

Strengthening Your Model-Based Enterprise with Validation

Raising
the **Value** of your
Product Data

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Introductions

□ ITI TranscenData

- Private, debt-free, profitable U.S. company since 1983
- International TechneGroup Inc. interoperability business unit
- “Transcend above your data problems”

“Smooth interoperability is a transcendental experience”

□ Doug Cheney

- US and European upbringing
- Mechanical engineering education
- CAD application development
 - CAD model quality, CAE optimization, assembly tolerancing
- Engineering process consulting
 - CAD to CAD/CAM/CAE interoperability
- International consortia team member
 - ISO, PDES, ProSTEP (LOTAR), OMG, SASIG (AIAG/VDA/JAMA)

Model-Based Enterprise

□ Scope

- Model-Based Engineering
- Model-Based Manufacturing
- Model-Based Sustainability

□ Objectives include:

- The model is the master (minimize use of drawings)
- Integrate all phases of the product lifecycle

□ Product *Model-Based Design* (MBD) Model

- Structure
- Geometry
- Annotations (aka 3D PMI, GD&T, FT&A, ...)
- Model attributes
- Domain-specific data

Why MBE Model Validation?

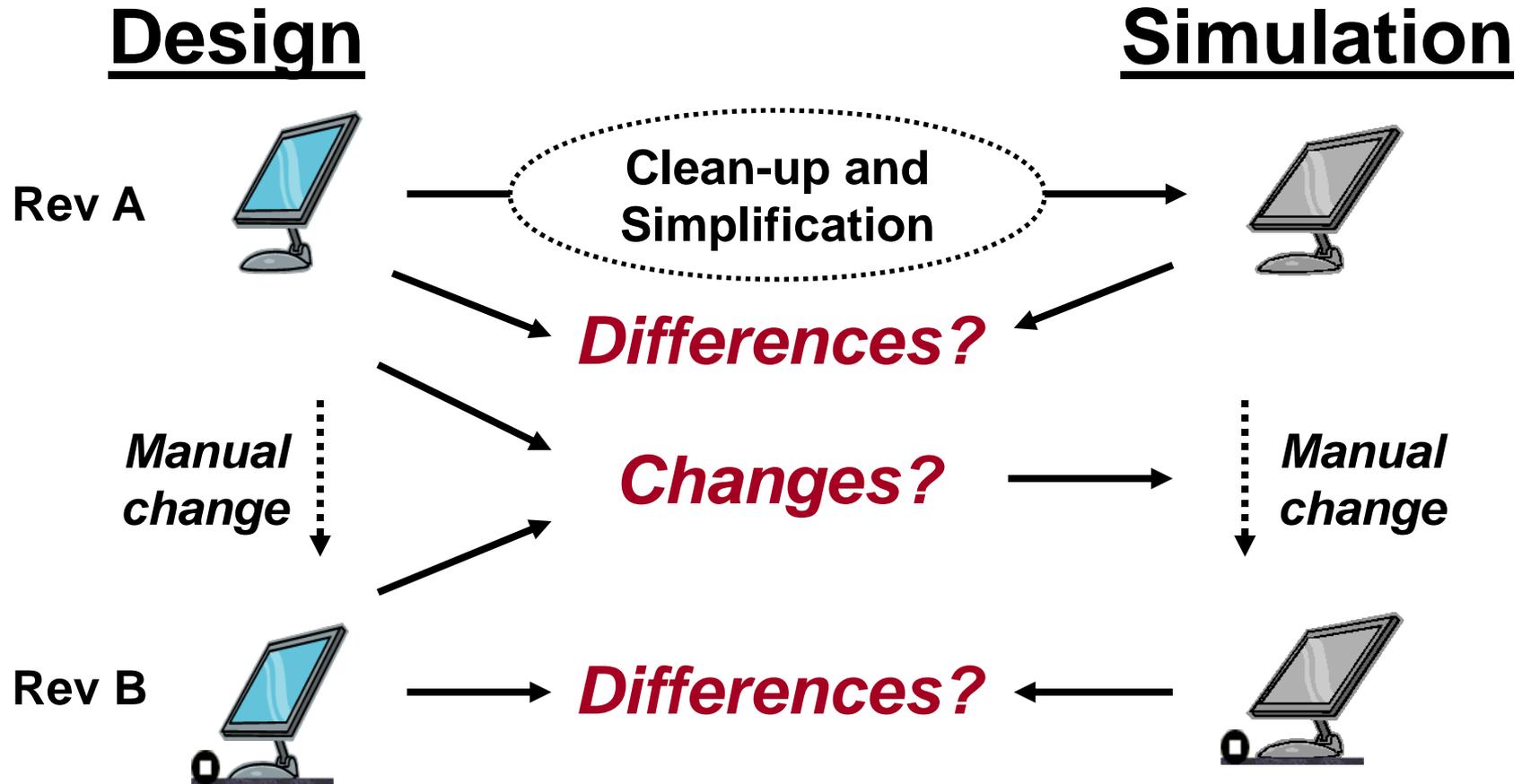
❑ If “The model is the master”...

...Then downstream modifications must be reconciled with the product design model.

❑ If “Integrate all phases of the product lifecycle”...

