



YOUR CENTRAL SOURCE FOR DATA EXCHANGE

# Technical Road Blocks for a Model-Based Enterprise

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Senior Consultant

FOCUS INNOVATION SOLUTION CHALLENGE  
PARTNERSHIP INTEGRATION



# Introductions

- ITI TranscenData

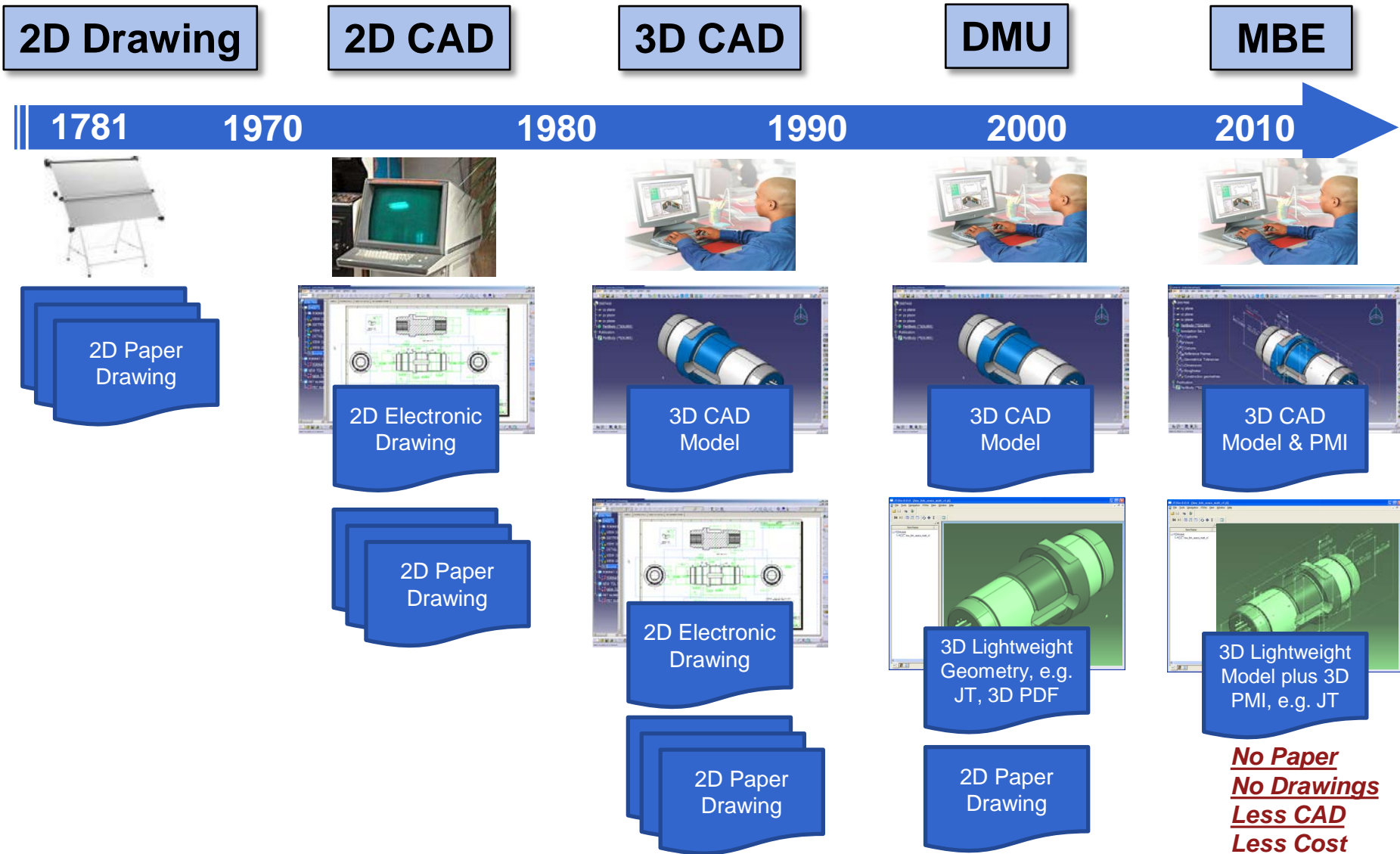
- Private company headquartered in Cincinnati since 1983
- Development offices in the United States, England, Israel and India
- Engineering software and services
  - PLM system migration solutions
  - **CAD interoperability solutions**

- Doug Cheney

- US and European upbringing
- Engineering education (Caltech and BYU)
- **CAD validation specialist**
  - Algorithms
  - International standards
  - Process improvement consulting



# The Digital Product Model Evolution



# Barriers to a Model-Based Enterprise (MBE)

## Non-Technical

- Limited capital expense budgets
- Legacy product reuse rather than new product design
- Human resistance to change

