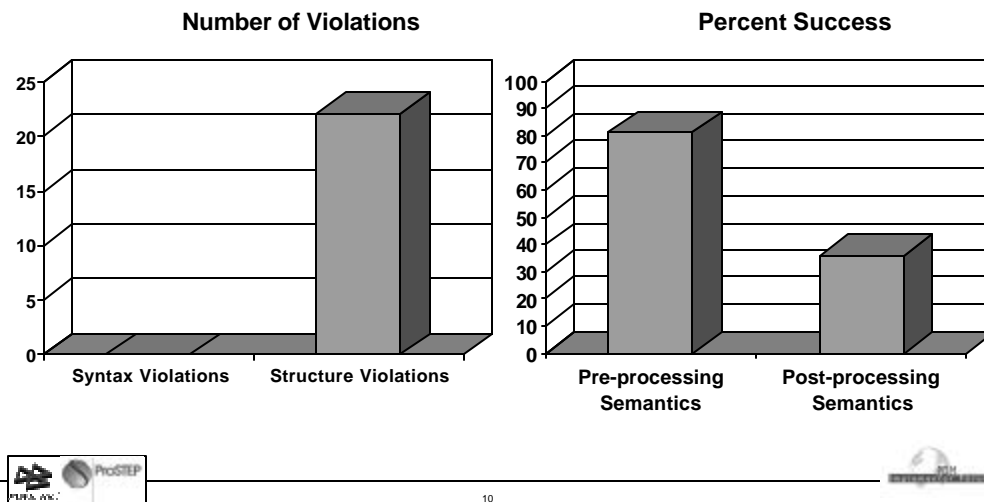
## PDM-IF

### Results Part Structure with External References



## PDM-IF

### Results Part Structure with External Shape, Geometric Model Structure and CAD File Reference



## **PDM-IF Summary of Round 4C**

- **External Reference testing with CAx-IF -- excellent results**
- **Participation could be better**
- **Discussion underway over the future of PDM-IF**



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## **PDM-IF Scope of the 5th Test Campaign** (ends December 2000)

- **Additional part properties (e.g., material, general)**
- **External References - document properties (format)**
- **Several item structure relationships (e.g., make\_from, alternate, substitute)**
- **Security classification**
- **Robust testing**



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## PDM-IF Implementation of STEP PDM Schema 1.1

Functional Sections	Test Campaigns				
	Sept. '99	Dec. '99	March '00	July '00	Dec. '00
Part Identification	✓				
Part Classification		✓			
Part Properties		S			
Part Structure and Relationships		✓			
Shape Properties				✓	
Document Identification			✓		
Document Classification					?
Document Properties			✓		
Document Structure and Relationships				✓	
External Files	✓				
Document and File Association to Product Data	✓				
Alias Identification				✓	
Authorization	✓				
Configuration and Effectivity Information			S		
Engineering Change and Work Management			✓		



S = initial

✓ = most constructs

completing

? = not decided



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## PDM-IF

### Back-up Slides



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## PDM-IF PDM Implementor Forum Contacts

Implementor	System	Status	Contact
BAE SYSTEMS	ENOVIApm	Prototype	Trisha Rollo
BMW	PRISMA	Prototype	Angelika Tischer
Contact Software	CIMDatabase	Prototype	Dr. Roland Drewinski
Daimler Chrysler/debis	GIS	Released	Helmut Kockelke
DASA M	Metaphase	Prototype	Joseph Vilsmeier
debis Systemhaus	CATIA	Prototype	Hans-Joachim Hospach
Eigner & Partner	CADIM/EDB	Commercial	Martin Boehm
ENOVIA/Dassault Systemes/IBM	VPM	Prototype	Olivier Clop
ISS	InSync	Prototype	Chuck Riehm
Matrix One	Matrix	Planned	Klaus Bruchhagen
Metaphase/SDRC	Metaphase	Commercial	Duane Silkworth
NASA	NED	Prototype	Steve Waterbury
ProSTEP	PDM Editor	Prototype	Dr. Mario Leber
PTC	Windchill	Prototype	Dr. Erik Rieger
Raytheon	Sherpa	Prototype	Ken Buchanan
SAP	R3 PLM	Prototype	Bernhard Iselborn
UG Solutions	IMAN	Prototype	Mitch Silverman
VW	KVS	Prototype	Dr. Hubert Sieverding

