

# Collaboration & INTEROPERABILITY

Congress - May 21-23, 2013

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## CAD Translation Validation

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## Definition - verification and validation

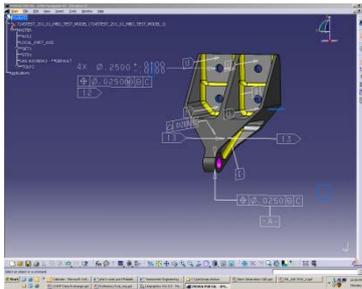
- **Definitions taken from LOTAR standard NAS/EN 9300-007**
  - **Verification** (1) - the assurance that a collection of information has the correct content (cf validation, & EN9300-003 5.3.5). In the context of LOTAR, verification rules test whether the structure of the model is correct, for example, that the faces that make up a shape knit together to form a solid, without gaps between the faces.
  - **Validation** Properties - information calculated from a model or document whose invariance is used to validate the content after recovery, and so to demonstrate that the key characteristics are unchanged. For example, the volume of a solid in a CAD file.

Model Quality Verification and Translation Validation  
ensures CAD data quality

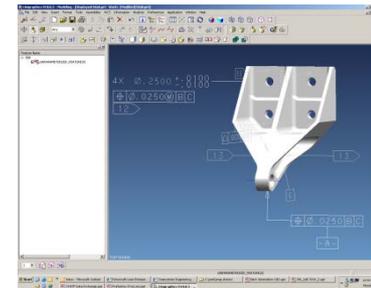




# CAD Translation Validation between CAD systems



**System A**



**System B**

**Is the translated model exactly “the same” as the original model?**

**Q: How do you define “the same”?**





# CAD Translation Validation between CAD systems

**Q: How do you define “the same”?**

- Different requirements for different applications
- Digital computing
  - It is all numerical approximation
  - different algorithms yield different results (e.g.mass properties)





## Define "the same" clearly, please.



Q: Are there 2 curves the same?



Q: A single curve vs composite curve, are they the same?

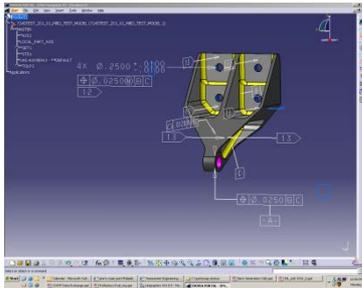
Identify WHAT to be validated – it all depends on applications

- Geometry – points (3D points, 2D points, validation points, Cloud of Points), lines, curves, faces, surfaces, solids, etc.
- Topology – one sphere vs 2 semi-spheres





# CAD Translation Validation from CAD to STEP



**System  
A**



**STEP  
file**

**STEP is a language,  
not a CAD system**

## How to validate a STEP translation?



To ensure that the CAD models before and after translation are “**the same**”

- Geometry
- Topology
- drawing
- Knowledge, design intent
- Electrical
- Composites
- BOM
- etc





## **Published References:**

- **SASIG (Strategic Automotive Product Data Standards Industry Group): Product Data Quality Guidelines for the Global Automotive Industry, 2005**
- **MIL STD 31000 (02-2013)**
- **ISO 10303-59 Quality of Product shape Data**





## Curve Validation Criteria

- Unmatched Curve
- Split Curves
- Merged Curve
- Duplicated Curves
- Deviant Curves
- Different Curve **Type** (e.g. conic curve vs NURBS curve, is this term clear enough for the general user community?)
- Different Curve Color
- Different Curve Direction





## Face Validation Criteria

- Unmatched Face
- Split Faces
- Merged Face
- Duplicated Faces
- Deviant Faces
- Different Face Type (e.g. conic vs NURBS)
- Different Face Color
- Different Face Area
- Different Face Orientation
- same thing for curves/edges/points/vertices



# Mass Properties Validation

- **Different Model Area**
- **Different Model Location**
- **Different Model Volume**
  
- Users may expect different results from different vendors using different algorithms
- What are the mass properties for geometry defined in a STEP file?