## Technical

- Incomplete CAx system functionality



- Lagging standards and regulations



- Digital data variation

# **Inertia**

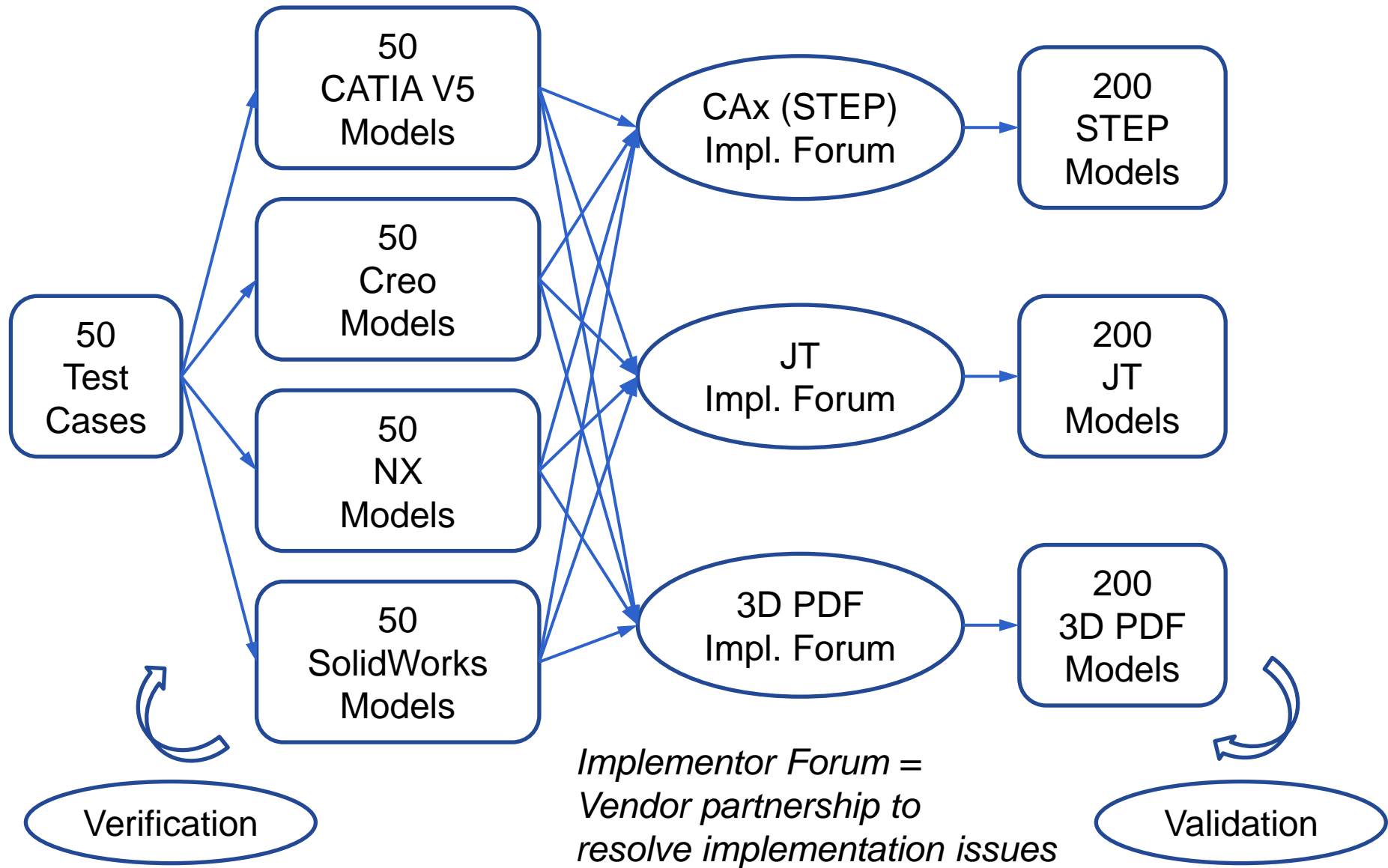
# NIST MBE

## PMI Validation and Conformance Testing Program

Develop test case **definitions**,  
test case **models** and  
software **algorithms**  
sufficient to ***measure conformance*** of CAD systems  
**to** American Society of Mechanical Engineers (ASME)  
**standards** for Product Manufacturing Information (PMI)

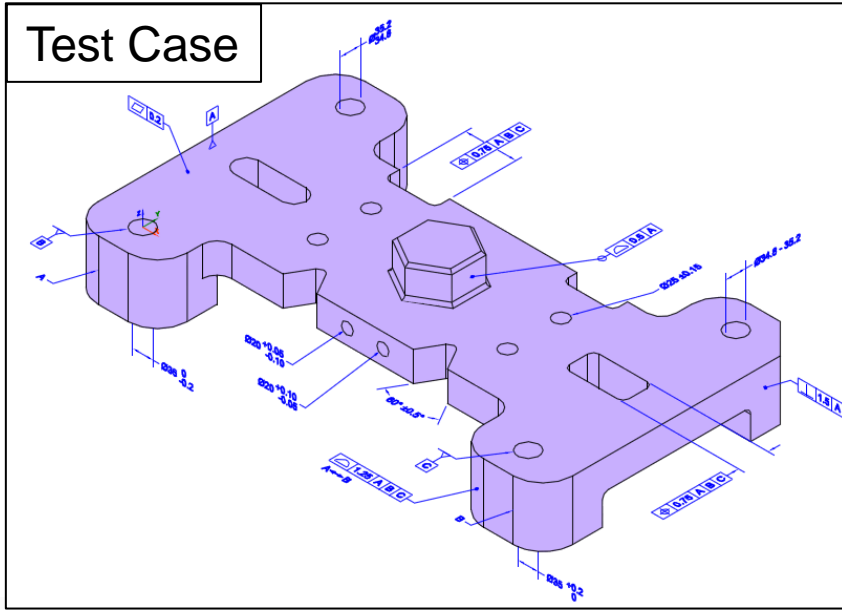


# NIST 3D MBE PMI Validation Data Process Flow

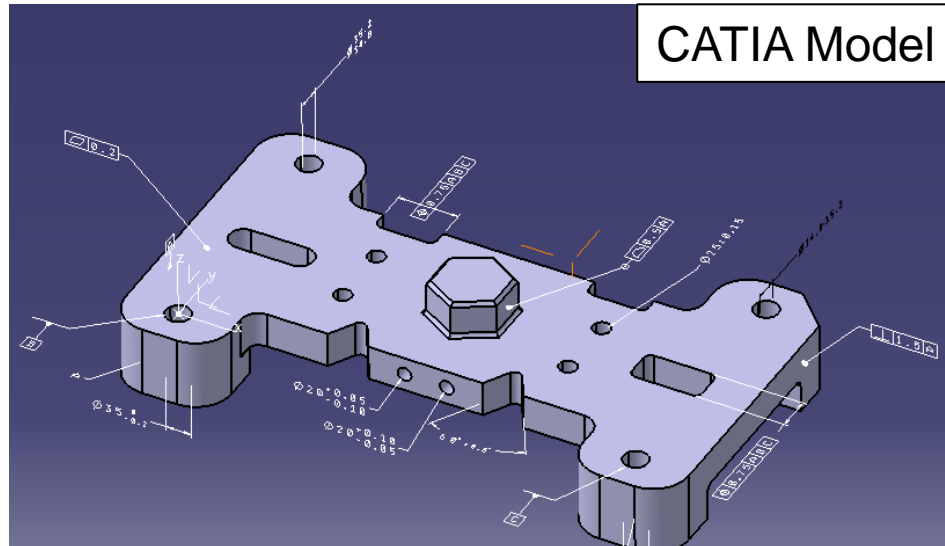


# NIST 3D MBE PMI Validation Test Case Example

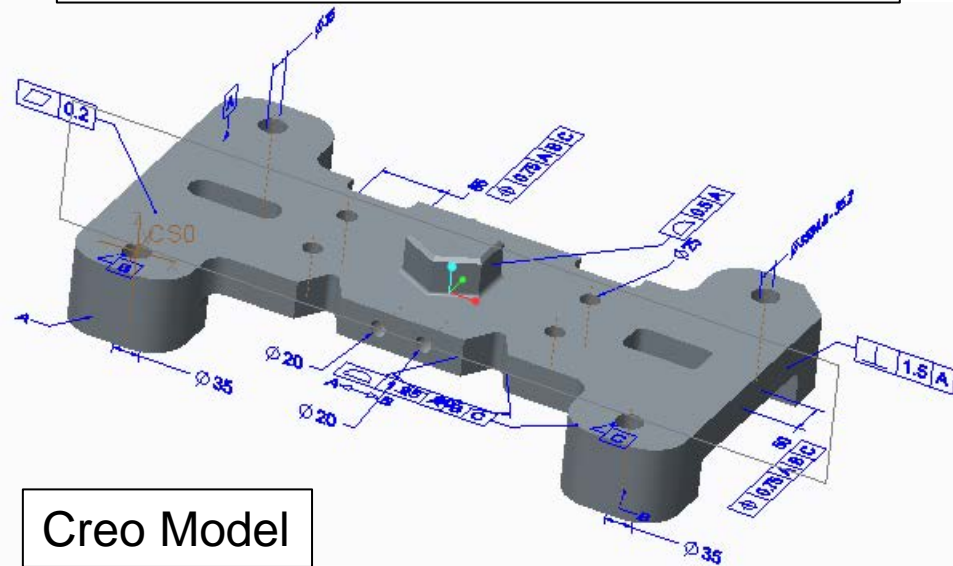
Test Case



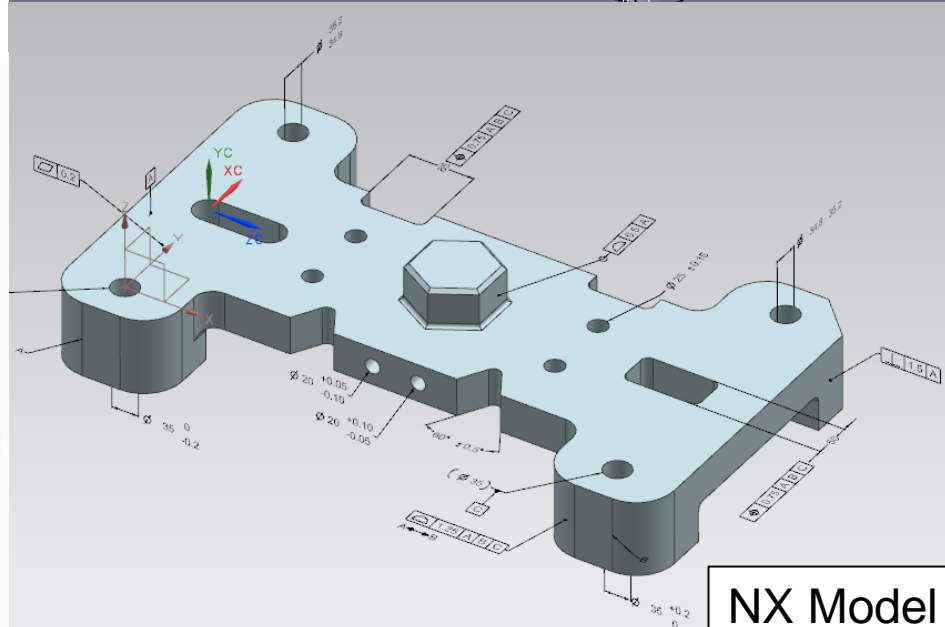
CATIA Model



Creo Model



NX Model





# Lagging Standards and Regulations – Not for long!

- International Data Modeling Standards

- ISO 10303-242 STEP AP242 = AP203 x AP214
- ISO 14306 JT
- ISO 14739-1 PDF with PRC



- FAA Aircraft Type Certification

- MBD approved for Gulfstream G650 and Boeing 787
- Other aircraft programs pending