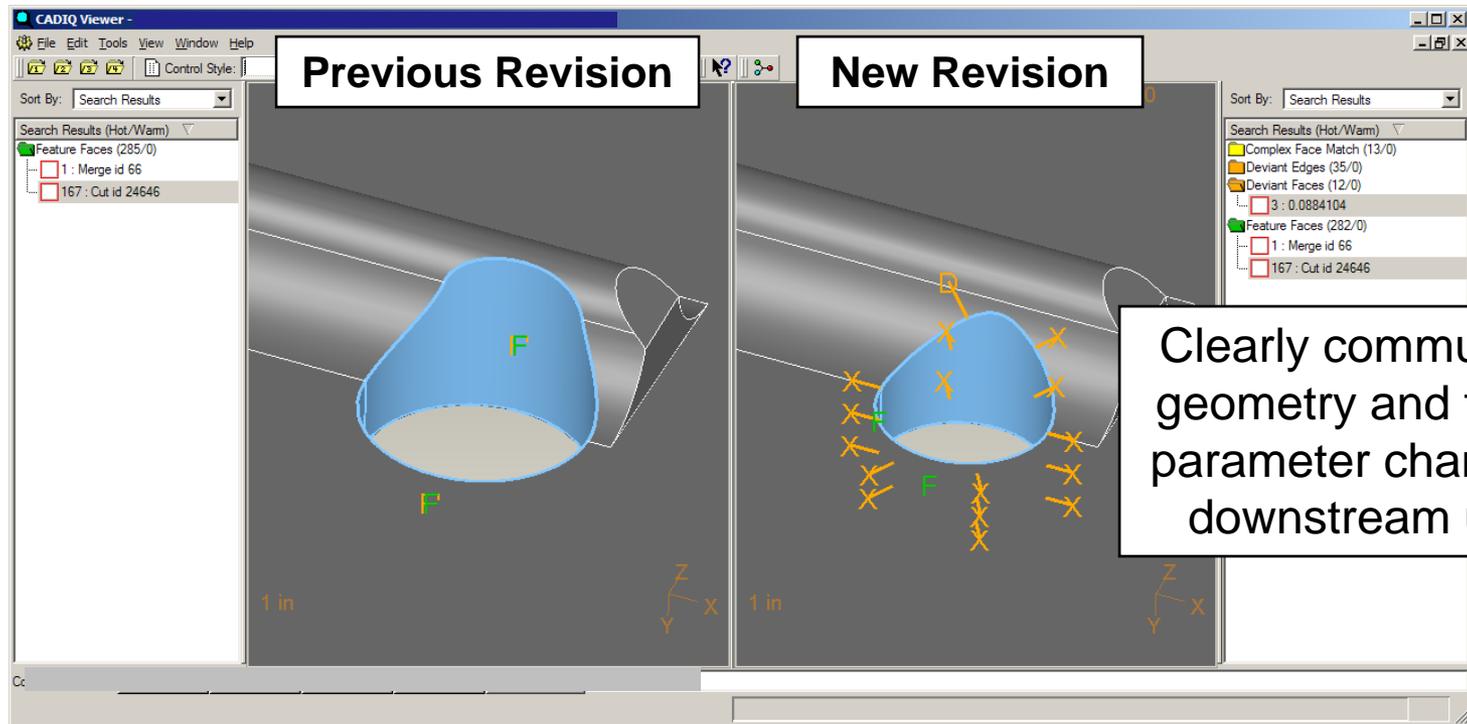
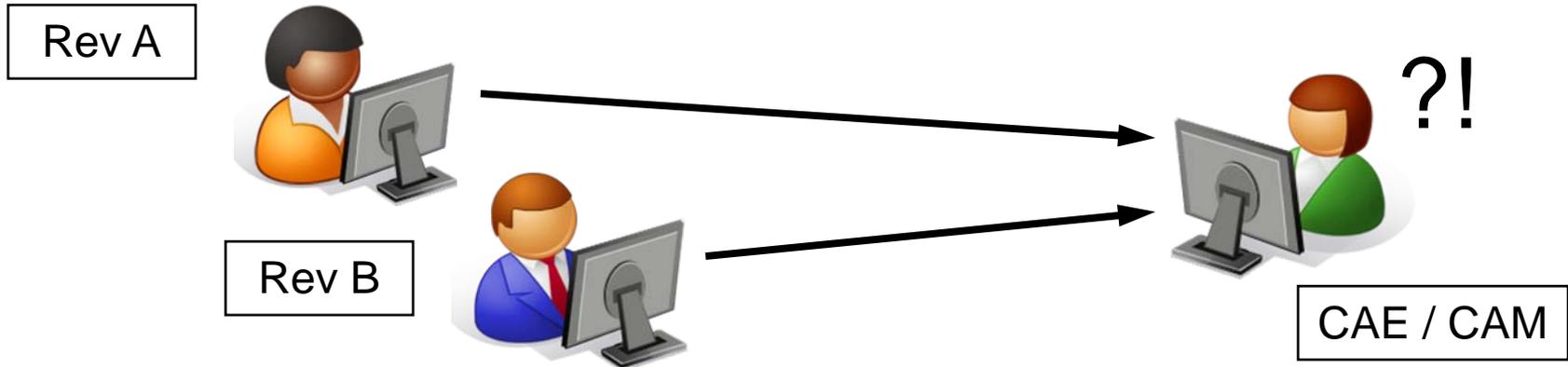
...Then the design model must be reusable in simulation, manufacturing, support, etc.

The Need for Simulation Validation



Unacceptable differences and unsynchronized changes undermine MBE integration of design and simulation

Design Change Validation



The Need for Manufacturing Validation

Engineering

Manufacturing

Defects?



← M B E →



Translation

Equivalent?

System A

System B

Extended Enterprise

Defects and translation differences undermine MBE integration of engineering and manufacturing