# Assembly Structure Validation

- Unmatched Assembly
- Unmatched Part
- Split Assemblies
- Split Parts
- Merged Assembly
- Merged Part
- Different Assembly Location
- Different Part Location





# Saved View Validation Criteria

- **Unmatched Saved View**
- **Different Saved View Location**
- **Different Saved View Orientation**





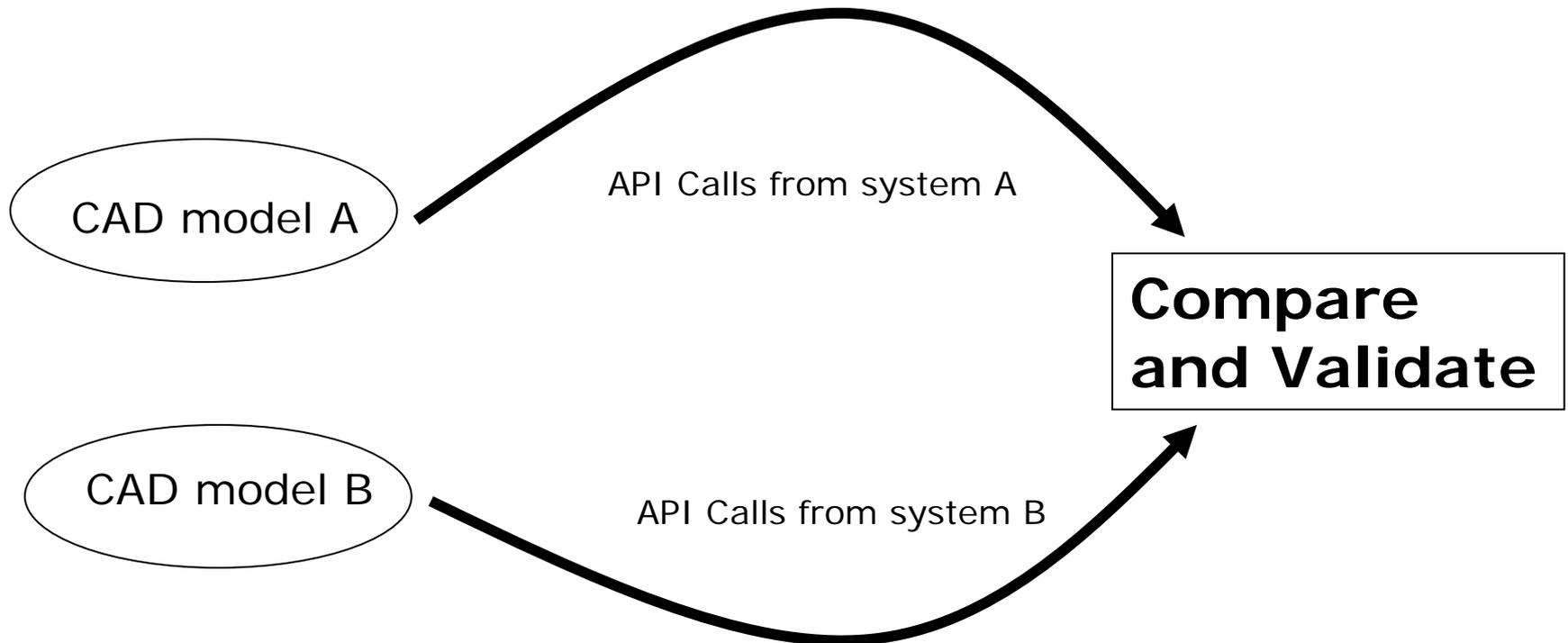
## **Validation Criteria ..... future**

- **PMI –**
  - **part and assembly**
  - **graphic vs semantic**
- **Meta Data**
- **3D annotation**
- **Composites**
- **Electrical**
- **2D drawings**