- Department of Defense Regulations

- MIL-STD-31000 Revision A
- Technical Data Package (TDP) can be 3D with PMI

Note: This draft, dated 17 August 2012, prepared by U.S. Army ARDEC (AR), RDAR-QES-E, Picatinny Arsenal, NJ has not been approved and is subject to modification. DO NOT USE PRIOR TO OFFICIAL APPROVAL. Project: SESS-2012-013.

NOT MEASUREMENT SENSITIVE

MIL-STD-31000A  
**DRAFT**  
SUPERSEDING  
MIL-STD-31000  
5 November 2009



DEPARTMENT OF DEFENSE  
STANDARD PRACTICE

TECHNICAL DATA PACKAGES

This standard is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE.

1.1 This standard provides requirements for the deliverable data products associated with a technical data package (TDP) and its related TDP data management products. A TDP contains elements, is described by a level and type, and may have associated metadata and supplementary technical data. TDP contains a sub-set of product data and product data is a sub-set of technical data. These relationships are shown in the hierarchical breakdown of data in Figure 1.



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- Digital data variation

# **Inertia**

# Types of Digital Data Variation

## 1. Master Design Interpretation

- Confusing structure
- Inconsistent data
- Unrealistic features

Can it be manufactured?

## 2. Data Translation/Migration

CAD A to CAD B or  
CAD A Rev 1 to Rev 2

- Data loss
- Degradation
- Unacceptable change

Is it equivalent?

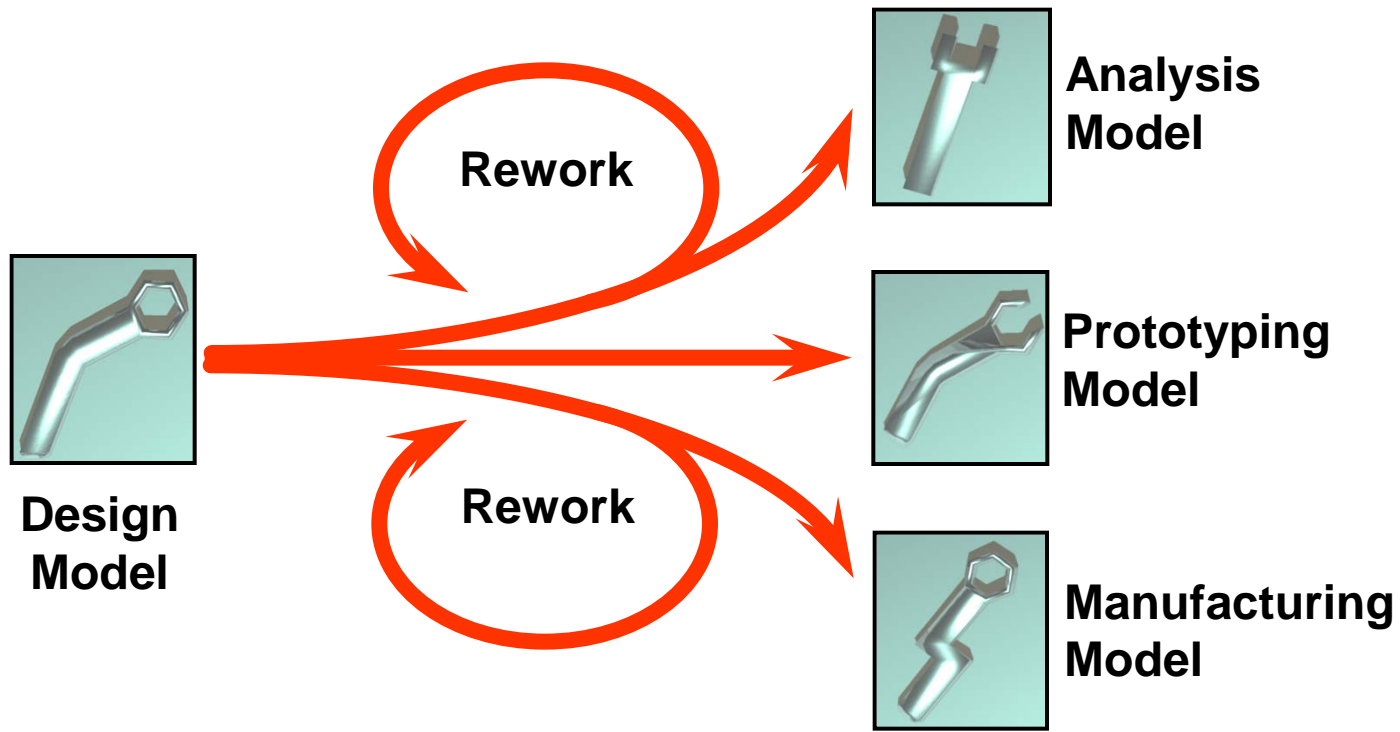
## 3. Engineering Revision

- Unintentional change
- Undocumented change

Is it correct and clear?

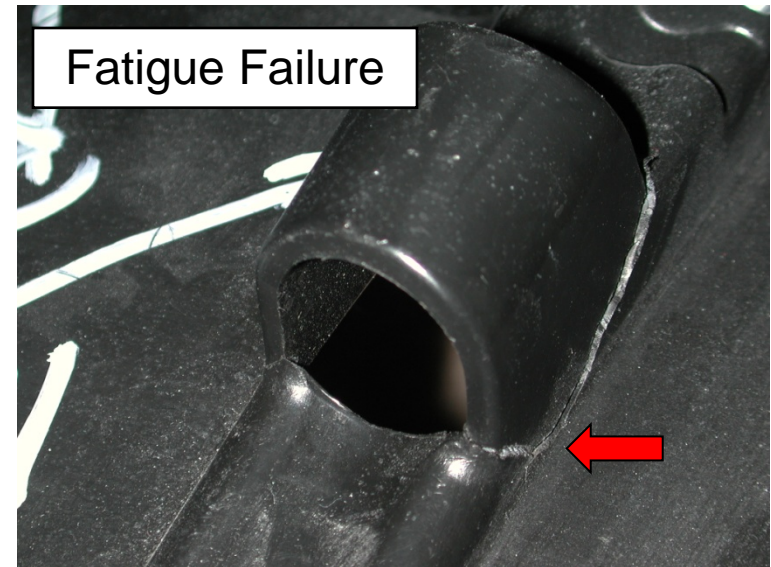
# Master Design Interpretation Divergence

- Unrealistic (ambiguous) features in models must be interpreted by downstream users
- Different interpretations can affect part quality

