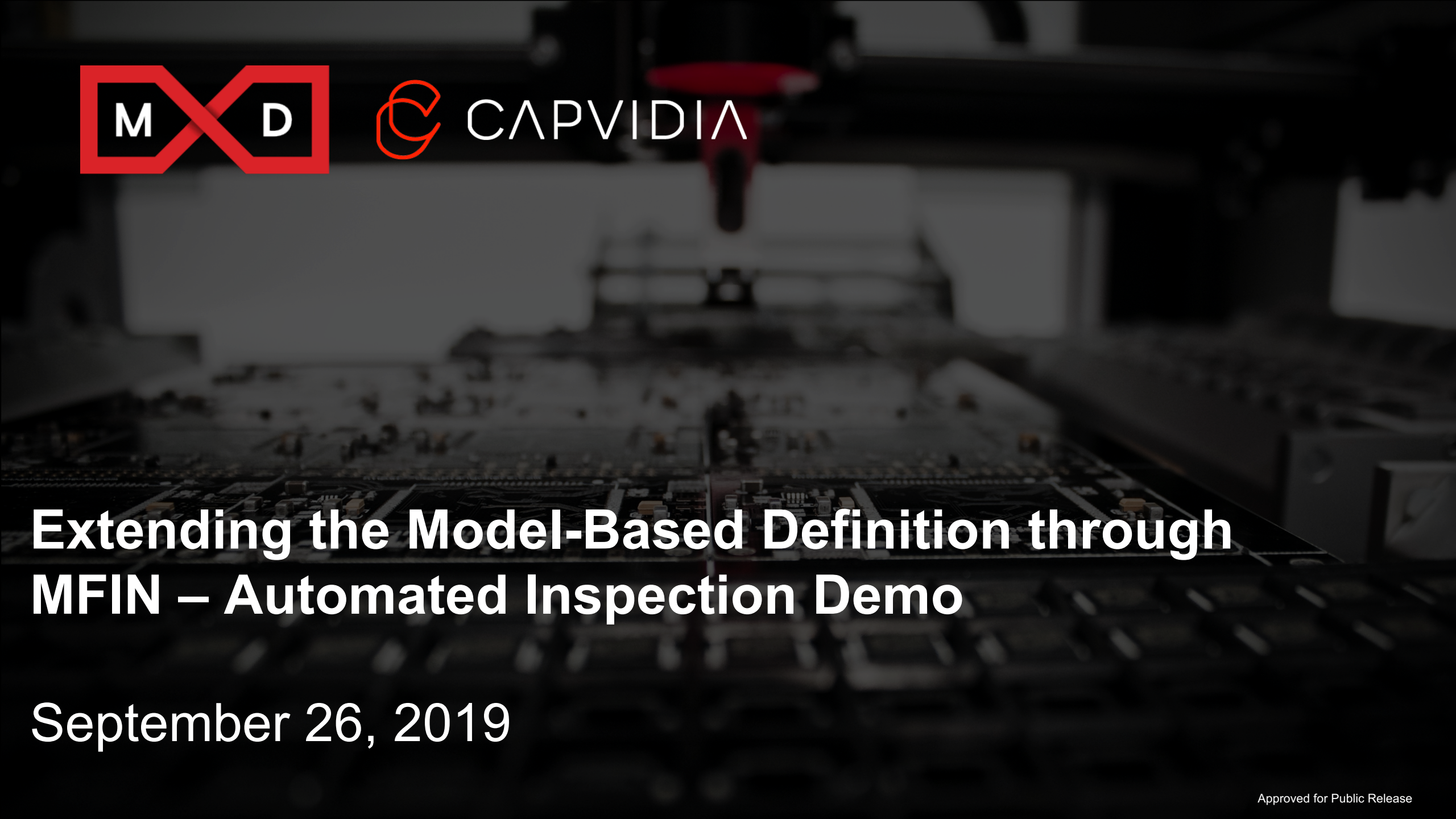


Extending the Model-Based Definition through MFIN – Automated Inspection Demo

September 26, 2019


LOCKHEED MARTIN


PURDUE
UNIVERSITY


ROLLS
ROYCE
Rolls-Royce


SIEMENS


CAPVIDIA


MSC Software


MATERIALS DATA
MANAGEMENT


ptc


TechAzul


M
D

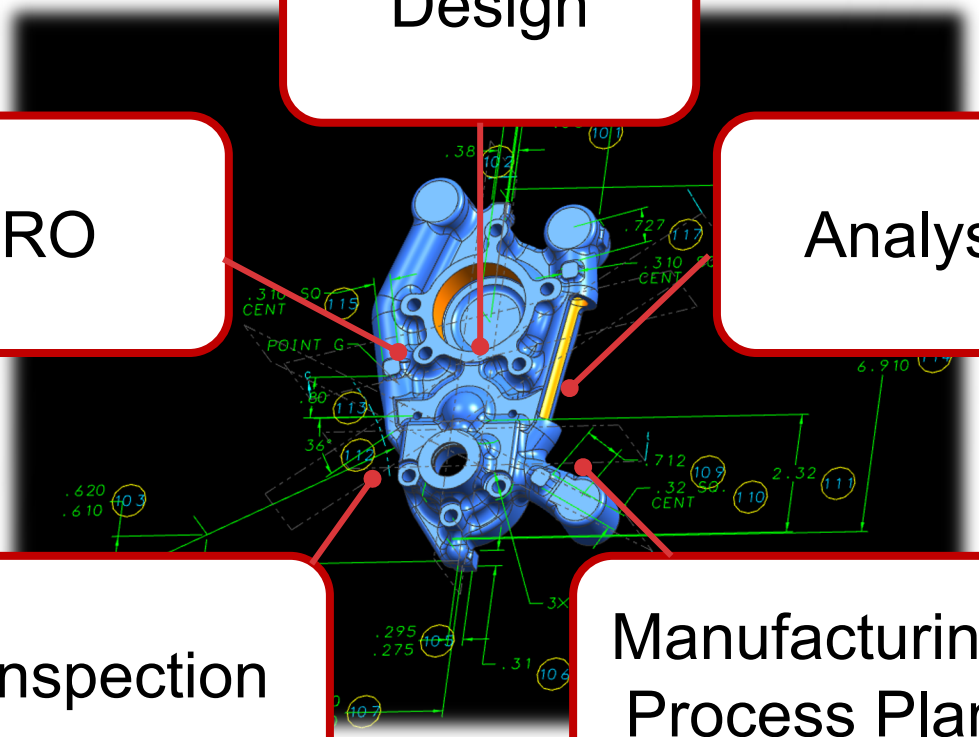
HIGH LEVEL OVERVIEW

Design Semantic PMI data
Linked in the MFIN

Design

MRO/Service decisions based on traceable data
Linked in the MFIN

MRO



Analysis

Analysis simulation constructed from MBD
Linked in the MFIN

Inspection plan, FAI, created via the MBD
Linked in the MFIN

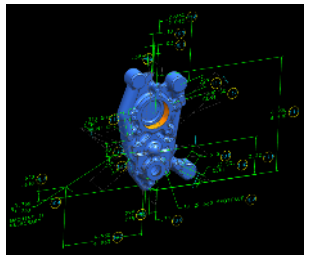
Inspection

Manufacturing Process Plan

Manufacturing process plan created via PLM from MBD
Linked in the MFIN

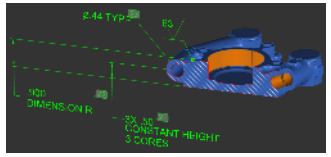
Workflow: Measurement

MBD Model



