Activities in the Development of Standards and Technology for the Long Term Retention of 3D Data

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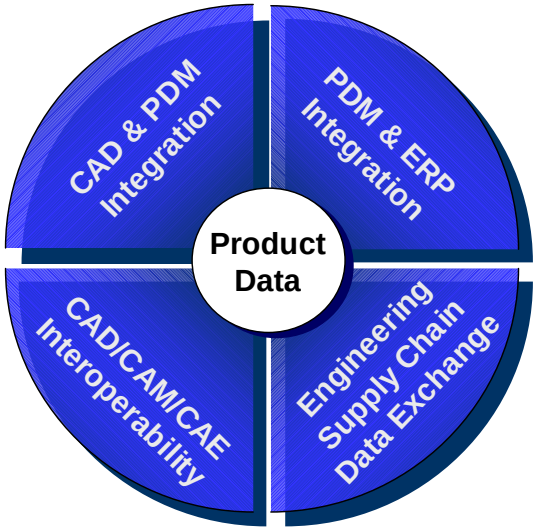
International TechneGroup Inc. (ITI)

- **Background**
  - Founded in 1983
  - Privately held
  - Headquarters in Cincinnati
- **Global Presence**
  - North America
  - Europe
  - Asia Pacific

- **Business Offerings**
  - Engineering Process Improvement Consulting (CP/PD™)
  - Analysis, Simulation, Test, and Reliability Engineering Services
  - ***TranscenData - Product Data Integration & Interoperability***

ITI TranscenData History



Automation & Comparison
- DEXcenter
- CADIQ V4

PLM Systems Integration
- Matrix One, TeamCenter, Pro/I, Pro/PDM
- Agile, Oracle, QAD, SAP

Quality Testing and Repair
- CADfix
- CADIQ

STEP Translator Development
- CADDS, I-DEAS, Inventor, VisView
- STEPworks

IGES Translator Development
- CADDS, Mechanical Desktop, Inventor, Medusa, Mentor Graphics
- IGESworks

1985 **1990** **1995** **Today**

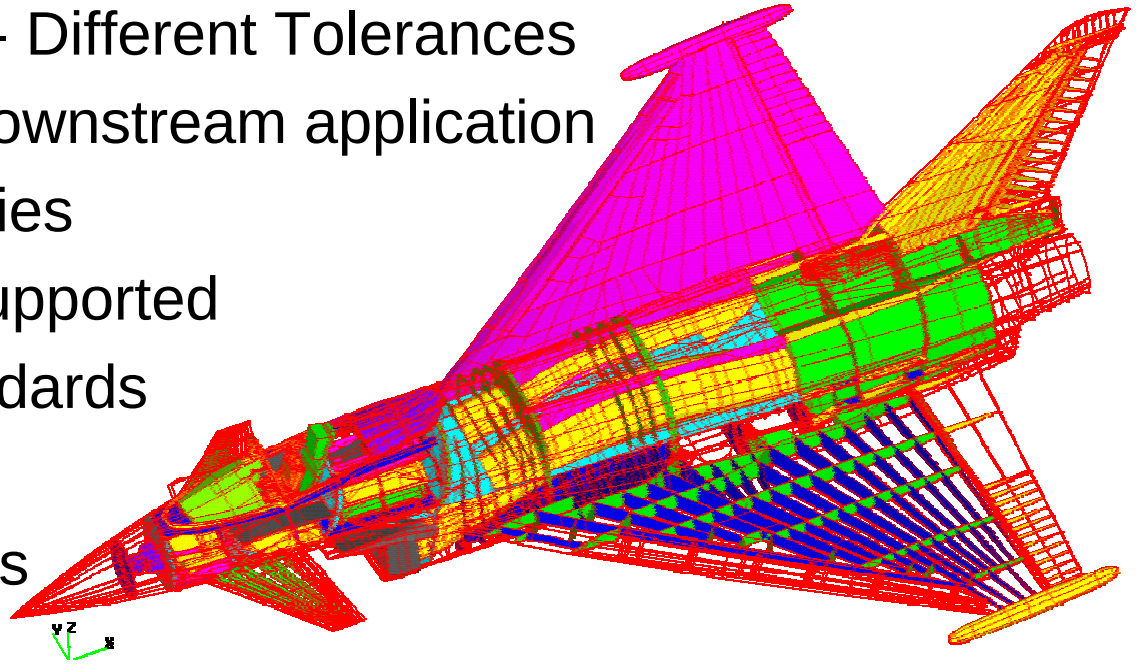
ITI TranscenData

Long Term Archival Process Requirements

- **Enable comprehensive and precise validation of part models that have been exported to STEP and imported into another CAD system after *long-term archival***
  - Can be 30 years or longer
  - Expecting two new CAD system generations
- **Avoid *false negative (incorrect fail)* mass property validation**
  - Accuracy differences between CAD system mass property algorithms can indicate a significant but *misleading difference*
- **Avoid *false positive (incorrect pass)* mass property validation**
  - Localized, significant geometric deviations can be *overlooked* when only mass properties are used
- **Enable the storage of all validation property data in a STEP part model to create a *self-validating* STEP file**
- **Same validation approach could be applied to other *open* archival formats**