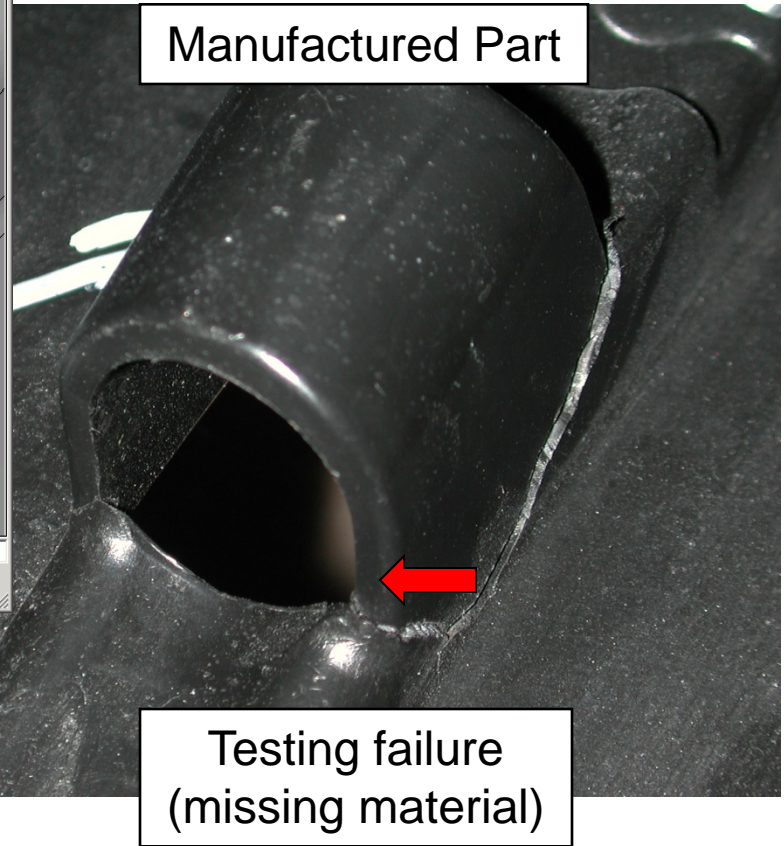
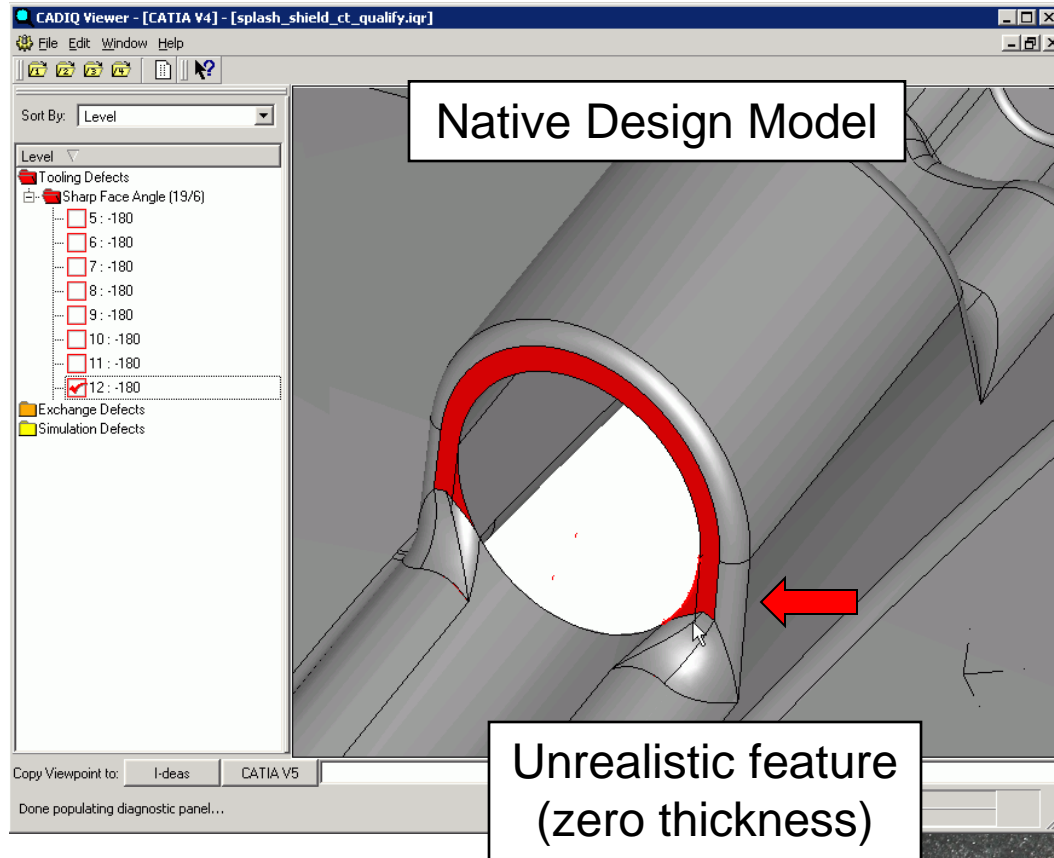


# Master Design Interpretation Divergence Example

- Simulation approved the design
- Manufacturing produced initial parts from native model
- All parts failed during final testing
- Caused last-minute schedule delay and retooling