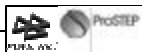


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## PDM-IF Members of the Joint PDES, Inc./ProSTEP PDM Implementor Forum (Status: Sept., 2000)

Company	System	Status	Company	System	Status
BMW	Prisma	In pilots used	NASA	NED	Prototype
Contact Software	CIM Database	Prototype tested	PTC	Windchill	Prototype tested
Daimler Chrysler	GIS	Released	Raytheon	Sherpa	Prototype tested
Debis Systemhaus	CATIA	Prototype	SAP	R3 PLM	Prototype tested
Eigner + Partner	CADIM/EDB	Commercially available	SDRC / Metaphase	Metaphase	Commercially available
Enovia/Dassault/IBM	ENOVIApm	Prototype tested	Unigraphics Solutions	IMAN	Prototype tested
Eurofighter	Metaphase Enovia/om	In pilots used	VW	KVS	In pilots used
ISS	Insync	In pilots used	ProSTEP	PDM Editor*	In pilots used
Matrix One	Matrix	Planned			



Commercial PDM Systems

\* PDM STEP file viewer/editor

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## AP 203 Certified Translators

- As of February 4, 2000, 4 CAD vendors had passed certification for ISO 10303-203 CC6a
- These are:
  - AutoCAD Mechanical Desktop Version 4
  - CATIA 4.2.2
  - Theorem Solutions CADD5 5
  - Unigraphics V16
  - SolidWorks 2000
- Contact the vendors or USPro for additional details



"STEP Certified" and the STEP Certified Logo are trademarks of the US Product Data Association (USPro)

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## Open Discussion

## Backups

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## Issues

- **Summary- 45 Issues - 4 Open**
- **Issue: 001 Scope**
  - Closed, SEDS
- **Issue: 002 Scope**
  - Closed, SEDS
- **Issue: 003 Integers**
  - Closed, SEDS
- **Issue: 004 ARM vs AIM**
  - Open
- **Issue: 005 Vertex Loop**
  - Closed. Resolved
- **Issue: 006 Conformance Classes**
  - A-Closed,B- Closed,C- Closed, D-SEDS,E-Closed,F-SEDS

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## Issues...

- **Issue: 007 Model Tolerance**
  - Closed. Being worked by the Accuracy Team
- **Issue: 008 Cooperative Use of APs**
  - Closed-Forwarded to WG10
- **Issue: 009 External Mappings**
  - Closed. Unpersuasive.
- **Issue: 010 Property Definition**
  - Closed. Unpersuasive.
- **Issue: 011 Uncertainties and Context**
  - Closed. Worked by Accuracy Team
- **Issue: 012 Model degradation**
  - Closed. Withdrawn.

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## Issues...

- **Issue: 013 Bounded Surfaces**
  - Closed, Accepted
- **Issue: 014 Mapping Documentation**
  - Closed. Unpersuasive.
- **Issue: 015 Processor Documentation**
  - Closed, Accepted
- **Issue: 016 Polyline**
  - Open
- **Issue: 017 Circular Arc**
  - Closed. Accepted.
- **Issue: 018 Surface Intersections**
  - Closed. Accepted

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## Issues...

- **Issue: 019 Scope**
  - Closed, SEDS
- **Issue: 020 Layers and Groups**
  - Closed. Withdrawn
- **Issue: 021 Implementors Agreement**
  - Closed. Accepted
- **Issue: 022 Units**
  - Closed. Will use accuracy team recommendation.
- **Issue: 023 Sphere Topology**
  - Closed. Accepted
- **Issue: 024 Part 21**
  - Closed. Accepted.

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## Issues...

- **Issue: 025 Angular Units**
  - Closed. Accepted
- **Issue: 026 Part 21 and Schemas**
  - Closed, SEDS
- **Issue: 027 Pcurve in Class 2**
  - Closed. AP 203 to use latest AICs
- **Issue: 028 Processor Usage**
  - Open
- **Issue: 029 Annotation**
  - Closed, SEDS
- **Issue: 030 Complex Instances**
  - Closed, SEDS

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## Issues...