Model Validation Categories

Master Model

Structure

Completeness

Accuracy

Complexity

Realism

Derivative Model

Loss

Degradation

Confusion

Deviation

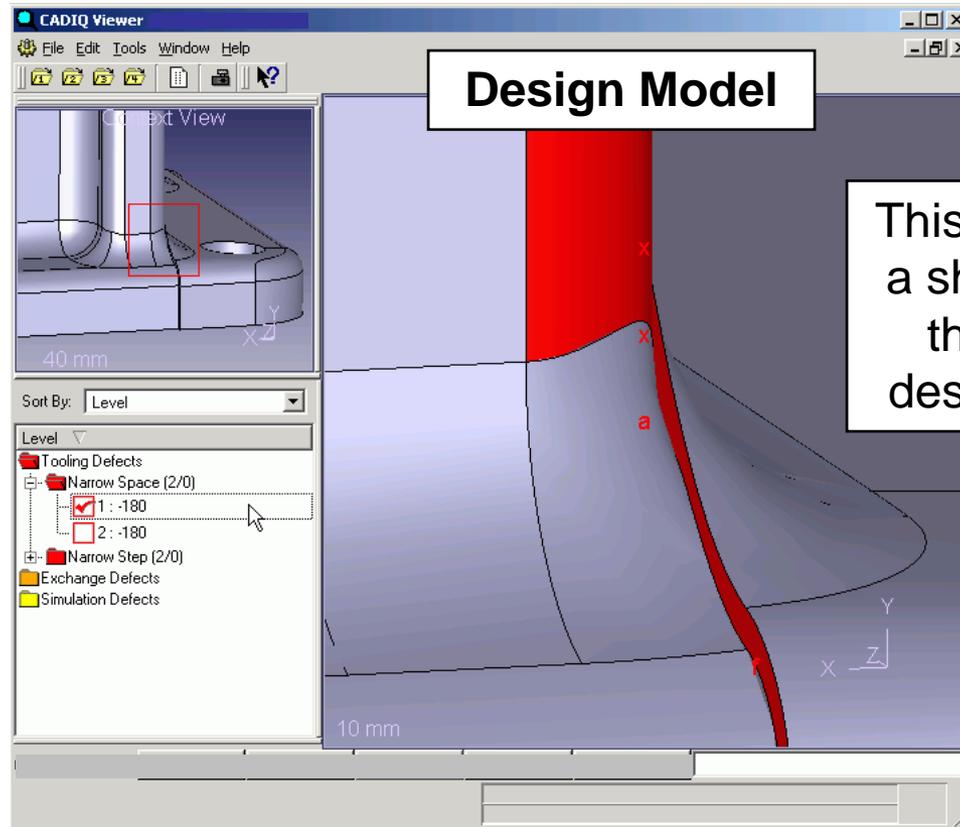
Design for Manufacturing Validation



CAD



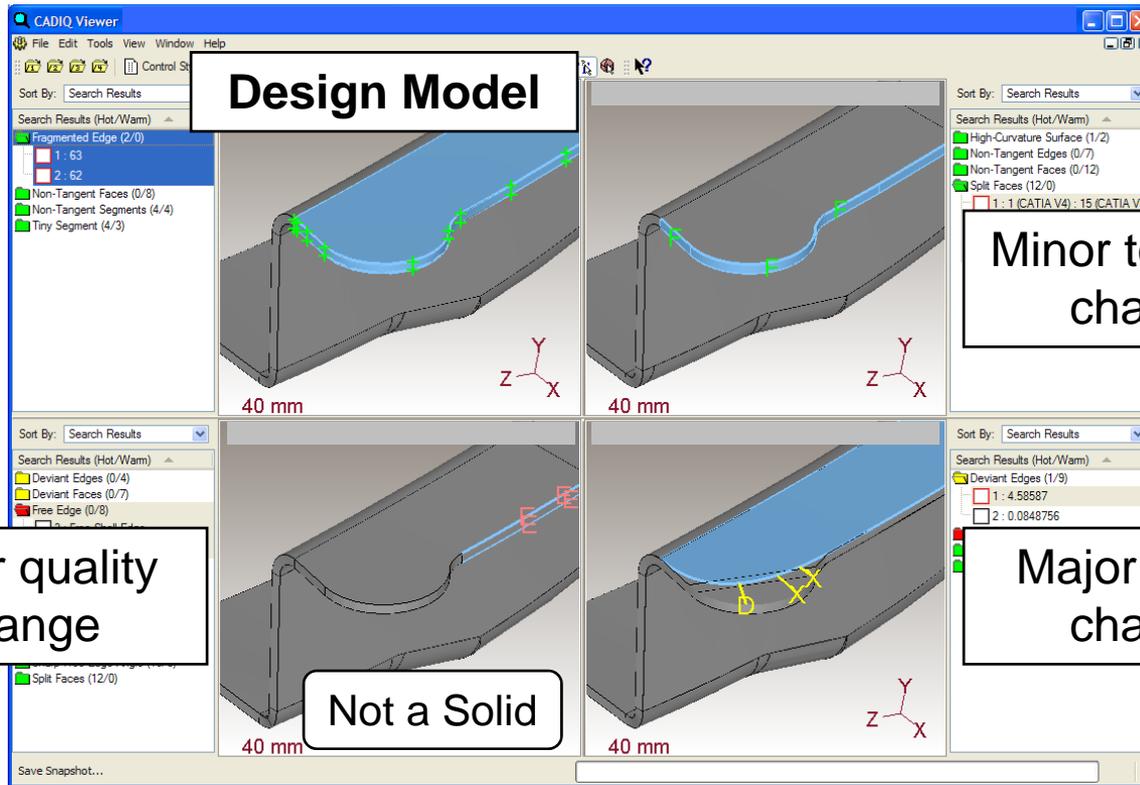
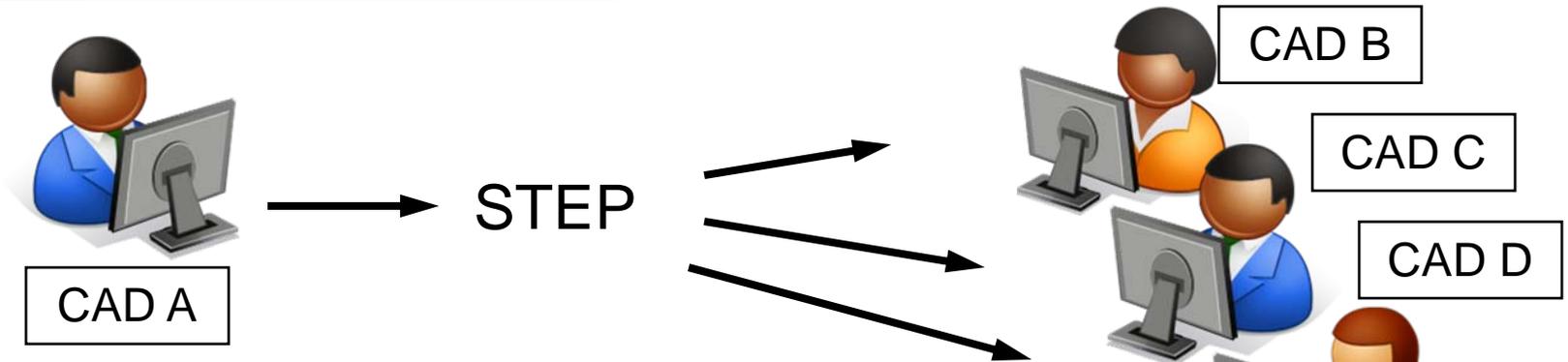
CAE / CAM



Design Model

This blend has a sharp offset that is not design intent.