## Translation Validation Methodologies - direct

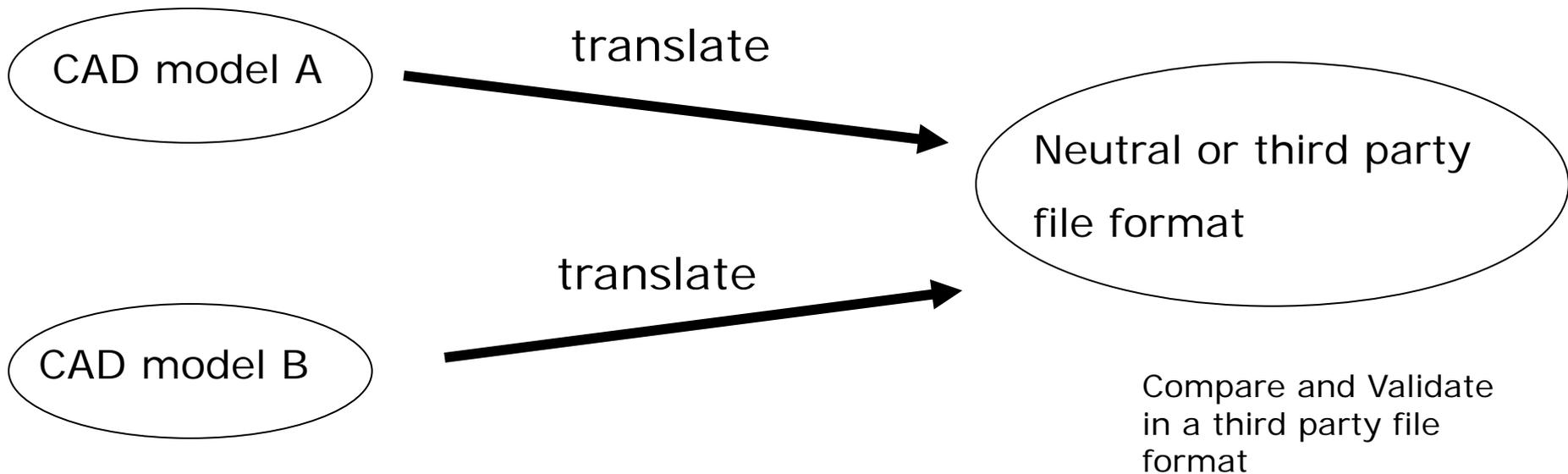


Access to each native CAD system and appropriate API calls are required





## Translation Validation Methodologies - indirect



- Access to native CAD systems is not required
- Q: How accurate is the translation?