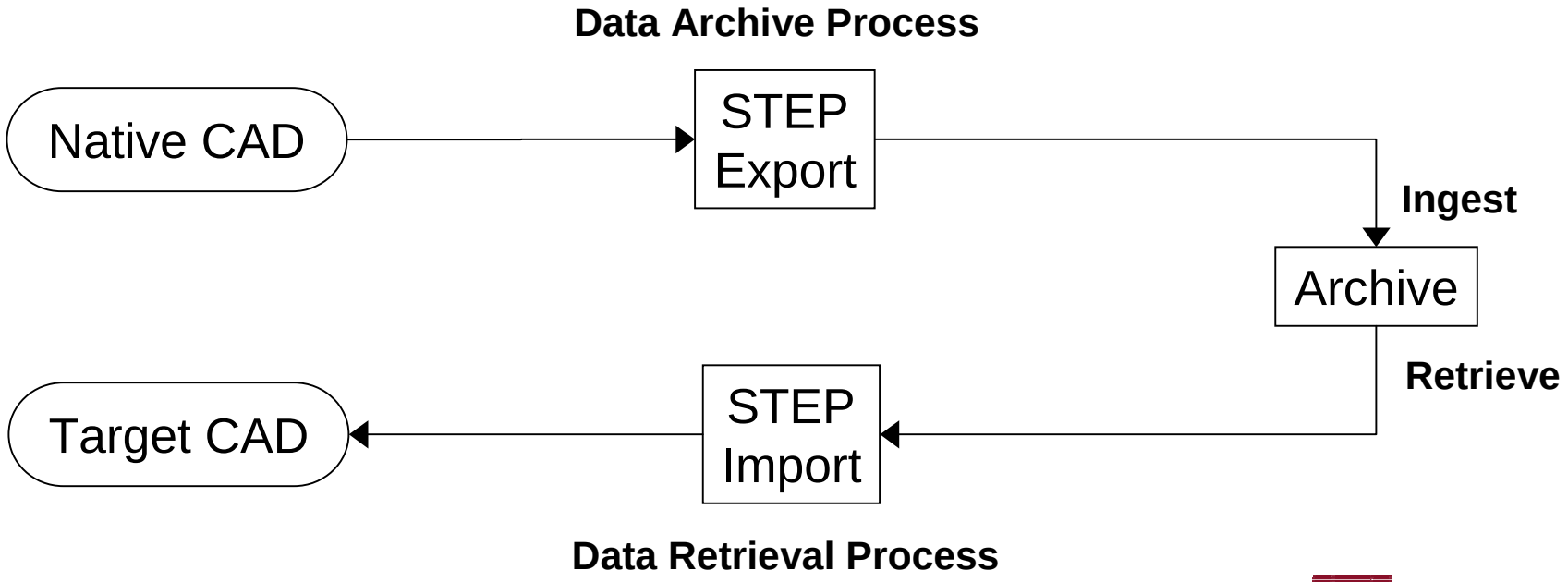
Complexity of 3D CAD Data for LTA

- **Inter dependencies on other systems and translators**
- **Inter relationships between parts of a single model**
  - Topology and Geometry
  - Features
  - Shape and Form
  - Different Systems - Different Tolerances
  - Requirements of downstream application
  - Different complexities
  - Different entities supported
  - Model Quality standards
  - Assemblies
  - Coordinate systems



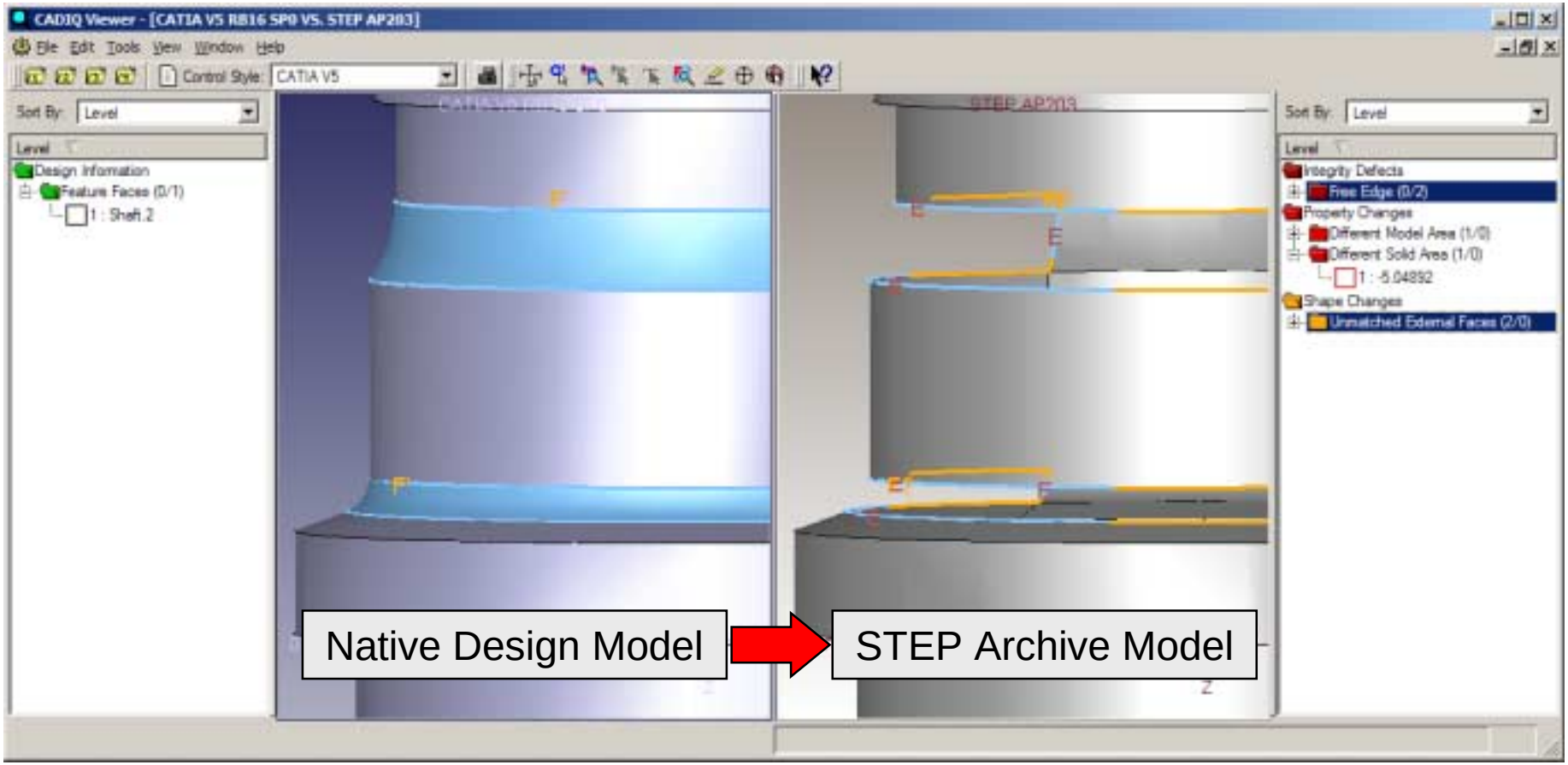
Basic Long Term Archive Process with STEP