- **Issue: 031 Implicit ANDOR**
  - Closed. SEDS
- **Issue: 032 Advanced BREP**
  - Closed. SEDS
- **Issue: 033 SDAI Iteration**
  - Closed, SEDS
- **Issue: 034 Non-manifold Solids**
  - Closed. Unpersuasive.
- **Issue: 035 Weight Unit**
  - Closed, Submit SEDS if needed.
- **Issue: 036 AP Identities**
  - Open
- **Issue: 037 Schema Identification**
  - Closed, SEDS

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## Issues...

- **Issue: 038 Symmetrical Parts**
  - Closed, Accepted
- **Issue: 039 Best Translation Practices**
  - Closed. Done by others.
- **Issue: 040 EXPRESS Precision**
  - Closed, SEDS
- **Issue: 041 Defining New Conformance Class**
  - Closed, Can be done by TC/Ammendment/New edition
- **Issue: 042 Use of Surface Entities**
  - Closed. Combine with #41.
- **Issue: 043 Use of Kanji in Part 21**
  - Closed. Being Worked by WG11.

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## Issues...

- **Issue: 044 Solid Model Construction History**
  - Open- Big Issue
- **Issue: 045 STEP File Meta Data**
  - Open- More appropriate in Quality Committee
- **Issue: 046 STEP and XML**
  - Open- Big Issue
- **Issue: 047 Need for New Chair**
  - Open- Have nominee- Should be closed by Friday

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## Formalization of the International Industry STEP Centers Organization

- **ISC Concept**
  - Formalize the STEP Centers so that they can develop and promote Advanced Industry Standards within ISO SC4
  - Work toward a fast track process so that Advanced Industry Standards can go straight to DIS/FDIS ballot cycles
  - Form a group similar to the Object Management Group (OMG) that can submit standards directly to SC4 for fast tracking
- **Concept in early discussion stage among STEP Centers**

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## **Geometric Accuracy**

## **Geometric Accuracy**

---

STEP for shape is in production!

Exchange of solids has proven to be as good as direct translators

Must use the latest translators and must have good models

Exchange rates over 90% (reported at 93-97%)

Accuracy problems minimal at present and either require model fixes or CAD kernel fixes

Users should look to system model checking process or third party model checker to validate shape

This is the first BIG issue to be subdued!!!!

## Geometric Accuracy Example



- The following example is provided to give additional background on the nature of the problems encountered in the representation and exchange of Boundary Representation (B-rep) solid models.
- Figure 1 shows an “idealized” solid model. Vertex A “is” the intersection of edge curves e1, e4, and e5 and edge curve e1 “is” the intersection of face surfaces F1 and F2.

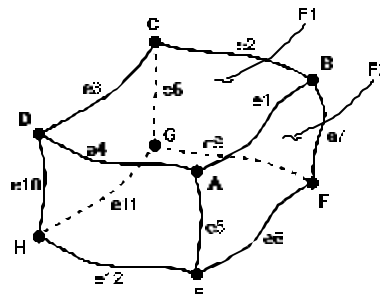


Figure 1. “Idealized” Solid

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## Geometric Accuracy Example (Cont'd)



- Operations and algorithms are used to create solids resulting in vertices that may not lie exactly on edge curves and edge curves that may not lie exactly on surface intersections. The “actual” or “real” solid may have gaps, etc as in Figure 2.
- Scenario: CAD-X creates the valid solid in Figure 2 using a tolerance of .003mm to determine if vertices are on edge curves. Topology structures would state A and B are start and end vertices of edge curve e1, B and C are start and end vertices of e2, etc. Edge curve e1 forms the boundary of F1 and F2, etc.