## Validation the validation tools

### 1. Validation by the vendor

- Be able to convince the users that the validation tool is accurate

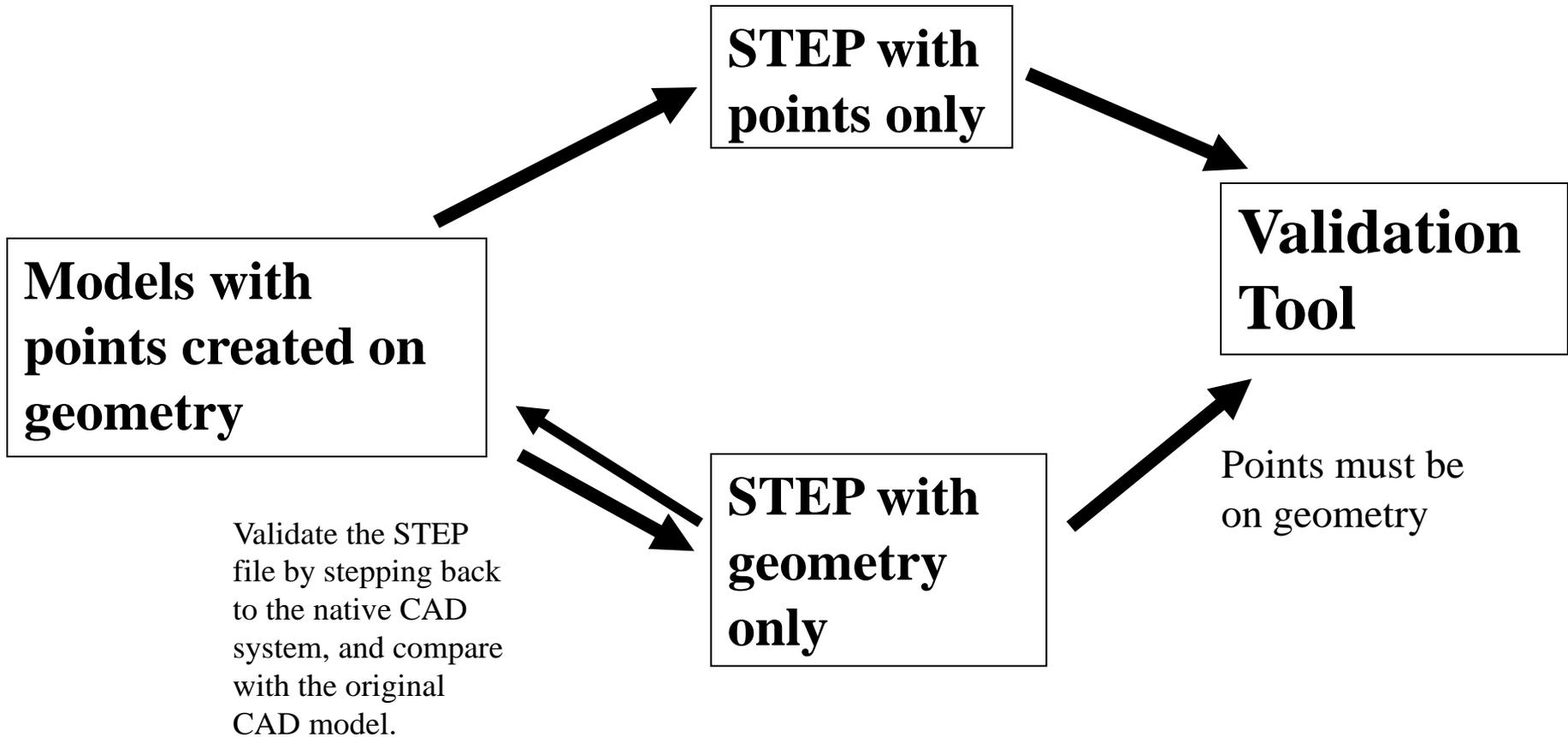
### 2. Validation by the user

- Users shall have an easy way to validate the validation tool as well





## Validate the Validation Tools



## Translation Validation - challenges

- We are exploring a new territory, and we are discovering new scenarios without simple terms for description.
- Terminology – unified definition of commonly used terms, e.g., verification vs validation, etc.
- ROI (Return On Investment) or sound business case for our management





## Translation Validation – Challenges:

- PMI is an essential element of MBD/MBE
- PMI (Product Manufacturing Information) or GD&T STEP implementation
  - Polyline : CATIA V5R20 and NX 8.0 support PMI STEP AP203 E2
  - Semantics
    - LOTAR team is working on semantics PMI implementation
      - All 3 major CAD vendors and many translation vendors are involved
      - LOTAR Part 120 Ed 2
        - initial ballot: end of 2013
        - publication: Q1 of 2014





## User Expectation

- Batch capability
- Configurable – not “one size fits all”
  - Be able to select or deselect WHAT to validate for different applications
- Terms are easy to understand
- Avoid false positive and false negative reports
  - User errors due to configuration
  - Software bugs



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# Thank You



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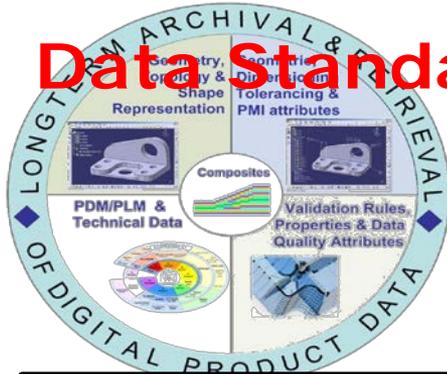
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# Backup Charts