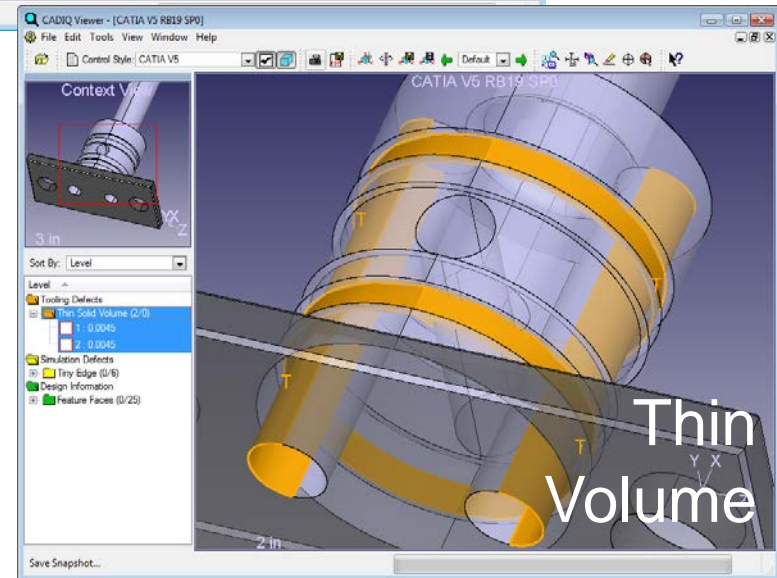
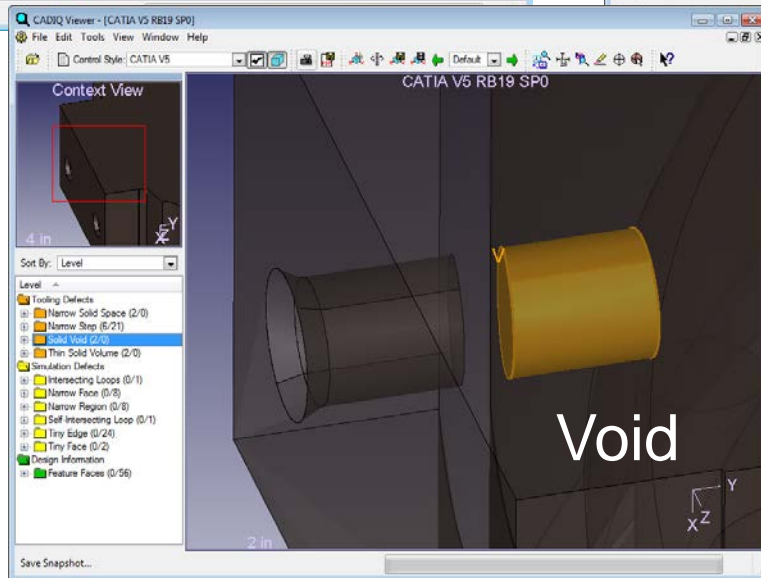
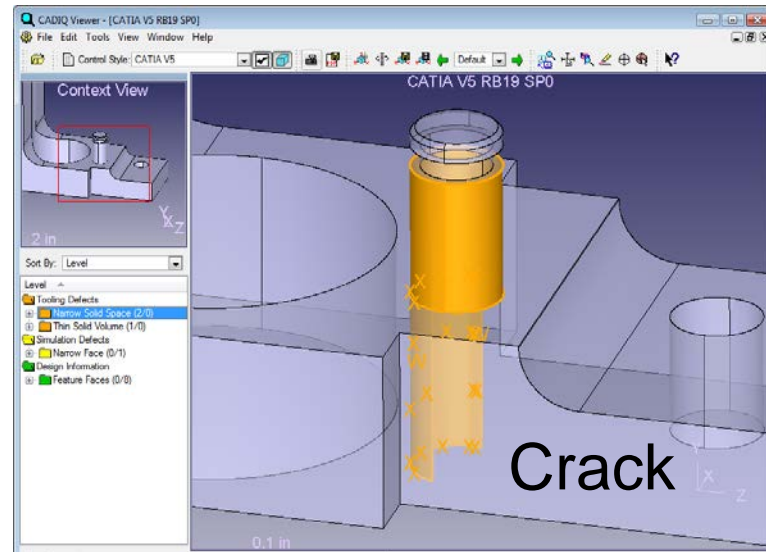
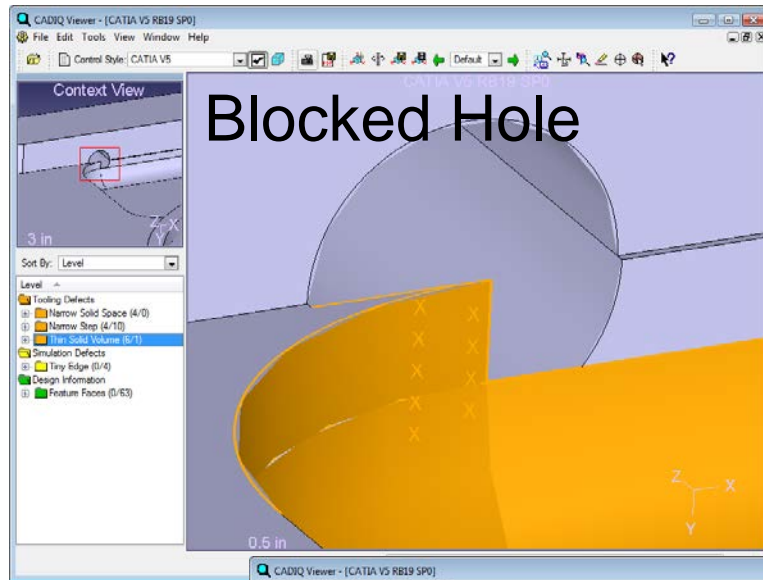