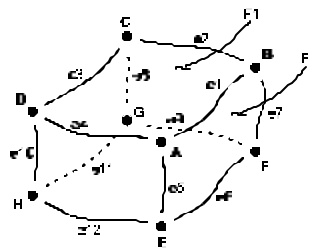


Figure 2. “Actual” Solid

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## Geometric Accuracy Example (Cont'd)



- Since CAD-X used a .003mm tolerance criteria for determining if a vertex is on an edge curve, a sphere of radius .003mm centered at A will contain “end segments” of e1, e4, and e5 as in Figure 3. Thus, A is on e1, e4, and e5 in CAD-X.
- A STEP file is created containing the geometry and topology structures to define the solid. The STEP file is translated into CAD-Y which uses .001mm for determining vertex/edge curve relations. Now, a sphere centered at A of radius .001mm in CAD-Y does not contain points on e1, e4, or e5. Thus, CAD-Y indicates vertex A does not lie on any edge curves and the solid is invalid.

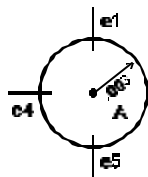


Figure 3

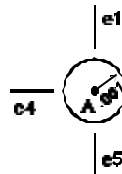


Figure 4

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## Geometric Accuracy Example (Cont'd)



- If CAD-X sends the .003 mm tolerance value (uncertainty value in STEP) in the file then CAD-Y would be alerted that it may need to perform some operations, such as reintersect the edge curves e1, e4, and e5, or associated surfaces, in order to calculate a vertex point within .001mm of the edge curves.
- The situation for edge curves that fail to be exactly on surfaces is more complex. Generally, surface-to-surface intersection algorithms require an iterative approach that converges on a solution. The 3-D points output will generally be on one surface and be within some tolerance of the other. The accuracy of that curve may be increased by increasing the density of the points output from the algorithm.

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## **Part 21 Amendment Contents**

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## **Requirements**

- P21 itself upward compatible
- Short name capability for entities, defined types And enumeration item names
  - Partially addressed by the Technical Corrigendum, need to add one sentence to P21, and APs need to start defining them.
- Remove all external mapping conformance class
- Remove scope construct
- AP conformance class in header
- Default language for file in header
- AP interoperability – multiple data sections

## P21 Upward Compatible

- Use general version identification mechanism introduced by the TC.
  - Introduce a new implementation value '3;1'
  - Note that '3;2' will not be needed since CC2 is gone.

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## Remove CC2 and Scope

- Remove/edit the specifications from the relevant document sections.
- P21 CC2 (All External Mapping)
  - Affected Clauses: 5.3, 9.2.1, 11.2.5.1
- Scope
  - Affected Clause: 10.3

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## Multiple Data Sections

- Formalizes the multiple-data section proposal first circulated last year.
  - Current single data section P21 files are still completely legal.
  - When multiple sections used, data in each is defined by a single schema (although a list is used as with file\_schema.) Each section can have a name. If used, the names must be unique.
  - References between sections legal. Type compatibility of references an EXPRESS issue, not Part 21.
  - Header file\_schema contains the complete list of schemas used by the file.

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## Multiple Sections - Extension Schema

```
ISO-10303-21;
HEADER;
/* some header entities omitted */
FILE_SCHEMA (('CONFIG_CONTROL_DESIGN', 'EXTENSIONS'));
ENDSEC;

DATA ('AP-203 Data', ('CONFIG_CONTROL_DESIGN'));
#19=PERSON('099-111-2222', 'Jones', 'Tom', $, $, $);
#20=ORGANIZATION($, 'Foo', 'Foo Bar Inc. ');
#21=PERSON_AND_ORGANIZATION(#19, #20);
ENDSEC;

DATA ('Local Extensions', ('EXTENSIONS'));
#100=SOME_EXTENSION_ENTITY (#19, #21);
ENDSEC;
ISO-10303-21;
```

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## Multiple Sections - One Schema

```
ISO-10303-21;
HEADER;
/* some header entities omitted */
FILE_SCHEMA (('CONFIG_CONTROL_DESIGN'));
ENDSEC;

DATA ('People', ('CONFIG_CONTROL_DESIGN'));
#19=PERSON('099-111-2222','Jones','Tom',,$,$,$);
ENDSEC;

DATA ('Organizations', ('CONFIG_CONTROL_DESIGN'));
#20=ORGANIZATION($,'Foo','Foo Bar Inc. ');
ENDSEC;

DATA ('The Rest', ('CONFIG_CONTROL_DESIGN'));
#21=PERSON_AND_ORGANIZATION(#19,#20);
ENDSEC;
ISO-10303-21;
```