Design Translation Validation



Advantages of Automated Validation

❑ Technical

- Comprehensive
- Consistent
- Repeatable
- Precise

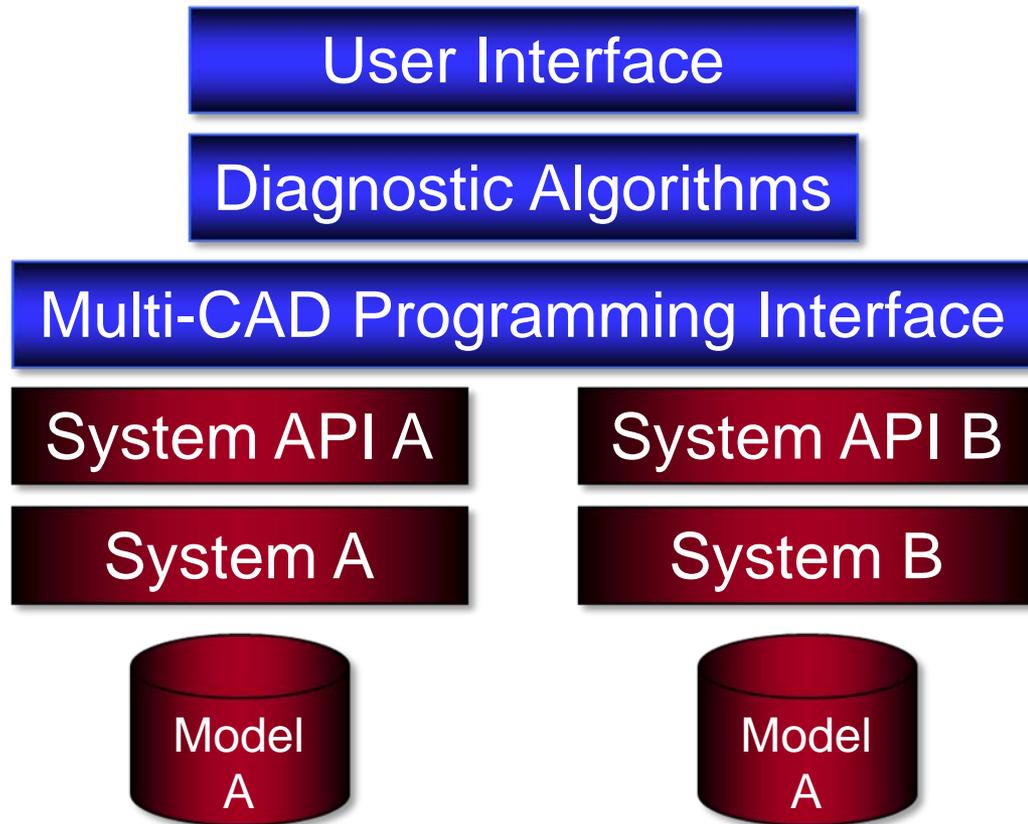
❑ Business

- Lower cost (after initial investment)
- Transferable to extended enterprise
- Supports process quality improvement

❑ Human

- Not dependent on human initiative (or lack thereof)
- Avoid employee burnout

Ideal Validation Software Architecture



Advantages

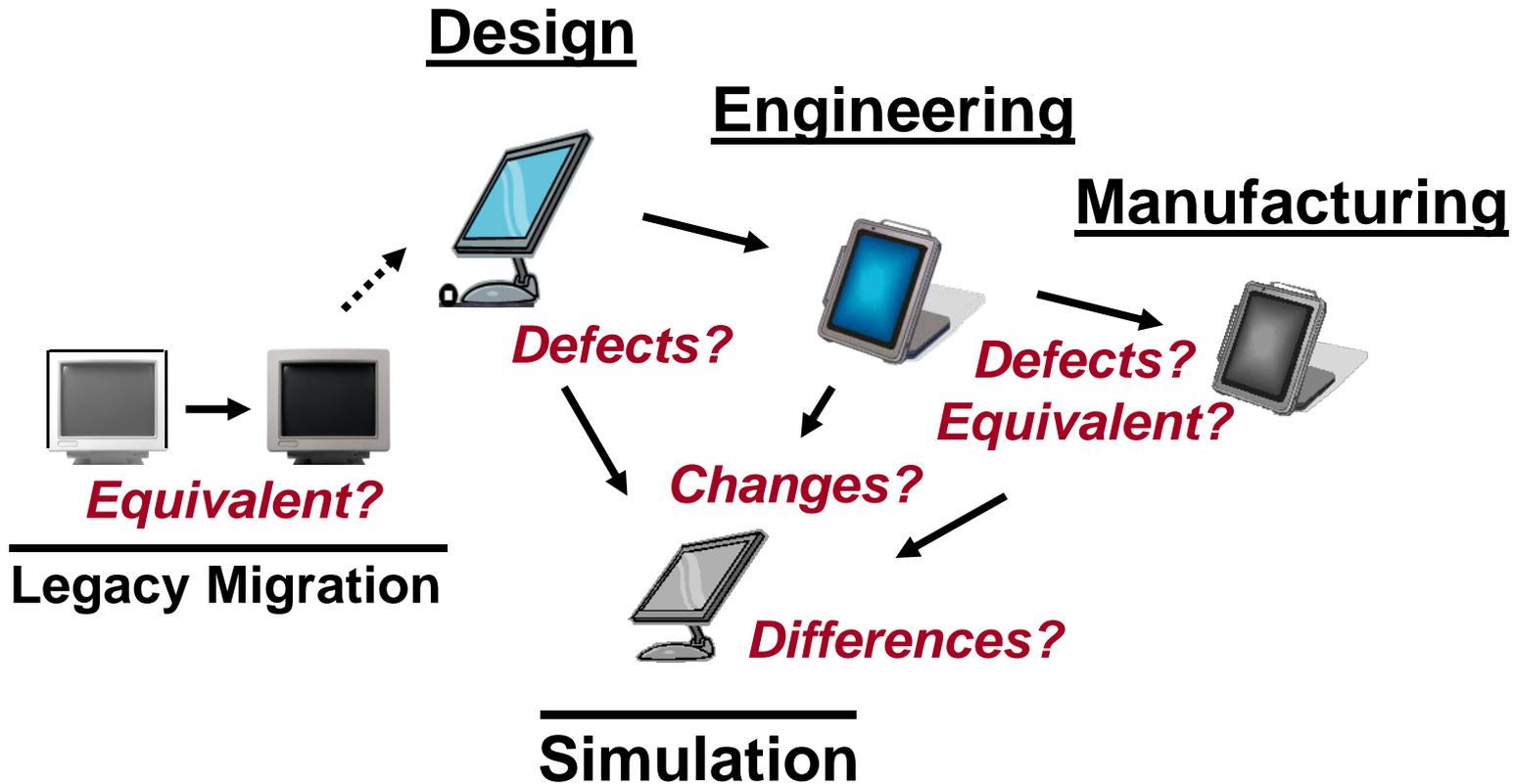
- Consistent functionality
- No data conversion
- Native system evaluators
- Access to full data model
- Rapid upgrades