# Master Design Interpretation Divergence Example

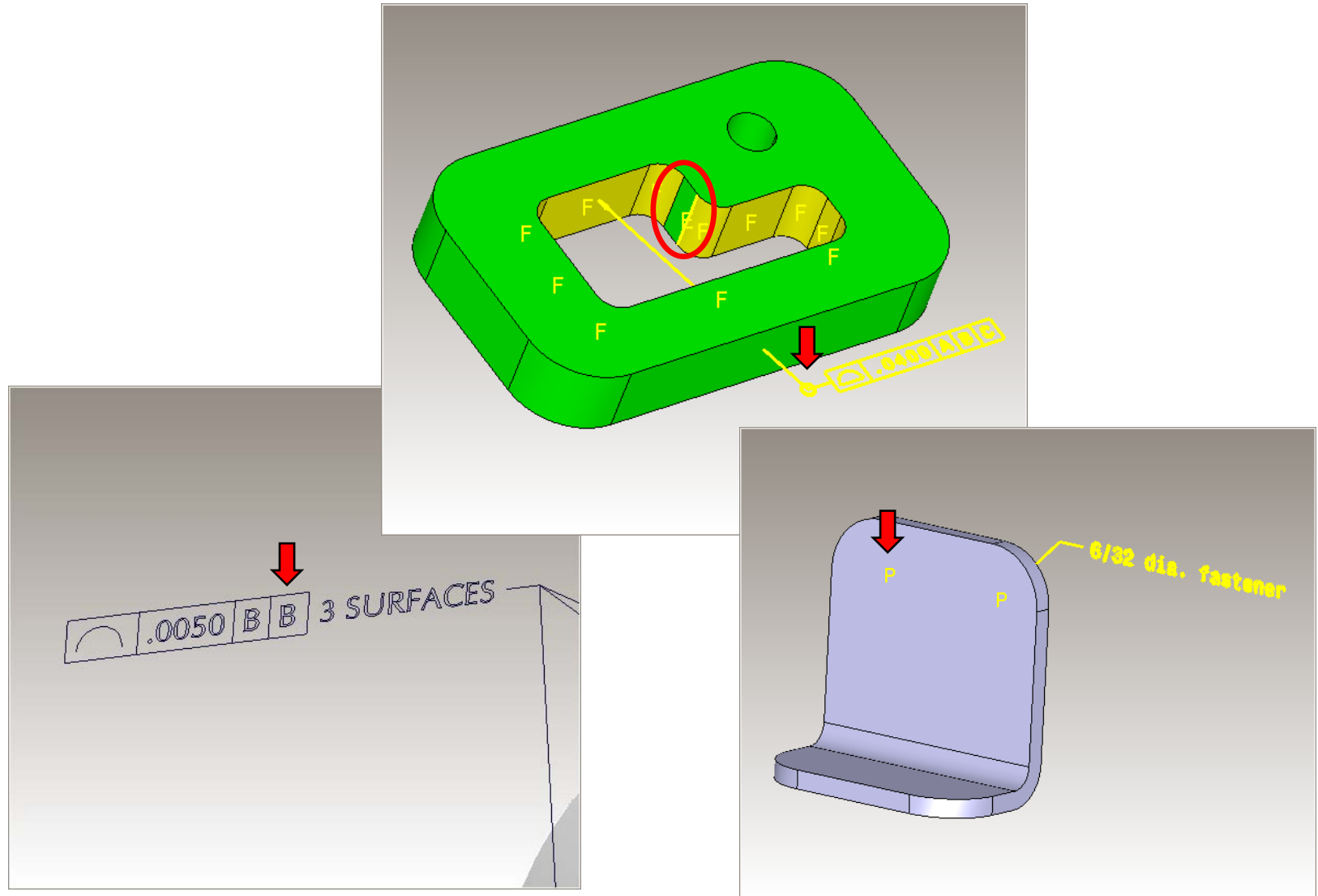




# Master Design Geometry Defect Examples



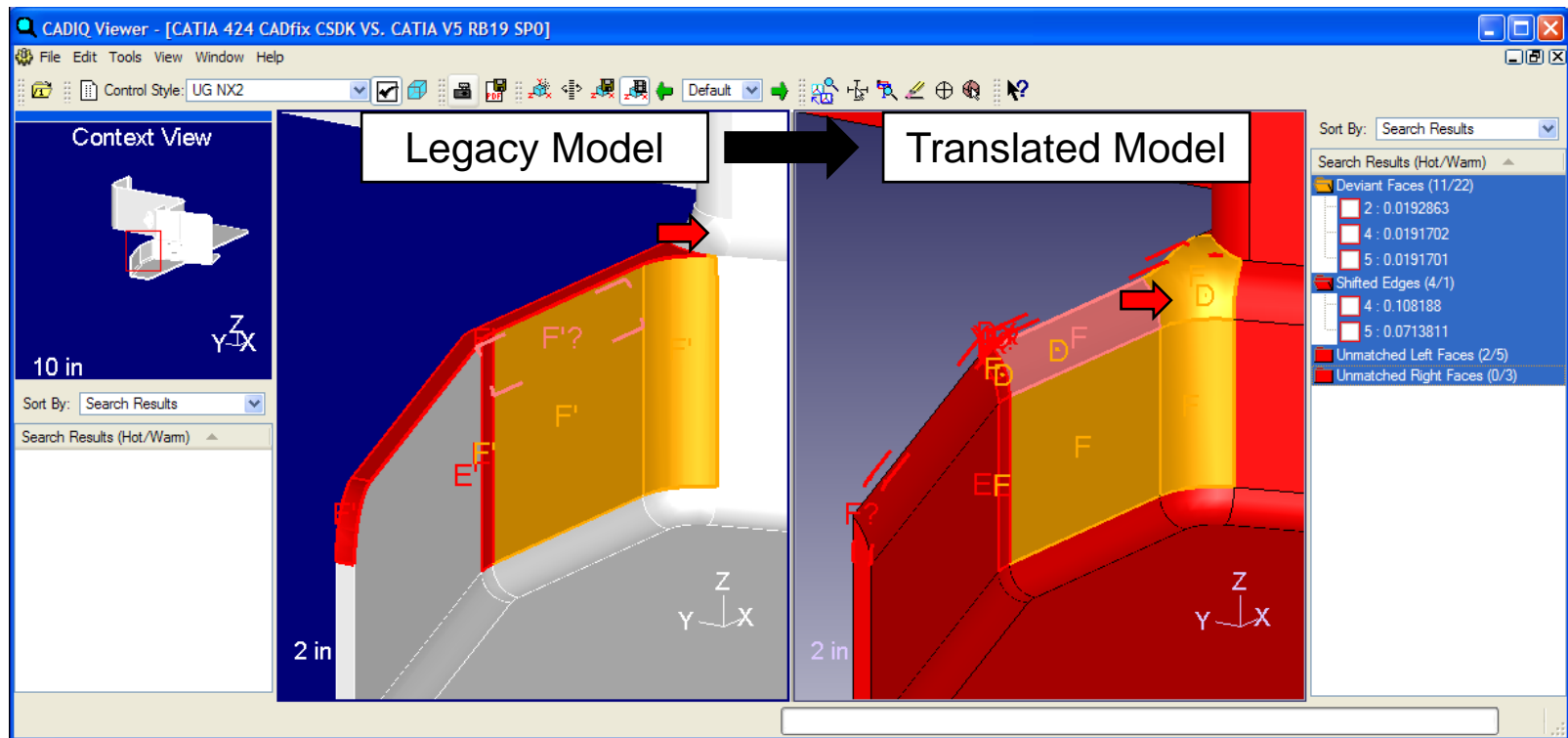
# Master Design PMI Defect Examples





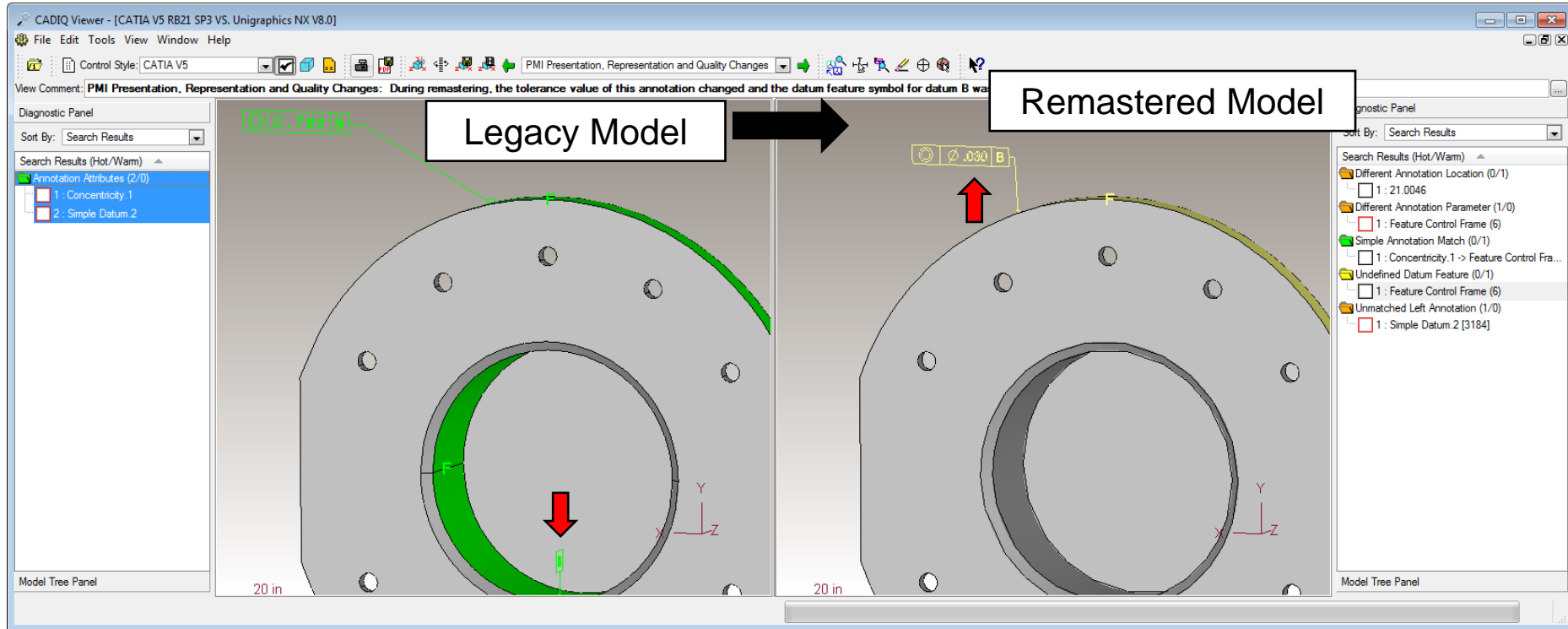
# Geometry Translation Variation Example

- Parametric design features preserved
- Different geometry solution in target system
- Fillet converted into a round which extends along top of flange