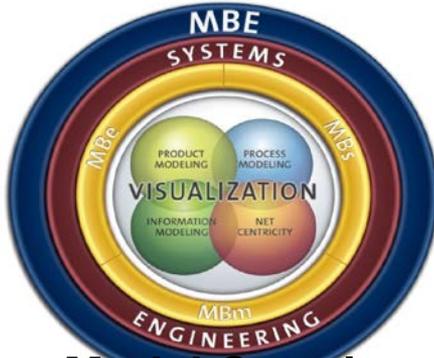




## Data Standards Organizations



**LOTAR  
Governance**



**Model Centric  
Data  
Management**



**International  
Organization for  
Standardization  
Data Exchange  
Standards**

**NIST**

**Data Neutrality**



**SASIG**

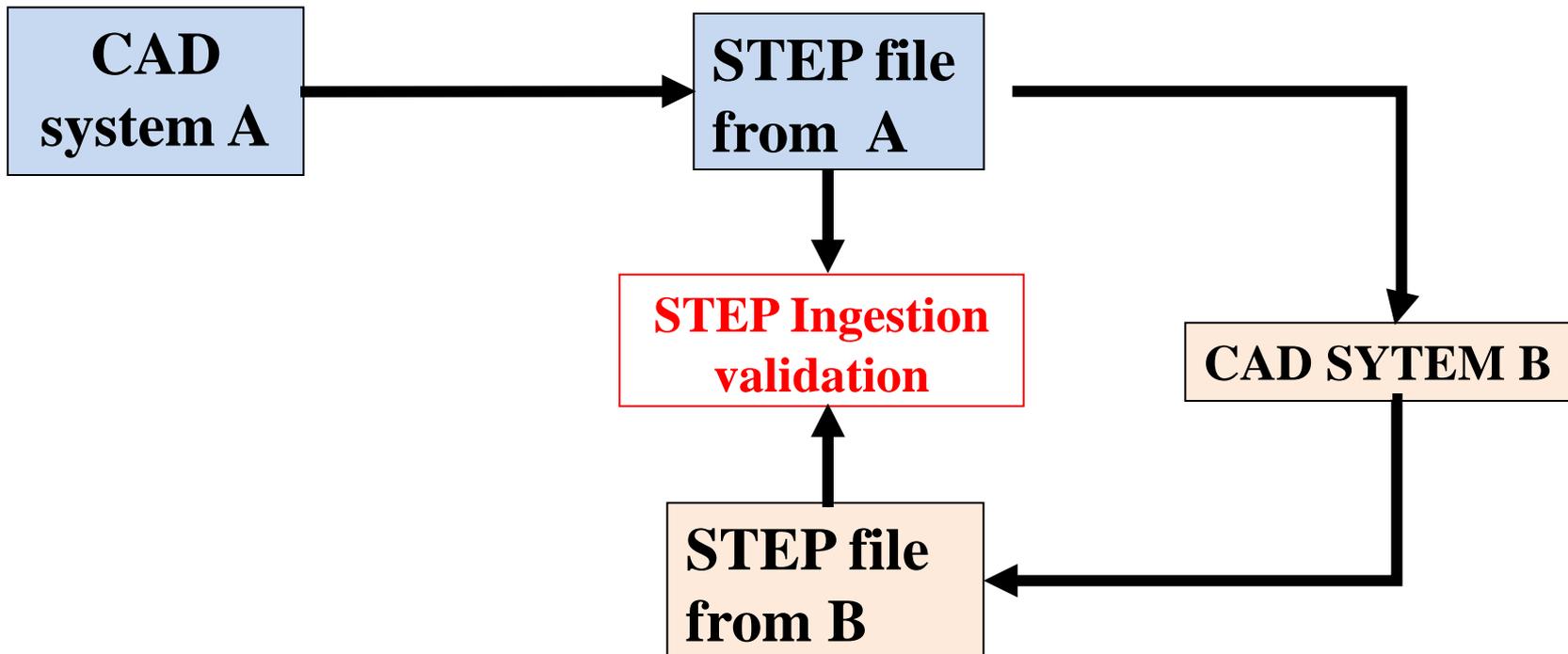
Strategic Automotive product  
data Standards Industry Group