- **Is this a robust process?**
- **Is the archive reliable?**
- **Can you trust the archive and future retrieved data?**
- **What checks are in place to validate the process?**
- ***What could possibly go wrong…?***



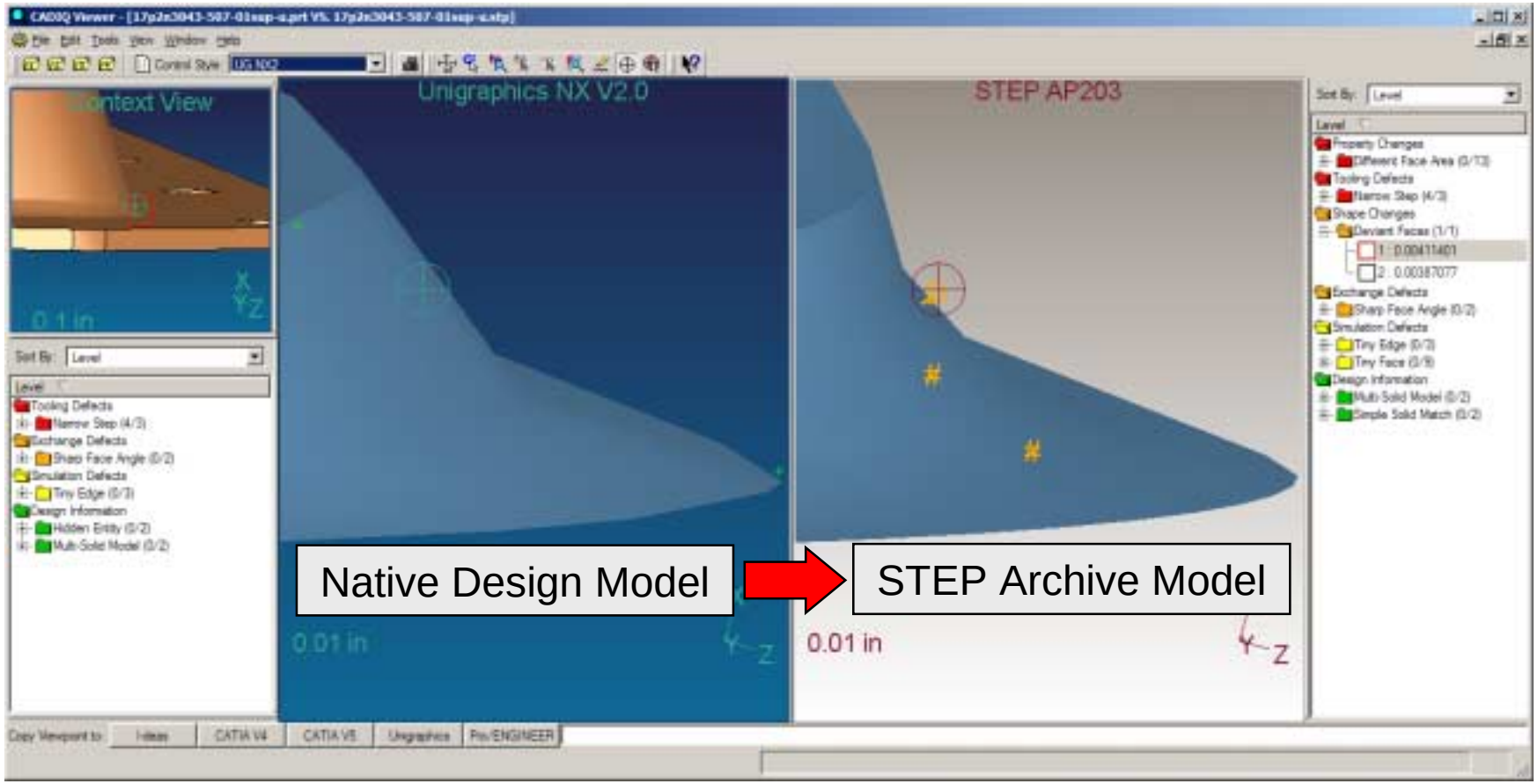
Data Lost During STEP Export for LTA

- **Revolved faces are lost during STEP export from source CAD system producing invalid STEP solid model**