Disadvantages

- System installation and licensing prerequisites

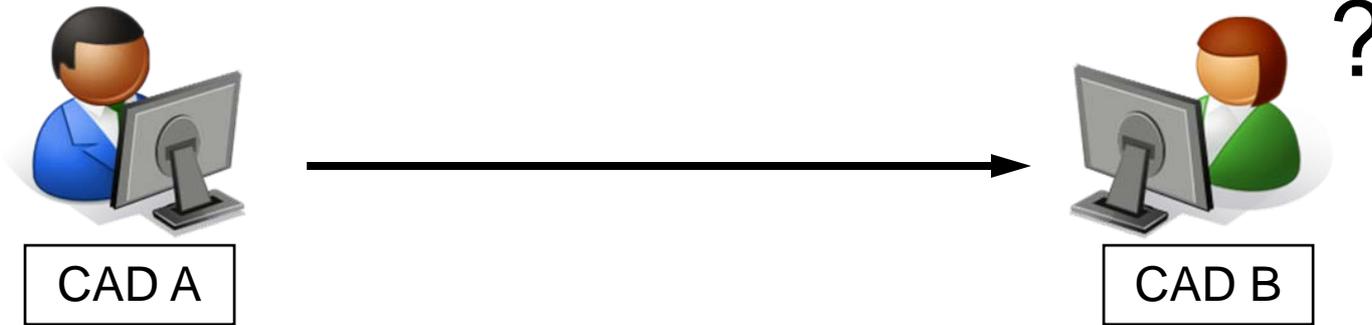
Powered by:
 python™

The Need for Legacy Migration Validation



***Unacceptable differences introduced during migration
undermine MBE reuse of legacy data.***

Legacy Migration Validation



The screenshot shows the CADIQ Viewer interface. The main window is split into two panes: "Legacy Model" on the left and "Migrated Model" on the right. Both panes display a 3D model of a mechanical part. The "Legacy Model" pane shows a complete, solid blue part with a red "S" on its side and a "20 in" dimension. The "Migrated Model" pane shows the same part, but it is semi-transparent, revealing a mesh structure underneath, and a red "S" is also present. The right-hand pane has a detailed "Level" list on the right side, which includes categories like "Form Changes", "Property Changes", "Shape Changes", "Topology Changes", and "Simulation Defects". The "Different Solid Location (1/0)" item is highlighted in blue. A text box at the bottom of the screenshot states: "Half of this model was lost after migrating the feature definition."

Legacy Migration Process Evaluation



Which process?