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## Multiple Sections - Multiple APs

```
ISO-10303-21;
HEADER;
/* some header entities omitted */
FILE_SCHEMA (('CONFIG_CONTROL_DESIGN',
              'ASSOCIATIVE_DRAUGHTING'));
ENDSEC;

DATA ('AP-203 Data', ('CONFIG_CONTROL_DESIGN'));
#19=PERSON('099-111-2222','Jones','Tom',,$,$,$);
#20=ORGANIZATION($,'Foo','Foo Bar Inc. ');
#21=PERSON_AND_ORGANIZATION(#19,#20);
ENDSEC;

DATA ('AP-202 Data', ('ASSOCIATIVE_DRAUGHTING'));
#100=PERSON_ROLE ('an AP-202 person role');
#101=DRAUGHTING_PERSON_ASSIGNMENT(#19, #101,
                                   (/* some things assigned */));
ENDSEC;
ISO-10303-21;
```

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## AP Conformance Class in Header

- Add `section_context` entity
  - Associates context strings with a section. Could contain numeric conformance class designations, or other keywords defined by the AP.
  - For multiple data sections, repeat as needed. For name is null (\$) for single, unnamed section.
  - Not mandatory, may be used if desired. If used, must appear after the standard three header entries.

```
ISO-10303-21;  
HEADER;  
FILE_DESCRIPTION(('','3;1')); /* note new impl level */  
FILE_NAME('foo','1998-02-24T16:15:31',(''),(''),'','');  
FILE_SCHEMA (('CONFIG_CONTROL_DESIGN','SOME_OTHER_AP'));  
SECTION_CONTEXT ('sect1',('1','5','6'));  
SECTION_CONTEXT ('sect2',('CC-XYZ'));  
ENDSEC;
```

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## Default Language in Header

- Add `section_language` header section entity.
  - Associates a default language with a data section.
  - Language must be identified using ISO 639 names, all uppercase as with `file_schema`.
  - For multiple data sections, repeat as needed. For name is null (\$) for single, unnamed section.
  - Not mandatory, may be used if desired. If used, must appear after the standard three header entries.

```
ISO-10303-21;  
HEADER;  
FILE_DESCRIPTION(('','3;1')); /* note new impl level */  
FILE_NAME('foo','1998-02-24T16:15:31',(''),(''),'','');  
FILE_SCHEMA (('CONFIG_CONTROL_DESIGN'));  
SECTION_LANGUAGE ('section1','DEUTCH');  
SECTION_LANGUAGE ('section2','US-ENGLISH');  
ENDSEC;
```

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## Certification Testing

### US Pro Testing Details

**US PRO**

- **Scope**
  - STEP AP203 cc1a, cc6a for initial test period
- **Initial Test Period**
  - Six months or up to six products/applications
- **Cost for initial test period \$5,000**
  - Pre and Post Processor
- **Up to two re-tests if required**
  - Cost of re-test \$2,500 per preprocessor
  - Cost of re-test \$2,500 per postprocessor
- **Common sense will prevail**
  - No re-test required for misinterpretations, typos, etc.

## Testing Process

**US PRO**

- **Sample test data available on certification web site at no cost**
  - Vendors encouraged to process sample data first
  - Test analysis not included on free site
  - STEP structure checker, other tools available on other sites
- **Official testing:**
  - Apply to US PRO for test account
  - Account established with “live data”
  - Ten business days allowed to process and submit data files
  - Results available from test lab within ten business days
  - Debriefing conference call to explain results
  - Re-test if necessary or apply for use of the mark