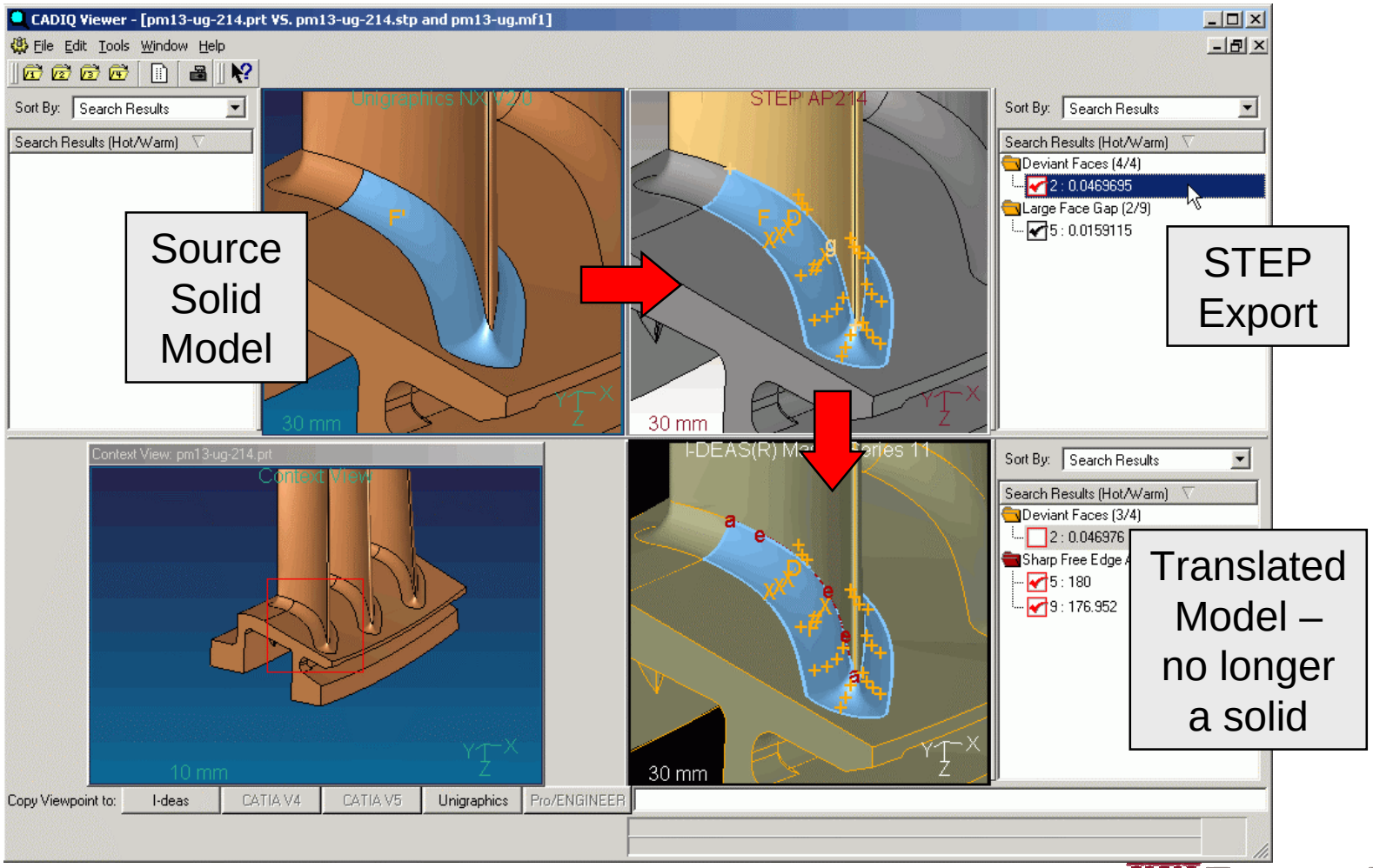
Shape Change During STEP Export for LTA

- **Complex blend (procedural surface in native model) is approximated in STEP and gives a deviation of 0.004 inch (0.1 mm)**



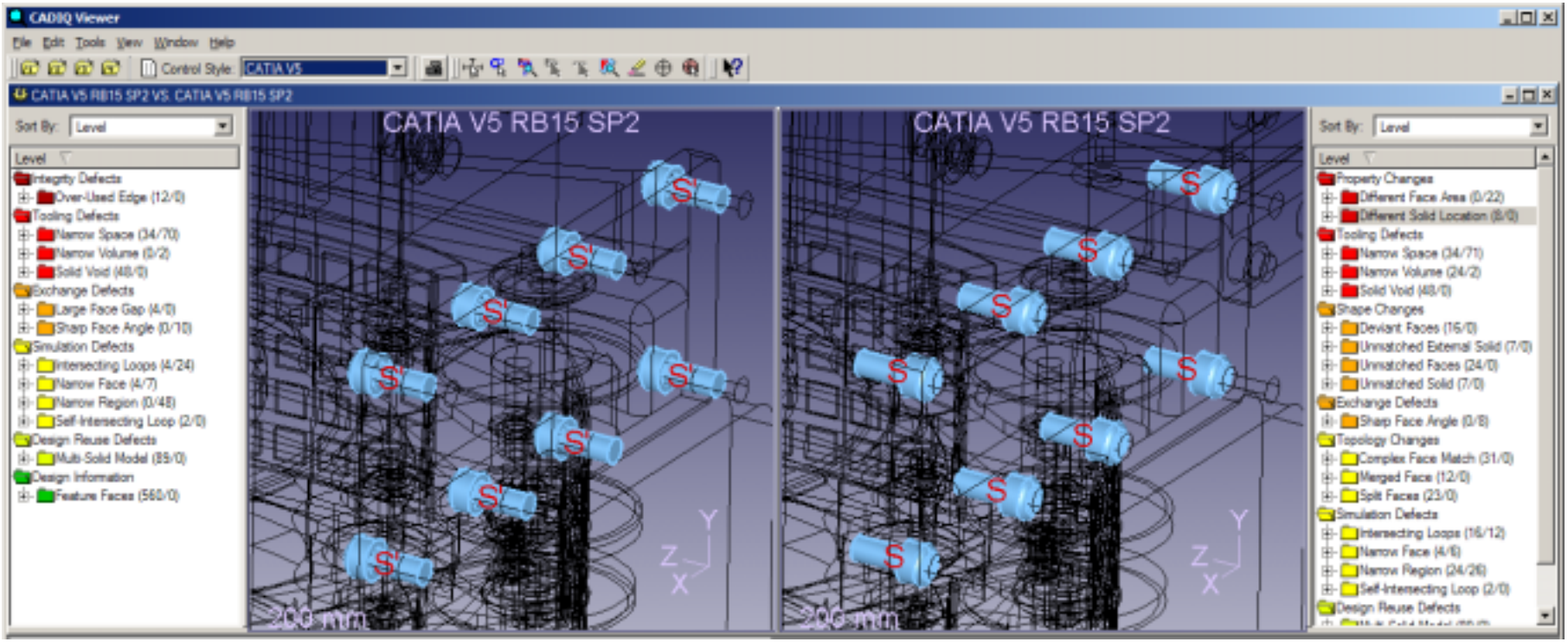
Shape Change During STEP Export for LTA

- **Quality defects and shape changes caused by poor surface approximation during STEP export**