Current CAD

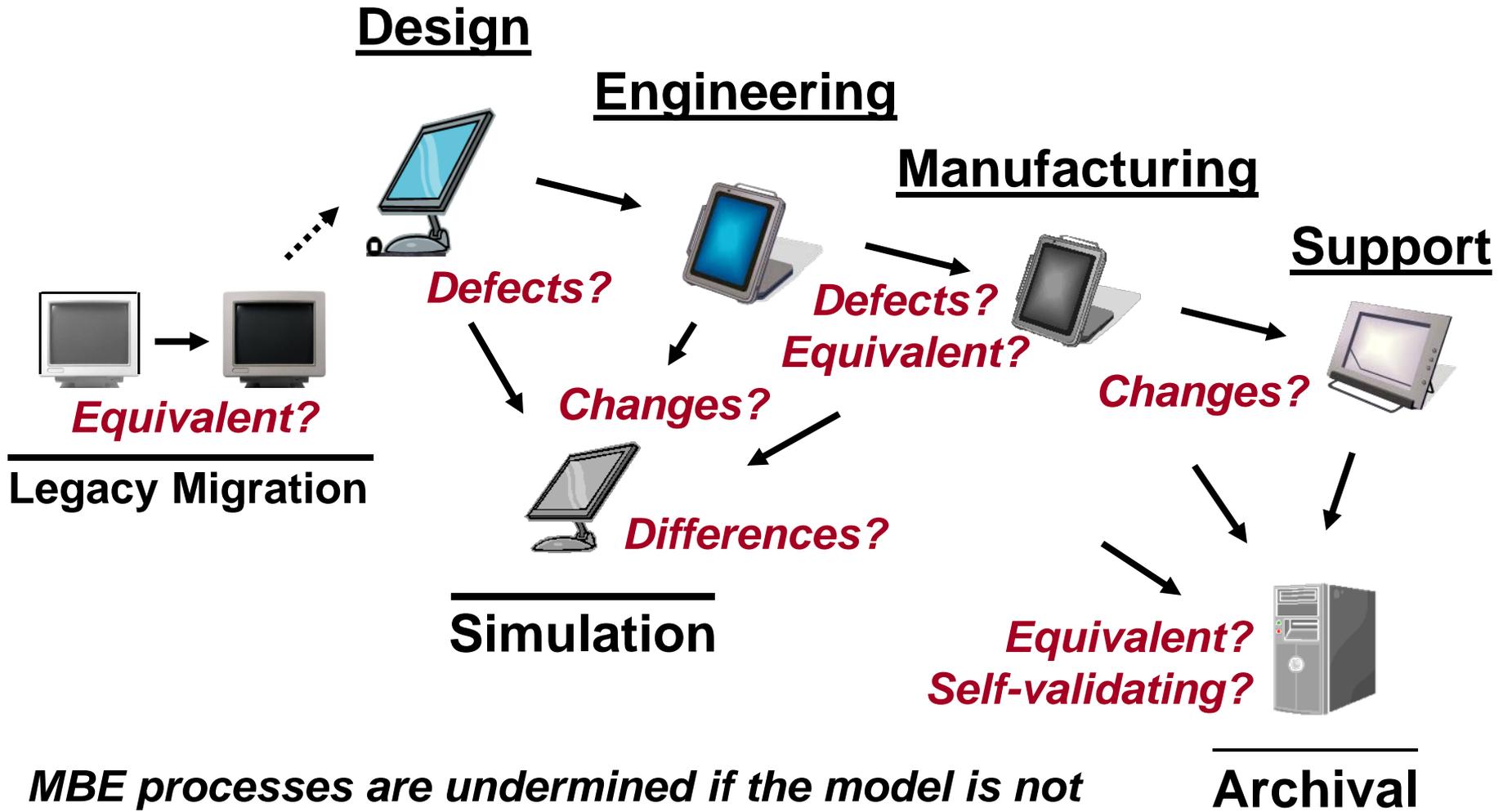
Legacy Model

STEP Translation
Minor changes
but no features

Feature Translation
Major changes

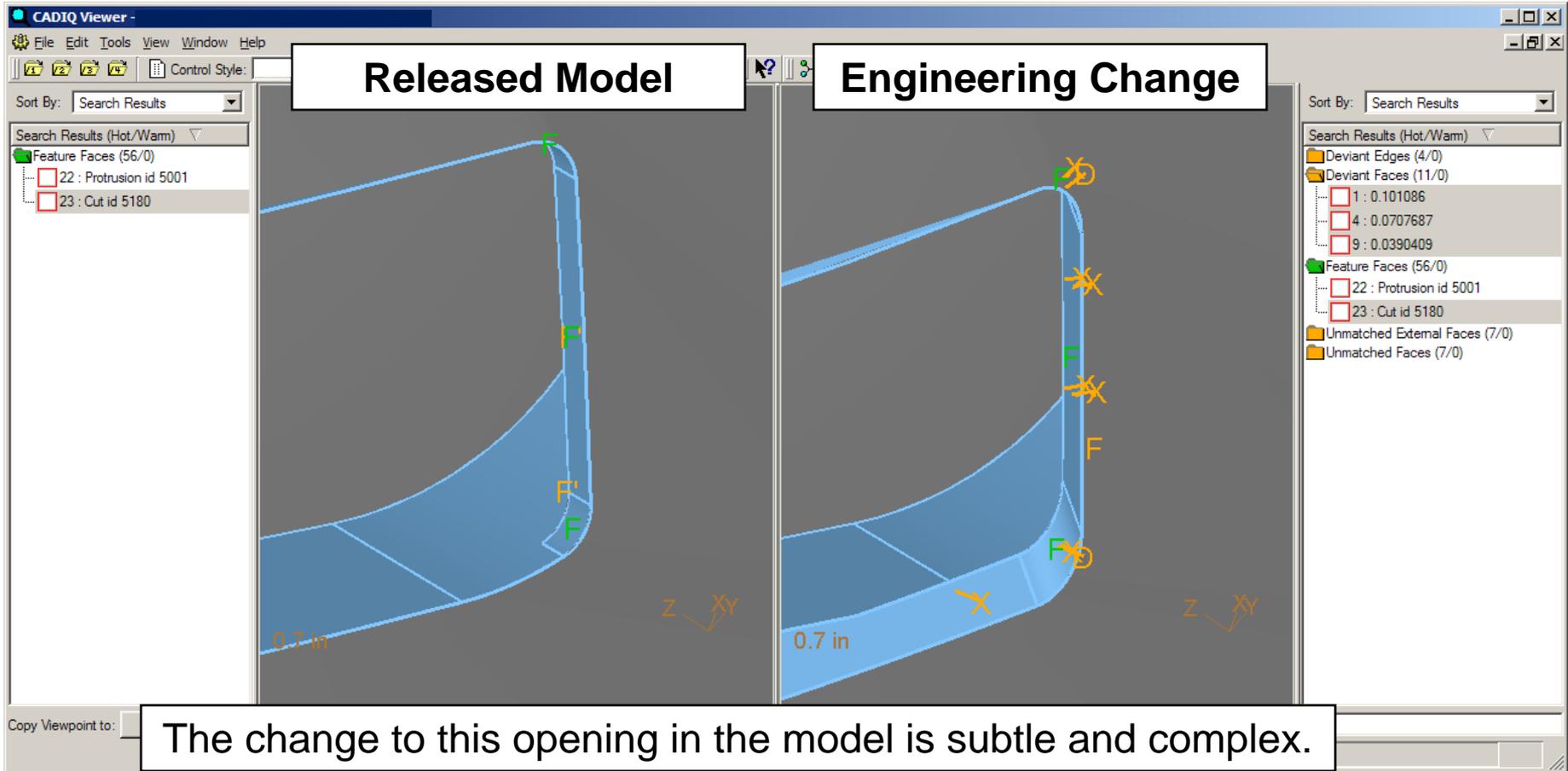
Manual Remastering
Unintentional changes