Data propagation in digital, interoperable format

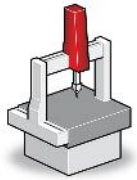
Measurement Planning



Use PMI downstream

Supplier FAI

CMM/Scanner Measurement



Digitally connected measurement results

MBD-Based CMM Demo: Overview

ZEISS CALYPSO

SIEMENS NX CMM

Automated CMM program

Optimized CMM program

From ZEISS:
Today, CALYPSO is one of the most successful software products for industrial metrology with more than 40,000 seats globally.

CMM program is optimized using measurement uncertainty simulation – Capvidia's Pundit software PUNDIT

Reduced programming time by 97%

- Manual: 5 hours
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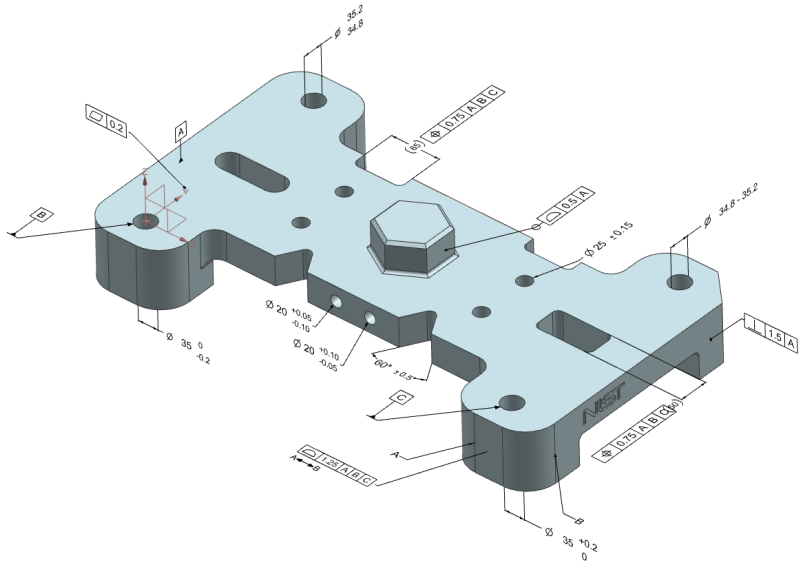
Reduce measurement uncertainty by a factor of 4



Why MBD –

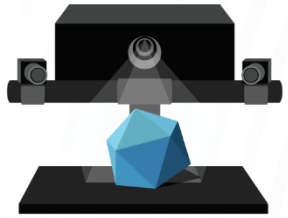
Model Based Definition: Why is it Important?