Position Change During STEP Export for LTA

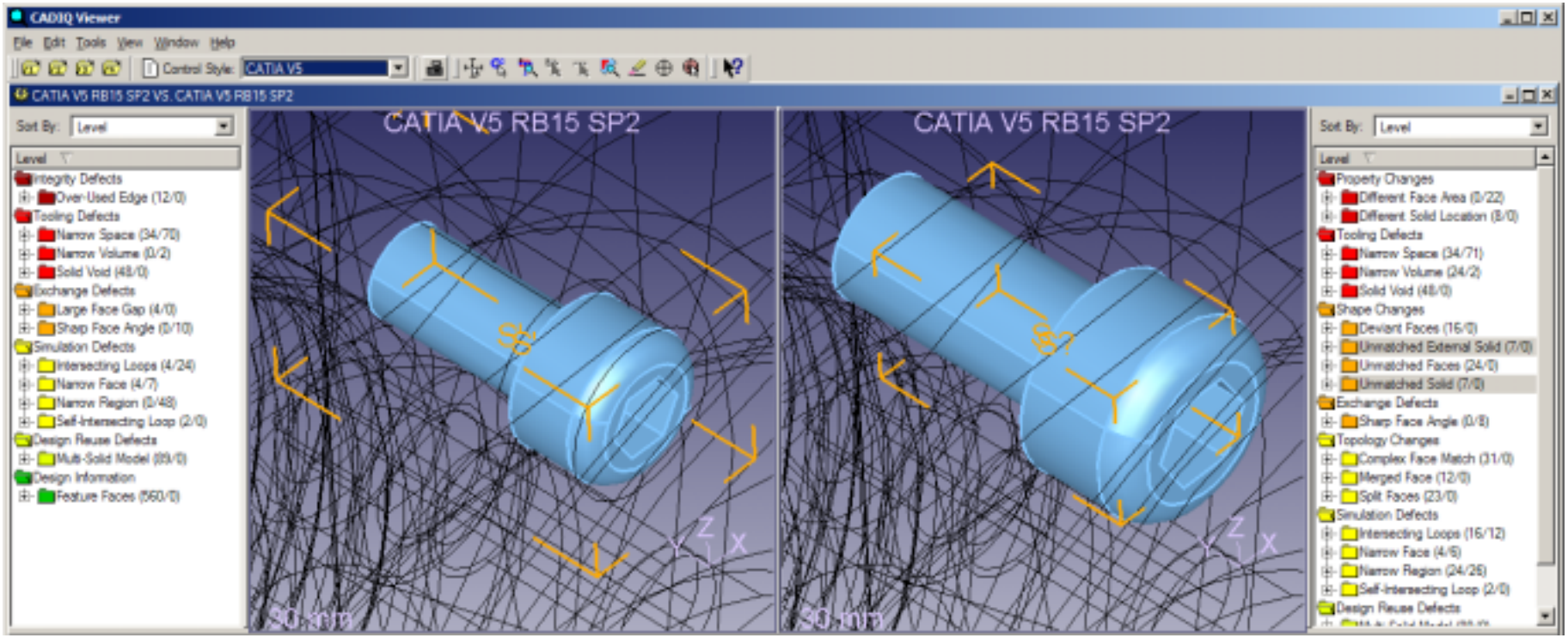
- **Orientation and location of this pattern of bolts changes because positional data is misinterpreted**



Native Design Model → Retrieved Archive Model

Part Re-size During STEP Export for LTA

- **Some of the bolts in this assembly are larger in size after STEP assembly import/export**