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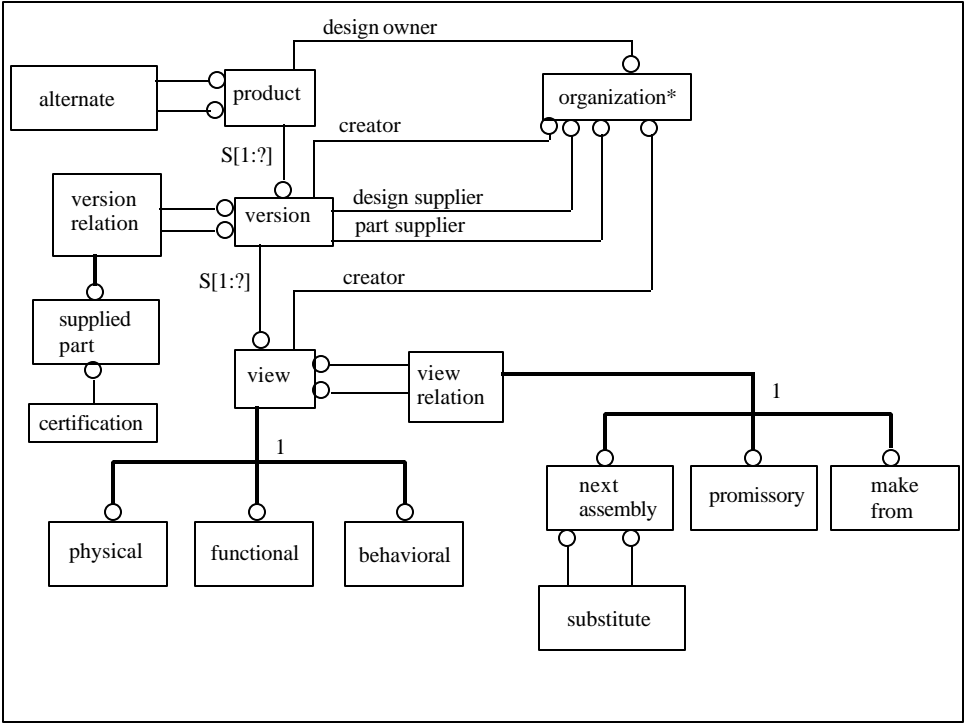
## Goset Testing Details



- **Scope**
  - STEP AP203 all classes using the French Z68-333 standard(currently)
- **International Recognition**
  - The device thus put in place for tests and the certification of interface SET and STEP AP 203 constitutes a world first.
  - The accreditation of GOSET's laboratory by the COFRAC ensures the recognition of the test reports in 16 countries.
  - Moreover, partnership agreements signed with AFNOR and its counterparts ensure an international recognition of NFTI Technical data exchange certificates

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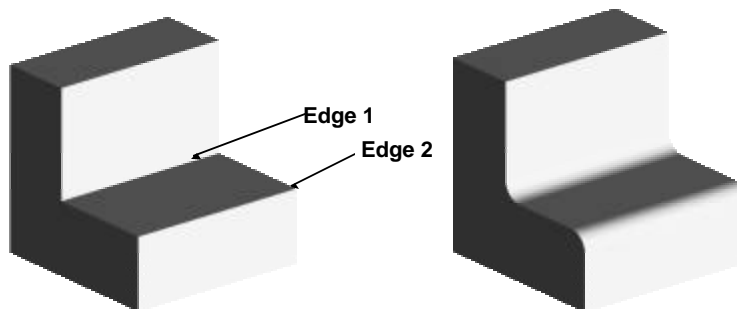