Product Lifecycle Transition Validation

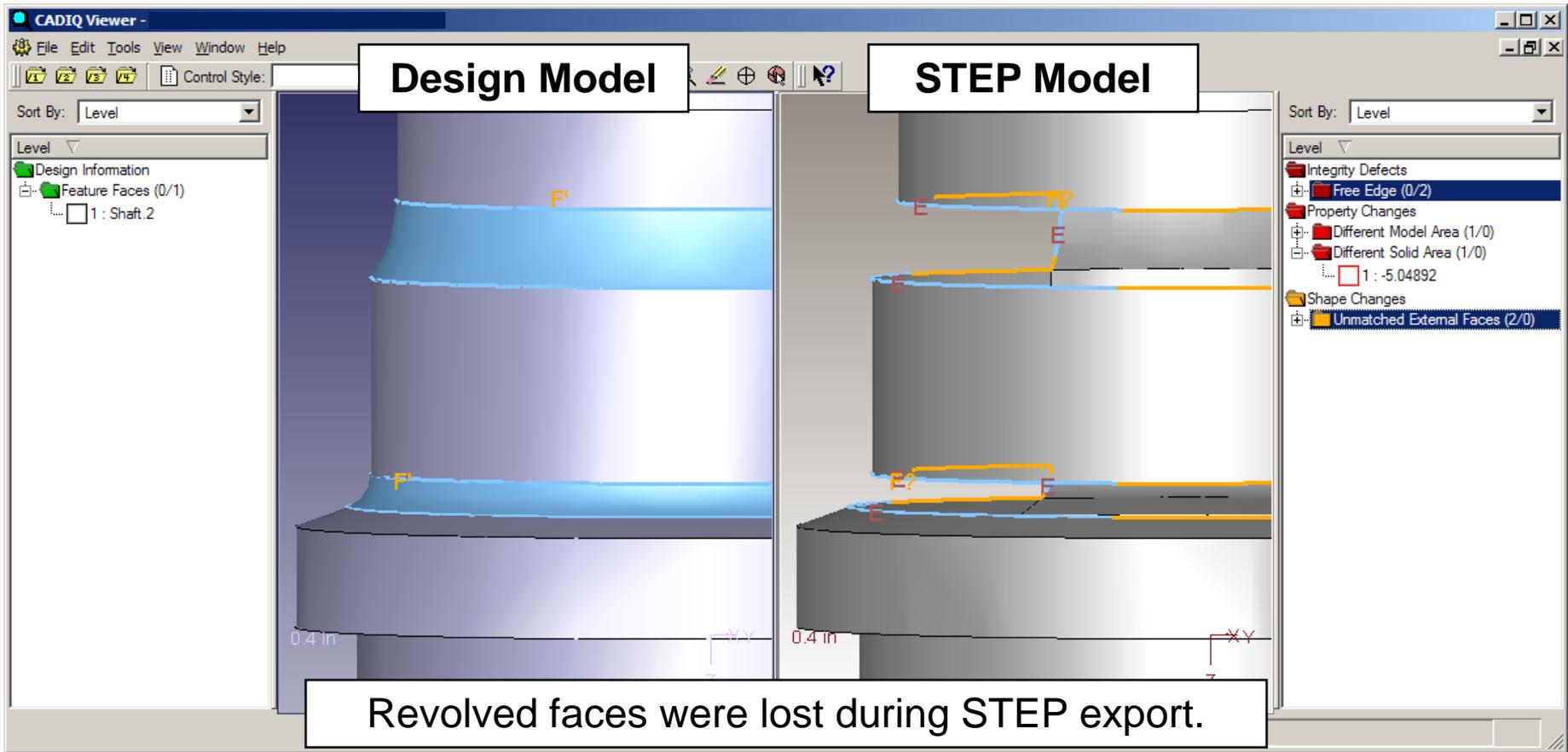
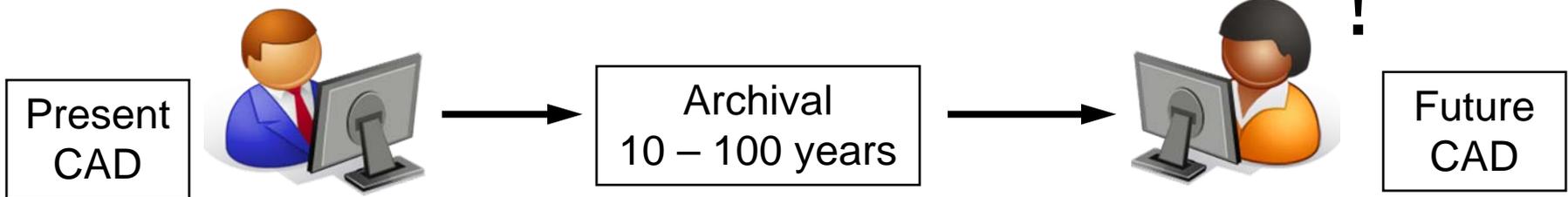


MBE processes are undermined if the model is not validated at critical transitions in the product lifecycle.

Engineering Change Validation



Part Model Archival Validation



Assembly Model Archival Validation

Design Model Assembly

Assembly after STEP export and re-import

Context View

The highlighted part's position within the assembly changed significantly.