Native Design Model → Retrieved Archive Model

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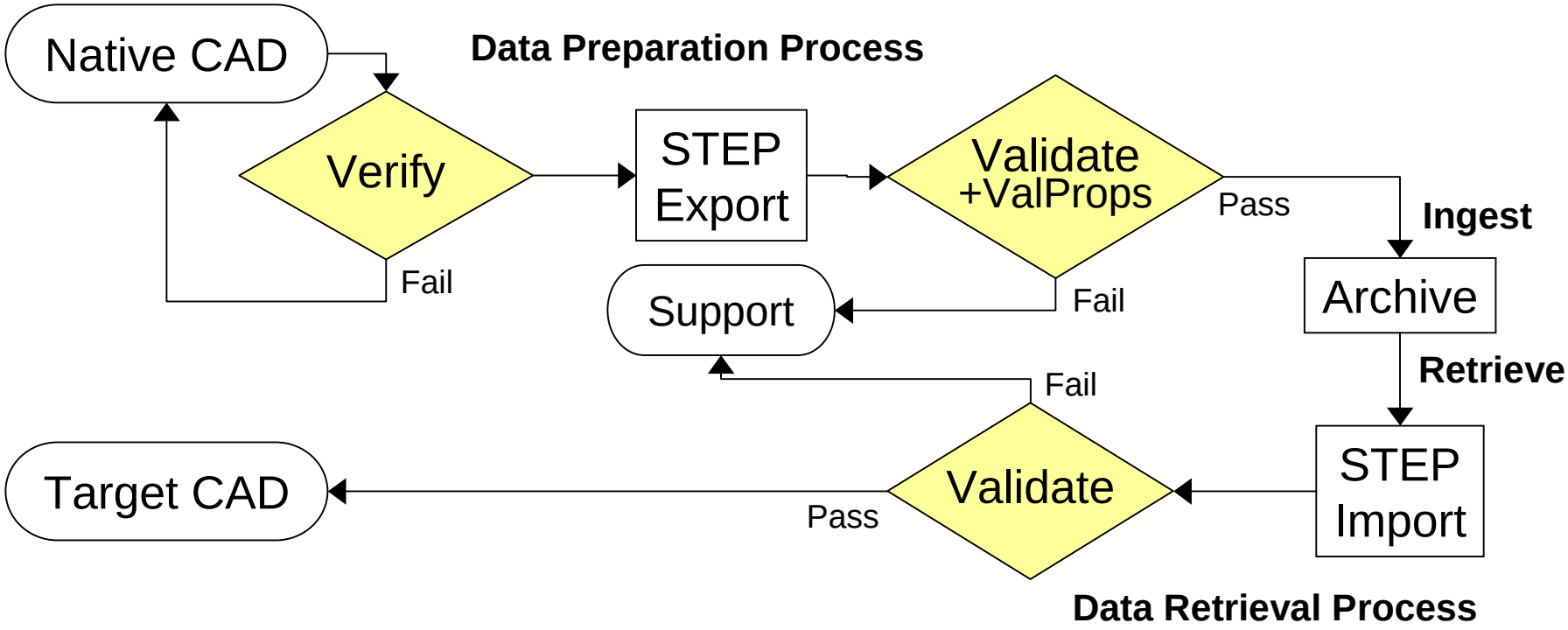
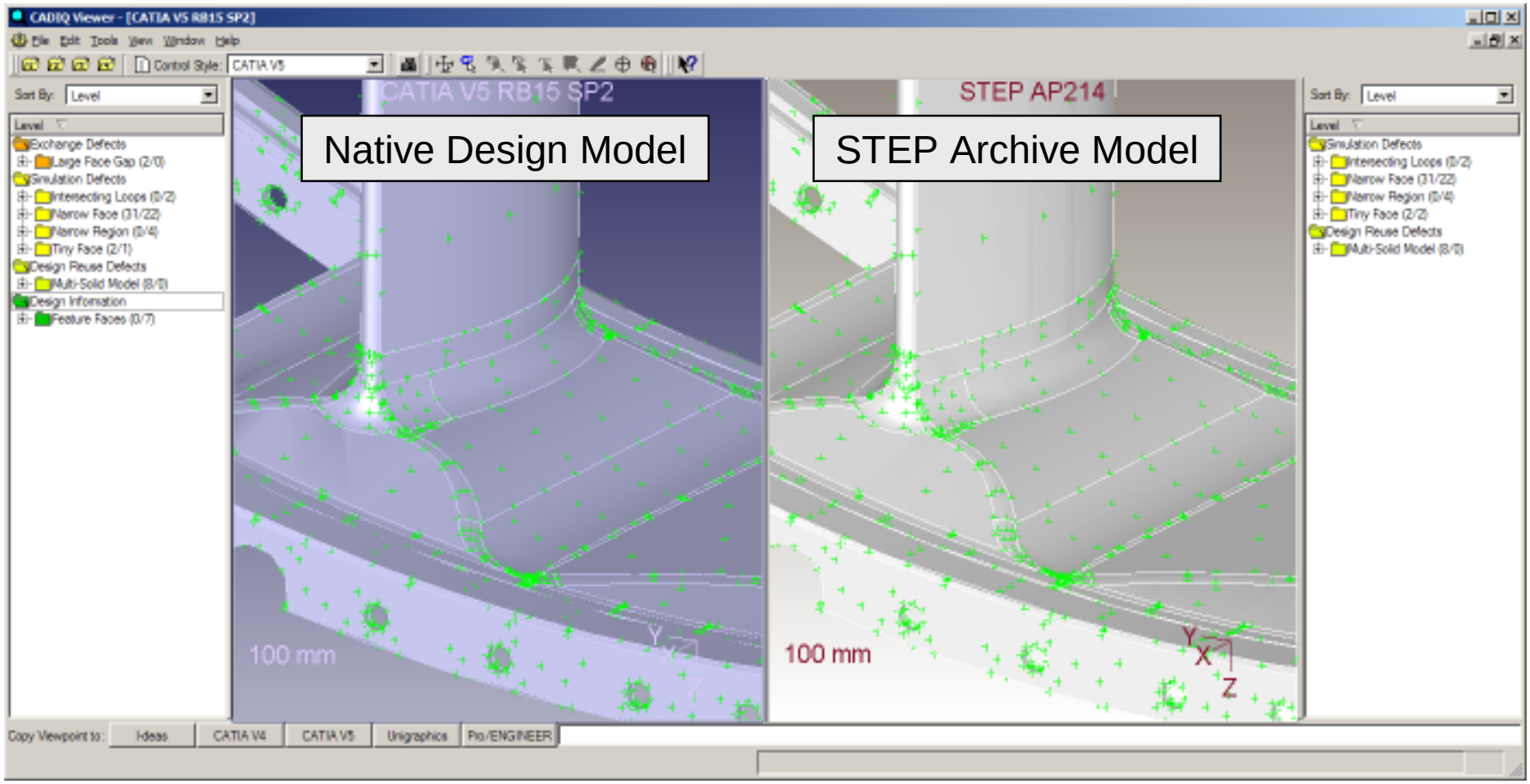
Validated 3D Long Term Archive Process

- **Verify native CAD model for downstream reuse**
- **Validate the STEP export has equivalent quality and shape and add validation properties to the STEP file**
- **Validate the STEP import has equivalent quality and shape**