An Assembly Parts List									
ASSEMBLY NUMBER	CAGE	REVNO	DATE	EN/EO NUMBER	NOUN				
8828292-1	QQQQQ	-	940102	EN111111	BOX				
ITM	REF	DES	QTY	UM	CAGE	DWG/DOC NUMBER	PART/DOC NUMBER	*-----NOUN-----*	S P C Y L E
001			1	01	QQQQQ	2828288	2828288-1	REAR PANEL	D
002			1	01	QQQQQ	2828289	2828289-1	FRONT PANEL	A
003			2	01	USA	3800000	3800000-1	PANEL	G D
004			1	01	QQQQQ	2828290	2828290-1	BOTTOM PANEL	D
005			1	01	QQQQQ	2828291	2828291-1	ACCESS PANEL	D
005			1	01	QQQQQ	2828291	2828291-2	ACCESS PANEL	S D
006			4	01	88888	1100000	1100000-1	SCREW	V N D
006			4	01	98989	2200000	2200000-1	SCREW	V K D
					QQQQQ	6-0001-120	6-0001-120	MATERIAL BRAZING	R R
						7865000_BOX	7865000_BOX	CAD SYSTEM MODEL OF BOX ASSEMBLY	R
UNIT OF MEASURE (UM)		SYMBOL CODE (SY)		PLANNING CODE (PL)					
01= PIECE EA.		FOR GOVERNMENT		K= ALTERNATE ITEM P= BULK MATL					
11= INCH		STANDARD ITEMS:		(ALL OTHER PL CODES ARE FOR					
12= FEET		E= ELECTROSTATIC SENSITIVE		REFERENCE ONLY) EG:					
18= CUBIC FOOT		H= HEAT SENSITIVE		G= GOVT FURN ITEM J= AS REQD					
21= METER		S= SOLVENT SENSITIVE		L= DO NOT FILL N= VEND FURN					
26= MILLIMETER		M= MULTISENSITIVE		R= REFERENCE Z= DUMMY CONN.					
31= OUNCE(AVDP)		FOR OTHER ITEMS:		X= DO NOT GENERATE S= SUBSTITUTE					
35= OUNCE(TROY)		V,E,H,S,M= VENDOR ITEM- SEE							
41= GRAM		CONTROL DRAWING		CHARACTER CODE (CH)					
44= CUBIC CENTIMETER		E,H,S,M= ALSO INDICATES PROCESS		A= WITH PARTS LIST					
59= FLUID OUNCE		SENSITIVITY AS		D= WITHOUT PARTS LIST					
66= CUBIC INCH		INDICATED ABOVE.		R= FACTORY REFERENCE					

## An Application List

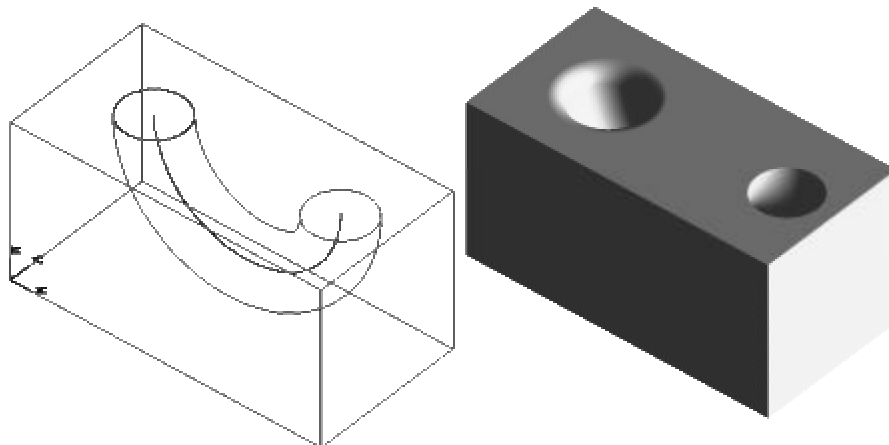
APPLICATION LIST  APPLICATION LIST ISSUES ARE INDEPENDENT OF DRAWING CHANGE LETTERS			PDES, INC.  CHARLESTON, SC CAGE CODE: PDESI		MODEL: TEST CI NO: TESTCI NOMENCLATURE:  TEST ASSEMBLY			DRAWING NO. AL2828289 DWG REV AL ISSUE SIZE J B AL DATE: 1999/08/30 AL SHEET: 1	
CONTRACT NO: XXXXXX-XX-X-XXXX									
CONFIGURATION/ PART	MODEL	SECTION	EFFECTIVITY FROM - THRU	REV	END ITEM QTY	ENA CUM QTY	NEXT ASSEMBLY DRAW/ENA	CONFIGURATION ITEM NO.	
2828289-1	TEST	FA362	T001-005 T005-007 D001 , S001	A B A	0001		2828289		
2828289-2	TEST	FA362	T001-005 T005-007 D001 , S001	A B A	0001		2828289		
2828289-3	TEST	FA362	T001-005 T005-007 D001 , S001	A B A		0000001	2828290-1		
2828289-4	TEST	FA362	T001-005 T005-007 D001 , S001	A B A		0000001	2828290-1		

## Edges Lost from Filleting



Since Edges 1 and 2 are 'lost', their identities must persist in STEP for editing in native system

## Toroidal Passage and Fillet



The two entry holes must be 'distinguished' in order  
that the fillet is identified with correct hole



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