**Data Quality  
Verification & Validation**



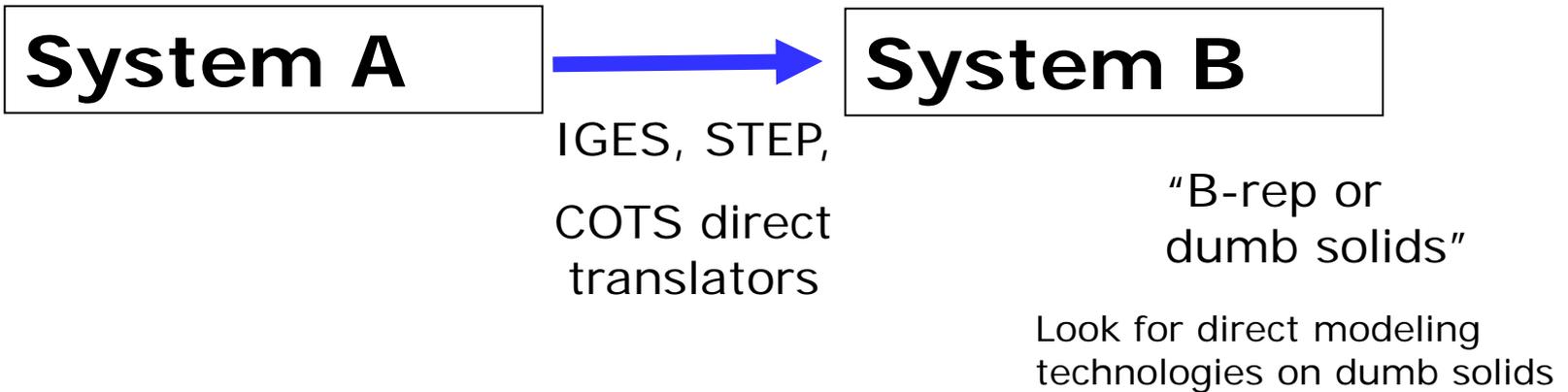


**STEP INGESTION VALIDATION – if validation between 2 different CAD files is not possible**

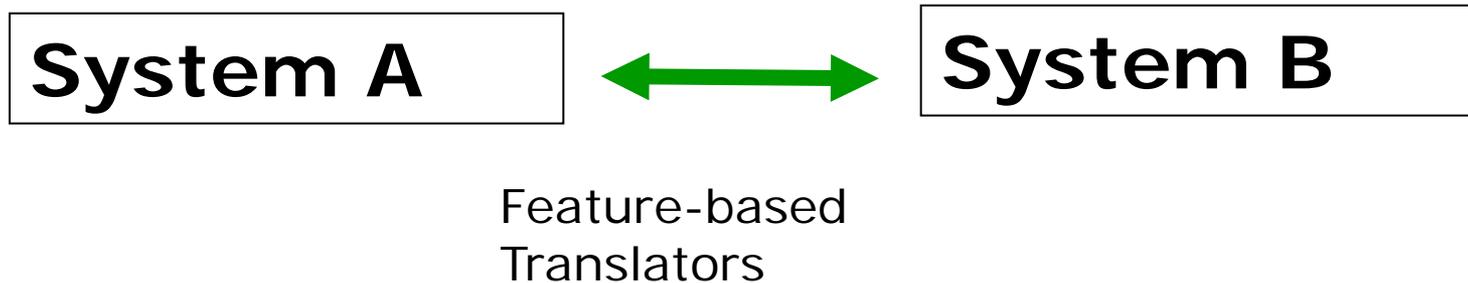




- **Consumable: one-way** data exchange



- **Collaborative: bi-directional** data exchange





## Translate

Automatically convert a model between dissimilar systems  
Use features, direct BREP or neutral BREP (IGES, STEP, ...)