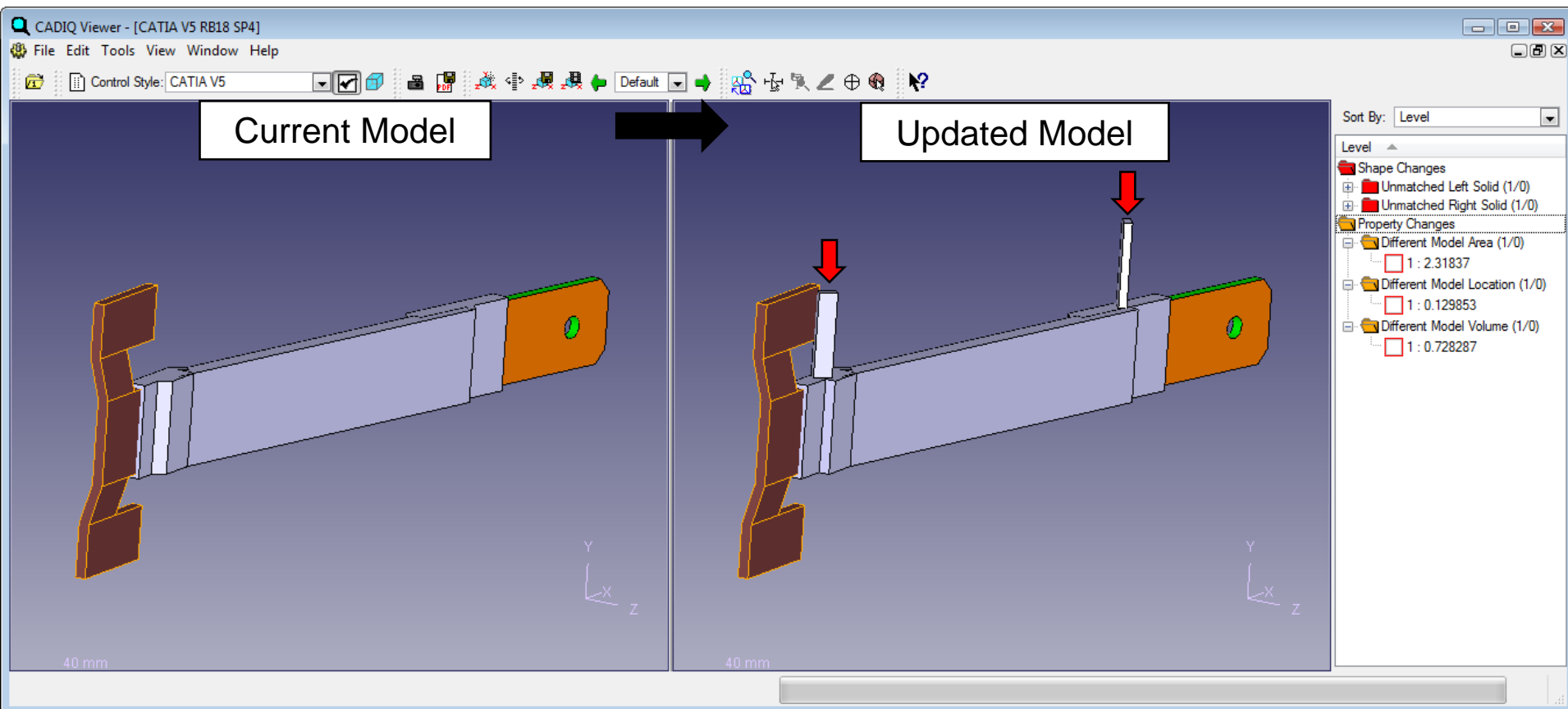
# PMI Remastering Variation Example

- Different graphical presentation (expected, acceptable)
- Lost datum feature symbol
- Tolerance value change



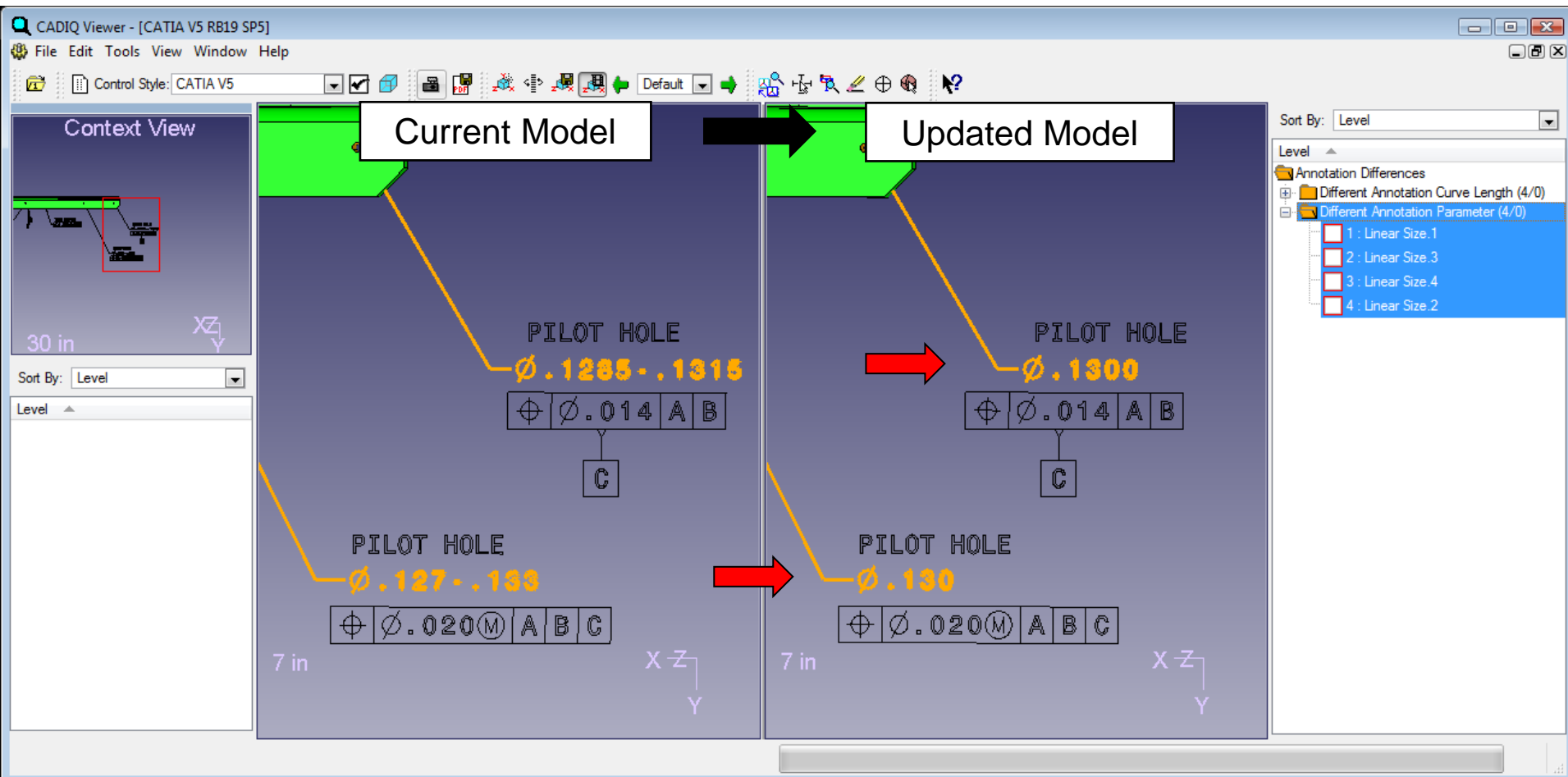
# Geometry Migration Variation Example

The geometry created by these features was added when all features in the model were **updated** in the **new version** of the CAD system



