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

Andy Chinn
TranscenData Europe Ltd
email: andy.chinn@transcendata.com
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
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 Archive Process

Native CAD → STEP Export → Archive → Ingest → Retrieve

Data Retrieval Process

Target CAD → STEP Import
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)
Quality defects and shape changes caused by poor surface approximation during STEP export.

Source Solid Model  ->  STEP Export  ->  Translated Model – no longer a solid
Position Change During STEP Export for LTA

- Orientation and location of this pattern of bolts changes because positional data is misinterpreted.
Part Re-size During STEP Export for LTA

Some of the bolts in this assembly are larger in size after STEP assembly import/export.
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”
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

Native Model
- Quality Metrics
- Sampling Points
- Mass Properties
- Geometry

STEP Model
- ISO PDQ 2007 → Part 59
- CAX-IF 2006 → Cloud of Points (CoPs)
- CAX-IF 1998 → Geometric Validation Properties (GVP)
- ISO 1995 → Part 42

AP203 Edition 2? AP203 or AP214
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
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

www.transcendata.com