## Migrate

Automatically convert a model between system releases

## Re-Master

Manually create an equivalent model in a new system  
Use best modeling practices of new system

## Verify

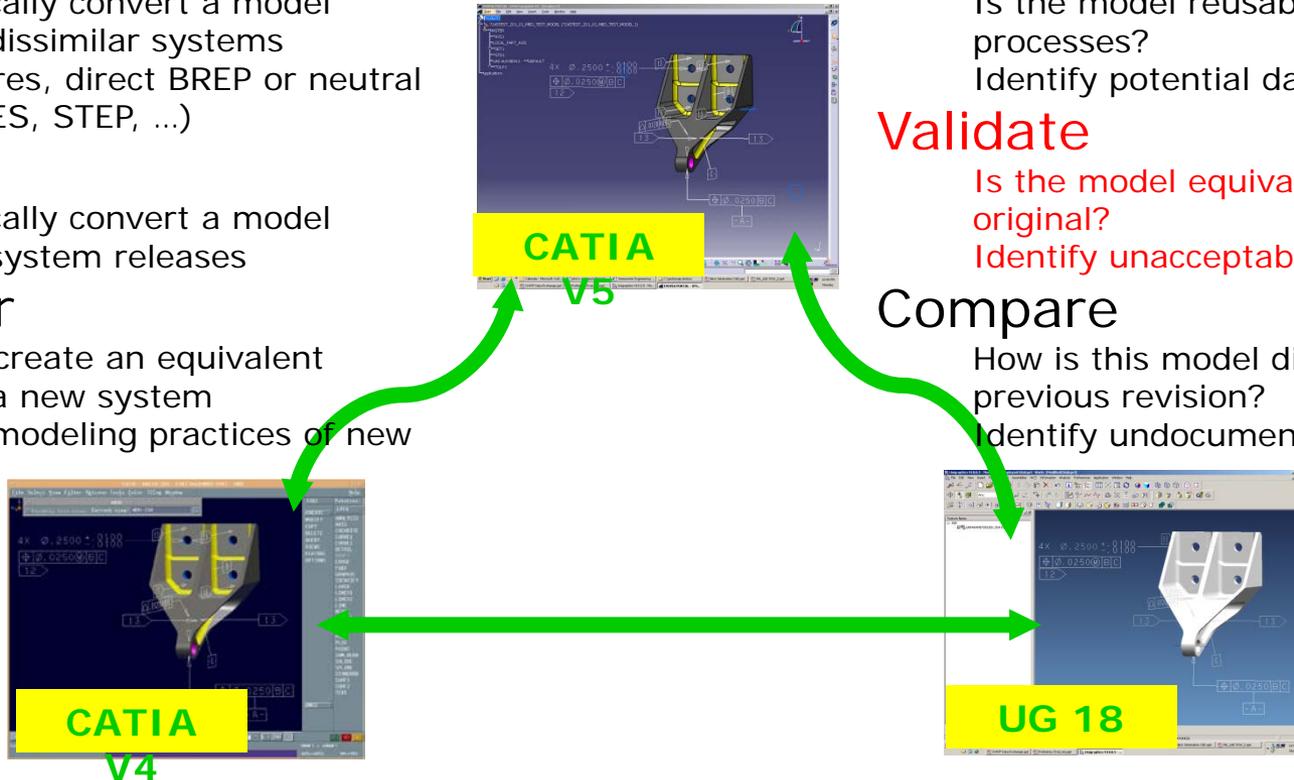
Is the model reusable for downstream processes?  
Identify potential data quality issues