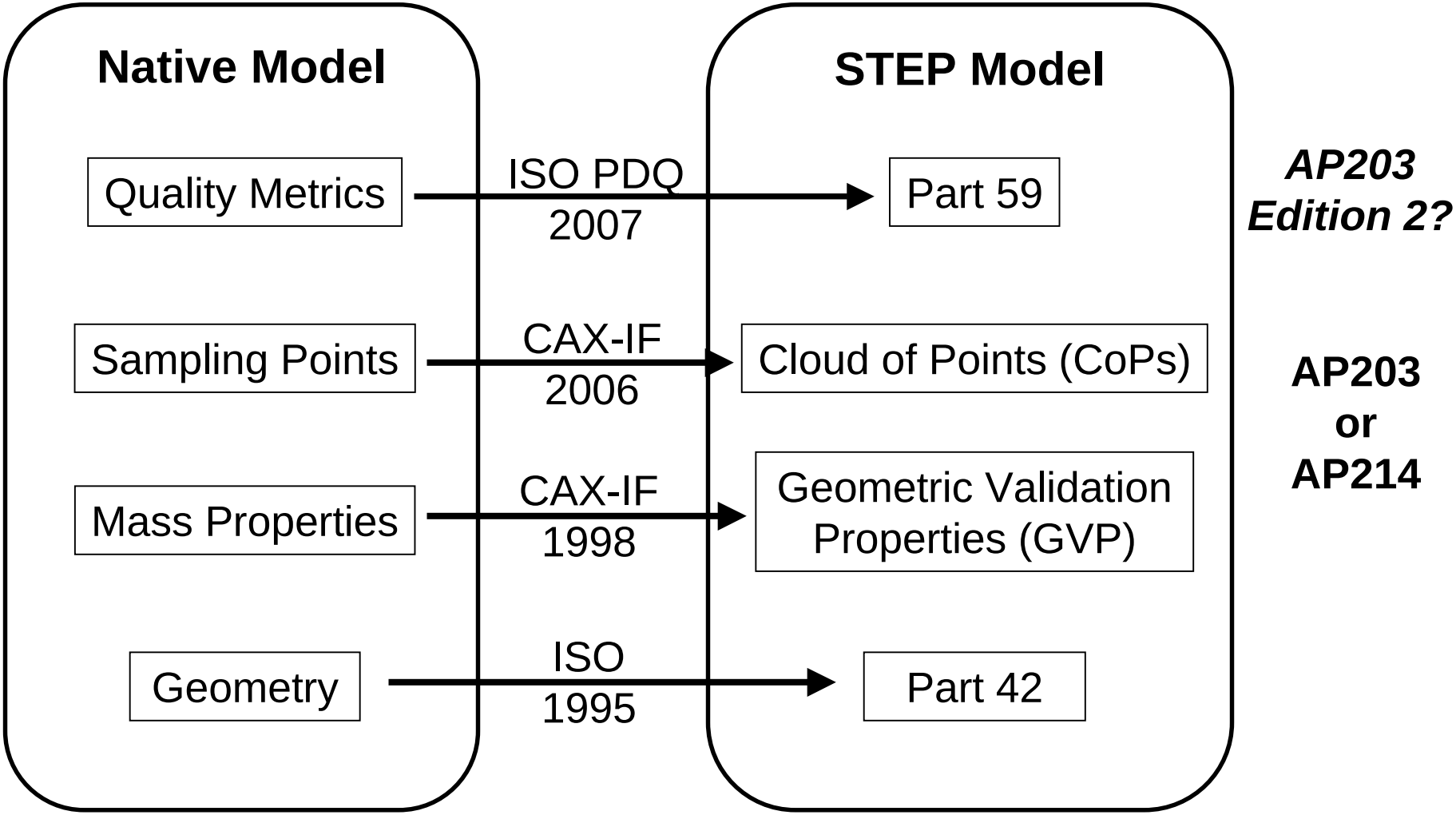
"Your long-term revenue is dependent on long-term preservation of your digital data"

Long-Term Archival Validation with STEP



Sampling points evaluated on the native model are stored in the STEP model to enable precise validation after retrieval into a future CAD system

STEP Developments for the LTA Process



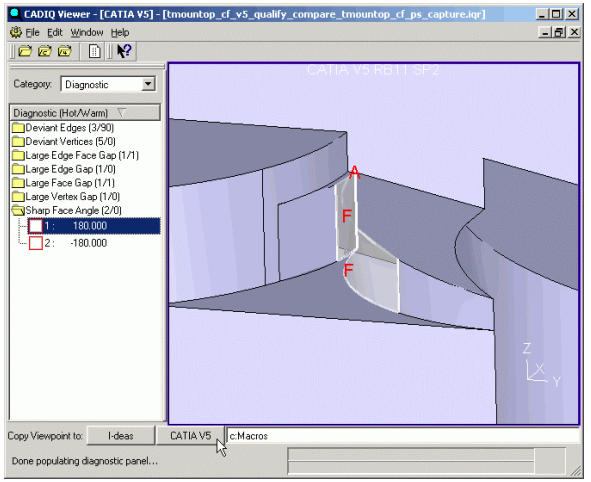
STEP Validation Properties

- **The PDES/ProSTEP CAX Implementers Forum currently recommends these mass property validation properties be defined in STEP part models**
  - Model (solids and/or surfaces) volume, area and centroid
  - Each solid's volume, area and centroid
  - Each open shell's area and centroid
  - Each assembly component's centroid
- **ITI & Theorem proposed an extension, that was accepted, to enable precise validation by adding these validation properties**
  - Smooth face sampling points (face interior and smooth edges)
  - Sharp face sampling points (sharp or open edges)
  - ITI has productionized the only commercial product to facilitate this