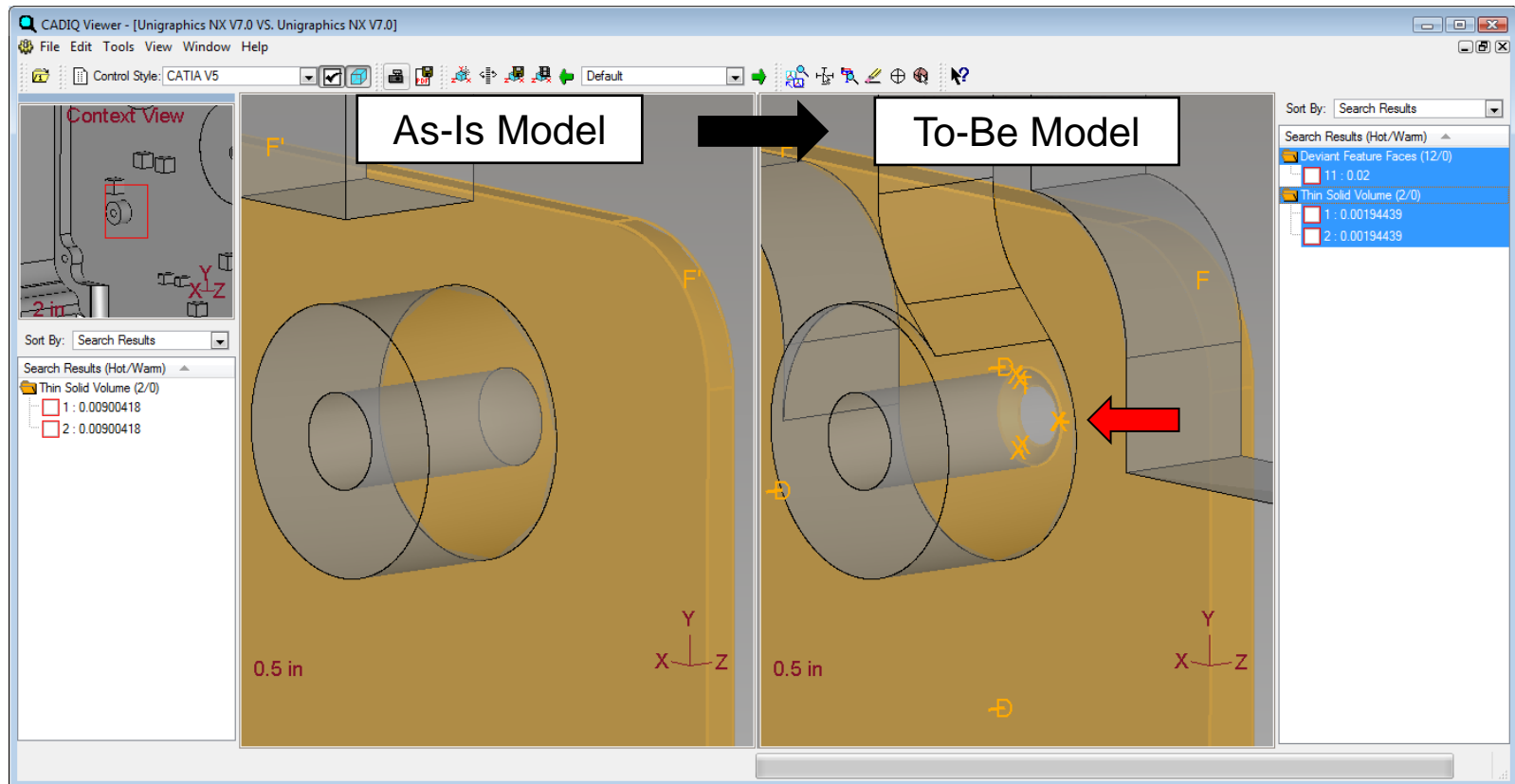
# PMI Migration Variation Example

Dimension display values changed when model were **updated** in the **new version** of the CAD system



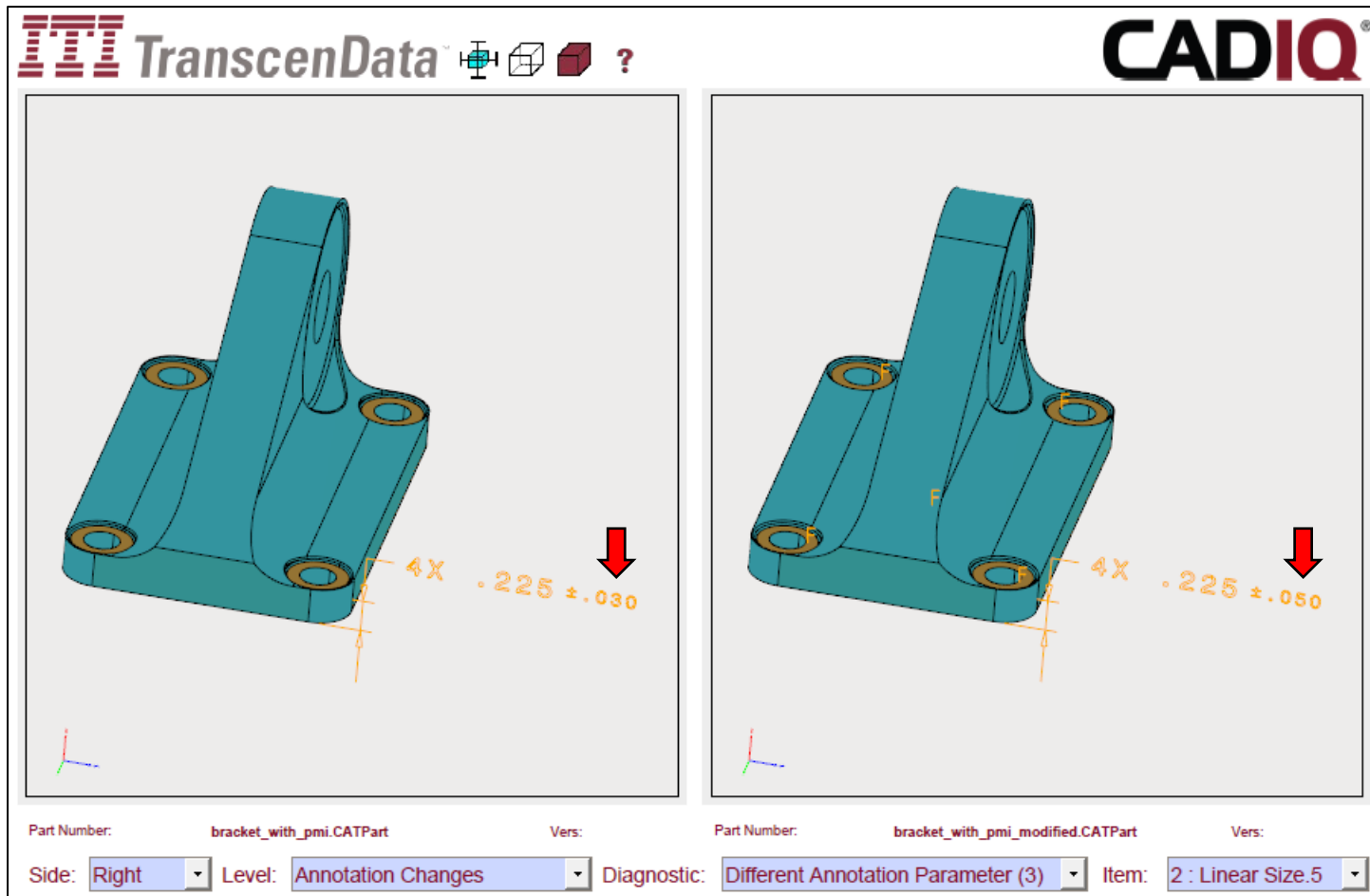
# Unintentional Revision Change Example

- Pocket depth on back side increased
- Hole break-out introduced
- Missed by drawing checker reviewing as-is drawing redline



# Intentional Revision Change Documentation

- Side-by-side 3D PDF with synchronized graphics
- Each geometric and PMI change highlighted separately



# Managing Variation in a Drawing-Based Enterprise

- Simpler data: 2D geometry, GD&T and notes
- Drawing checking before release
- Human interpretation in all downstream processes
  - Tooling, process planning, inspection
- Only graphical presentation must be translated and viewed
- Sufficient time for checking, release and consumption

***Controlled  
with  
Flexibility***



# Increasing Variation in a Model-Based Enterprise

- Complex data: 3D geometry, design features and PMI
- Limited checking before release
- Automated system consumption
- Precise representation must be translated and interpreted
- Fewer iterations, less time to market

***Uncontrolled  
yet  
Highly-Constrained***

# Why Not Continue Manual Checking of MBE Models?

- Complex
- Tedious
- Mind-numbing

***Time-consuming  
Expensive  
and  
Error-prone***



# Managing Variation in a Model-Based Enterprise

1. Automated design checking and expert review before release
  - Consistent structure
  - Complete content
  - Realistic features
2. Automated translation validation before delivery
  - No data loss or degradation
  - Only negligible changes
3. Automated ECO validation before release
  - No unintentional changes
  - Clearly document intentional changes

***Early warning  
systems  
with  
Issue resolution  
processes***



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# Questions and Comments?

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