## Validate

Is the model equivalent to the original?  
Identify unacceptable changes

## Compare

How is this model different from the previous revision?  
Identify undocumented changes



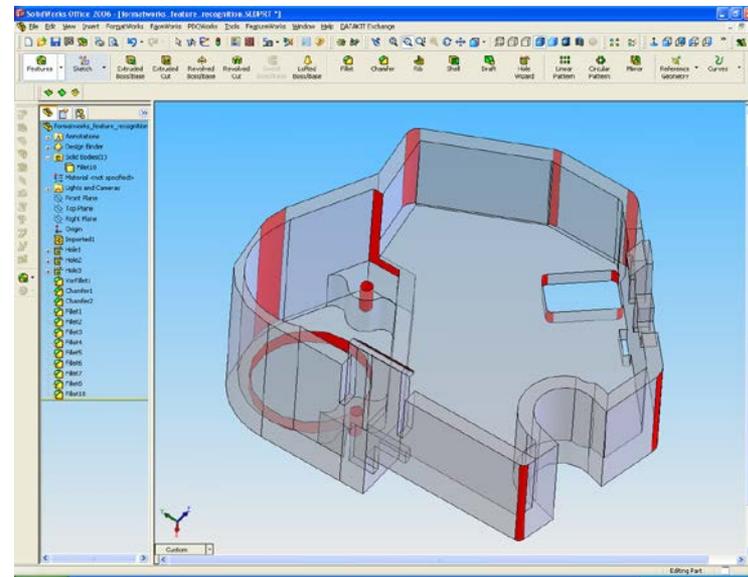
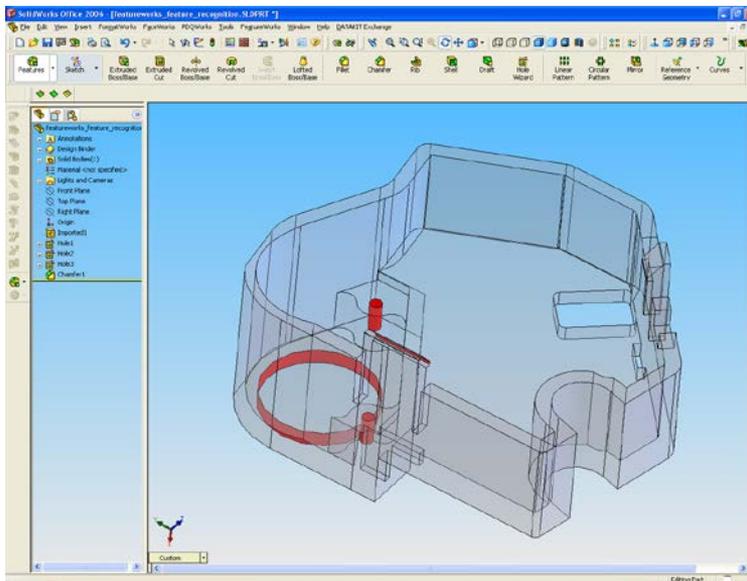
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- Incomplete parameterization
- Unnecessary features
- Spurious Data
- Design by preference or mood
- Ambiguous design intent

- Is Geometric Integrity maintained
- Are entities lost/added during translation?
- Surfaces, Wireframe, PMI, Geosets, etc.
- Inconsequential failure
- Consequential failure
- Product structure translated correctly?
- Assembly instance position, rotation



## What are the Challenges?

- Bad CAD Data
  - Native and/or imported
- Exchange Data Management !!!
  - End-to-End process. No ad-hoc translation
  - CAD attributes in CAD and PDM.
  - Metadata (PDM) to support interoperability
  - Scalability
- Process/Method
  - User discipline
- Quality and Integrity
  - How to ensure quality
  - Know what is wrong/missing/new is important
- Loss of information
  - PMI (Mfg.), Metadata (First Frame), Electrical
  - Design intents, History & Features
- Non-value added work
  - Make it transparent and efficient





# Content Page - Duplicate





# Content Page - Duplicate