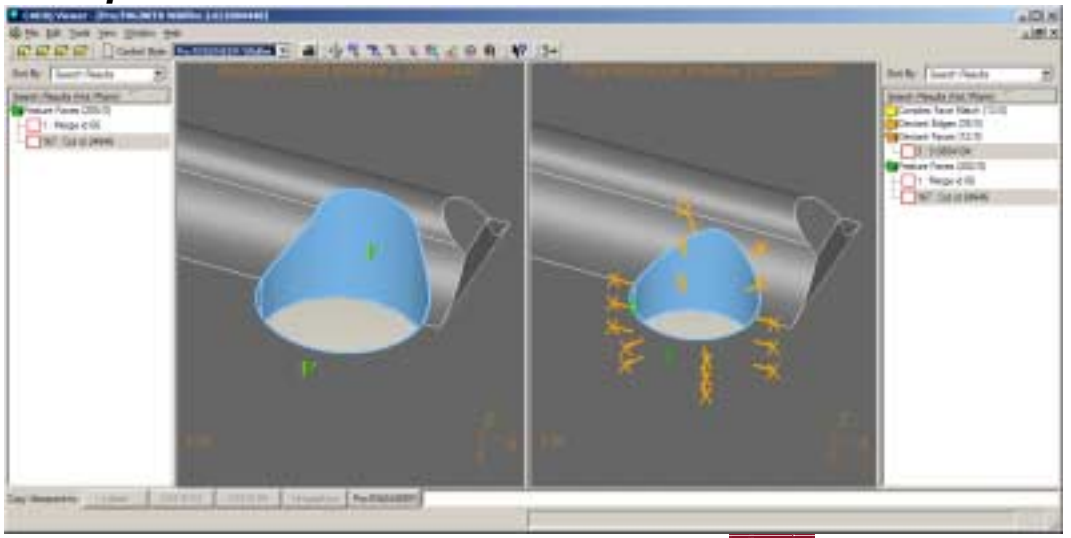
CADIQ Product Summary

- **Native CAD Interfaces (API)**
  - CATIA V5, Unigraphics, Pro/ENGINEER, SolidWorks
  - CATIA V4, I-DEAS, CADDS5
  - Parasolid, STEP, IGES
- **Specialized User Interface**
  - Rapid review of diagnostic feedback
  - Side-by-side viewing of quality or shape differences
- **Quality Diagnostics**
  - Invalid geometry
  - Unrealistic features
- **Comparison Diagnostics**
  - Unacceptable changes
  - Unintentional changes
  - Undocumented changes
  - STEP Validation Properties
- **Assembly Analysis**
  - CATIA V5, STEP, Parasolid

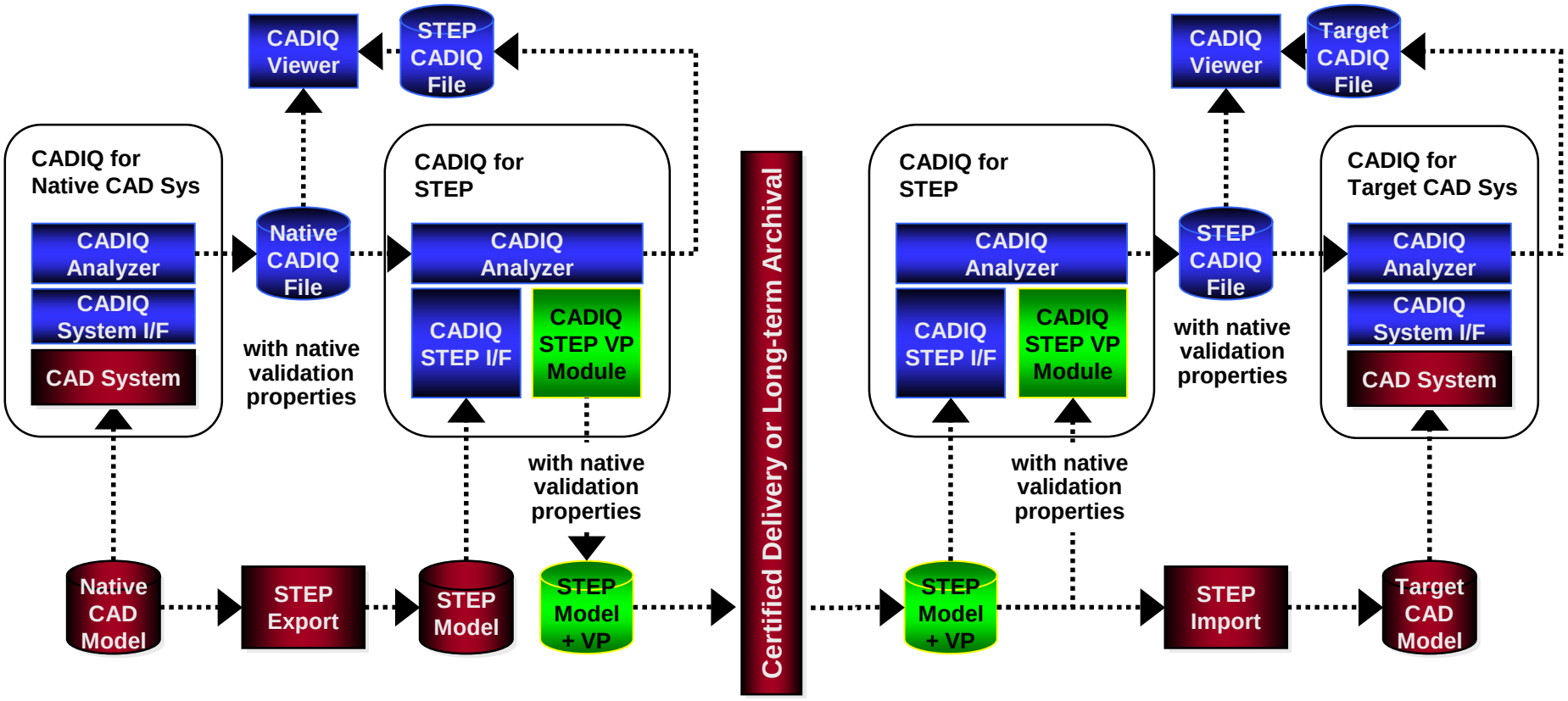
Identify quality defects



Compare CAD models



CADIQ STEP Translation Validation



Validate the exchange or archival of any STEP model produced by *any* STEP translator from *any* major CAD system

CADIQ STEP Validation Properties Module

- **Enable precise validation of part models that have been exported to STEP and imported into another CAD system**
  - Design data delivery
  - Long-term archival
- **Avoid false negative mass property validation**
  - Determine when differences in the accuracy of mass property calculation algorithms are reporting a false difference
- **Avoid false positive mass property validation**
  - Determine when significant localized geometric deviations are missed by overall mass property calculations
- **Enable the storage of all validation property data in a STEP file**
  - Extend existing CAx-IF Recommended Practices
  - Remove dependence on properties in a separate, proprietary CADIQ file
- **Add validation properties to any STEP file from any vendor**

Raising the Value of your Product Data

Ensure CAD Model Quality	Maximize CAD Model Re-use	Facilitate Global Product Development	Enable Engineering Supply Chain Data Exchange

Product Data Integration & Interoperability Solutions

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