300 mm

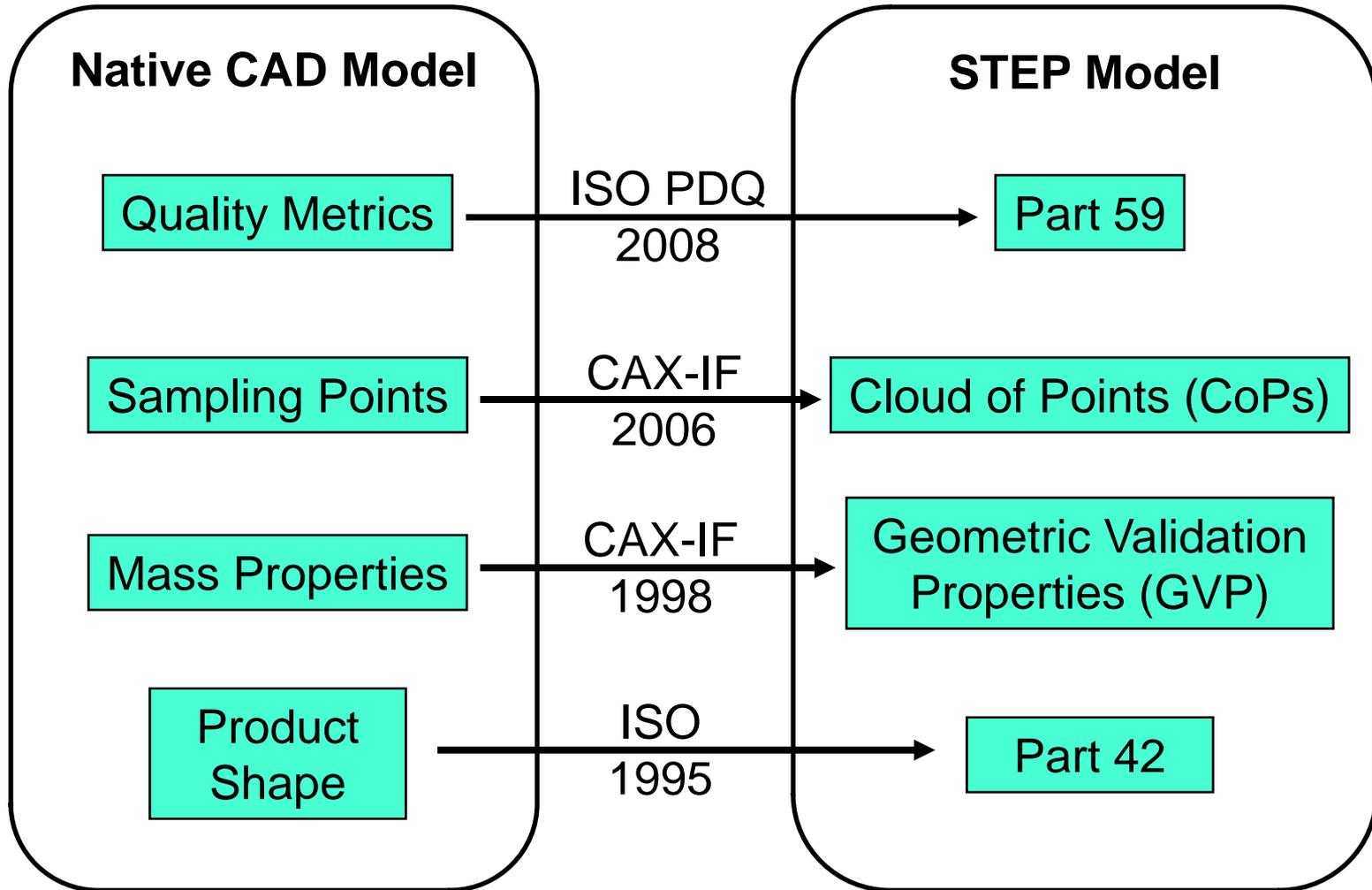
300 mm

900 mm

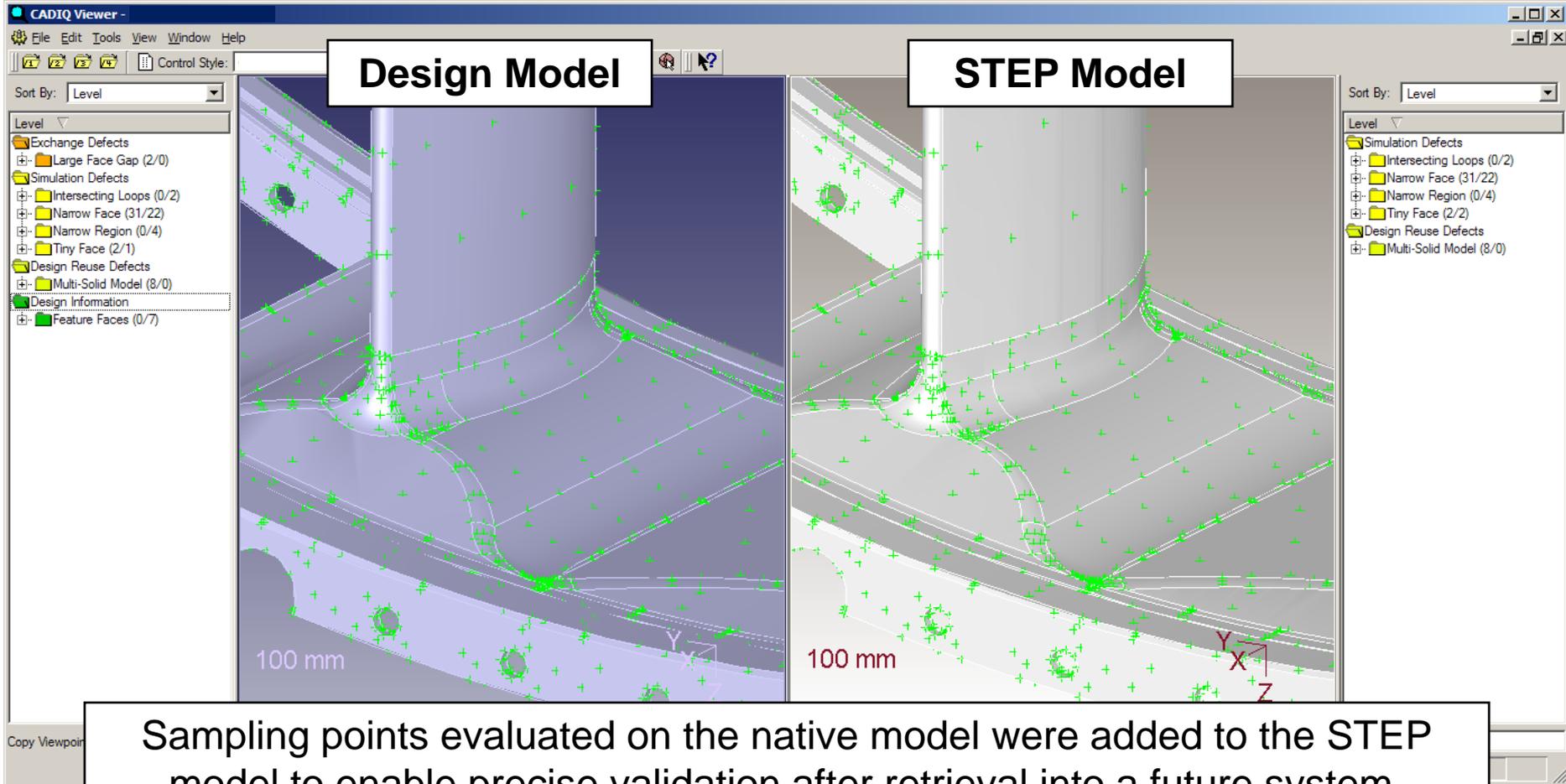
- Integrity Defects
 - Over-Used Edge (12/0)
- Tooling Defects
 - Narrow Space (34/70)
 - Narrow Volume (0/2)
 - Solid Void (48/0)
- Exchange Defects
 - Large Face Gap (4/0)
 - Sharp Face Angle (0/10)
- Simulation Defects
 - Intersecting Loops (4/24)
 - Narrow Face (4/7)
 - Narrow Region (0/48)
 - Self-Intersecting Loop (2/0)
- Design Reuse Defects
 - Multi-Solid Model (89/0)
- Design Information
 - Feature Faces (560/0)

- Property Changes
 - Different Face Area (0/22)
 - Different Solid Location (8/0)
- Tooling Defects
 - Narrow Space (34/71)
 - Narrow Volume (24/2)
 - Solid Void (48/0)
- Shape Changes
 - Deviant Faces (16/0)
 - Unmatched External Solid (7/0)
 - Unmatched Faces (24/0)
 - Unmatched Solid (7/0)
- Exchange Defects
 - Sharp Face Angle (0/8)
- Topology Changes
 - Complex Face Match (31/0)
 - Merged Face (12/0)
 - Split Faces (23/0)
- Simulation Defects
 - Intersecting Loops (16/12)
 - Narrow Face (4/6)
 - Narrow Region (24/26)
 - Self-Intersecting Loop (2/0)
- Design Reuse Defects
 - Multi-Solid Model (100/0)

Self-Validating STEP Models



STEP Cloud of Points Example



The Next Frontiers...

❑ Product Manufacturing Information (PMI)

- 3D geometric dimensions and tolerances (GD&T)
- Annotations (notes)

❑ Domain-Specific Models

- Composites
- Electrical harnesses

❑ Dissimilar Models

- Wireframe (legacy) data
- Collaboration (graphics) data
- Inspection (CMM) data
- Reverse engineering (point cloud) data

Raising the **Value** of your **Product Data** via integration and interoperability solutions

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