Looking to the Future:
What is the Value of MBD?

Process & Automation

Design

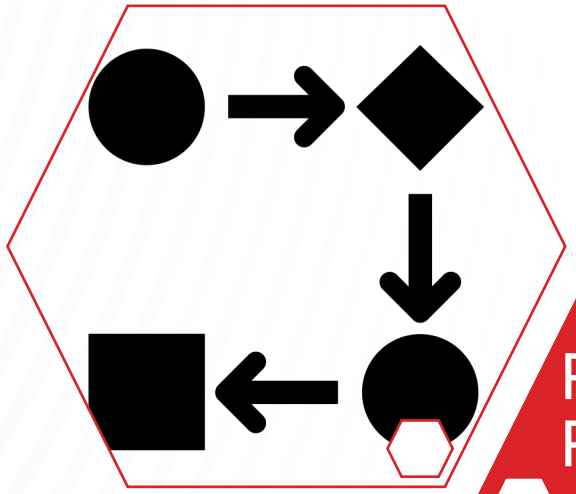
Manufacture



Measure

Data for Analytics

Process & Automation



Process, not Personnel

- Remove the “human-in-the-loop”

Automation

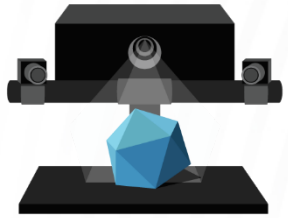
- Possible with a well-defined business process

Looking to the Future:
What is the Value of MBD?

Process & Automation

Design

Manufacture



Measure

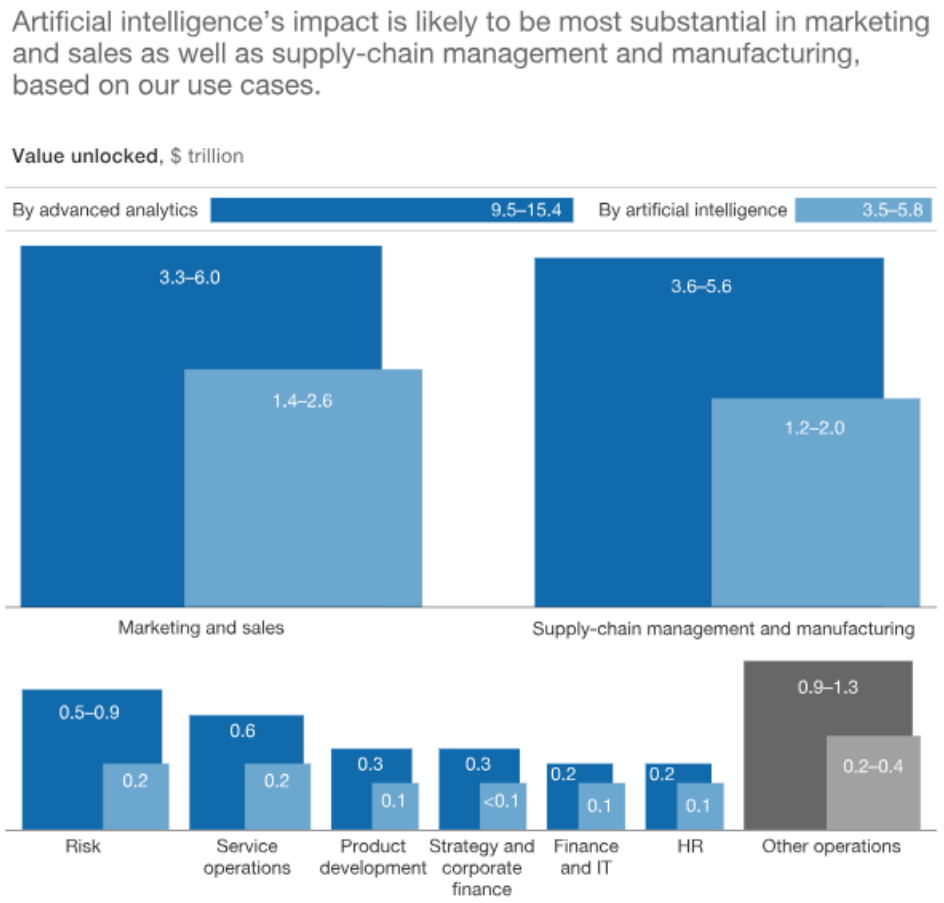
Data for Analytics

Value of Manufacturing Data

The world's most valuable resource is no longer gold or oil

McKinsey & Company case study:

> *"We estimate that the AI techniques we cite in this briefing together have the potential to create between $3.5 trillion and $5.8 trillion in value annually across nine business functions in 19 industries*



Data for Analytics

Automation: Capvidia + ZEISS CALYPSO

Automated MBD Measurement Process Using ZEISS CALYPSO

CMM Programming: Current Issues

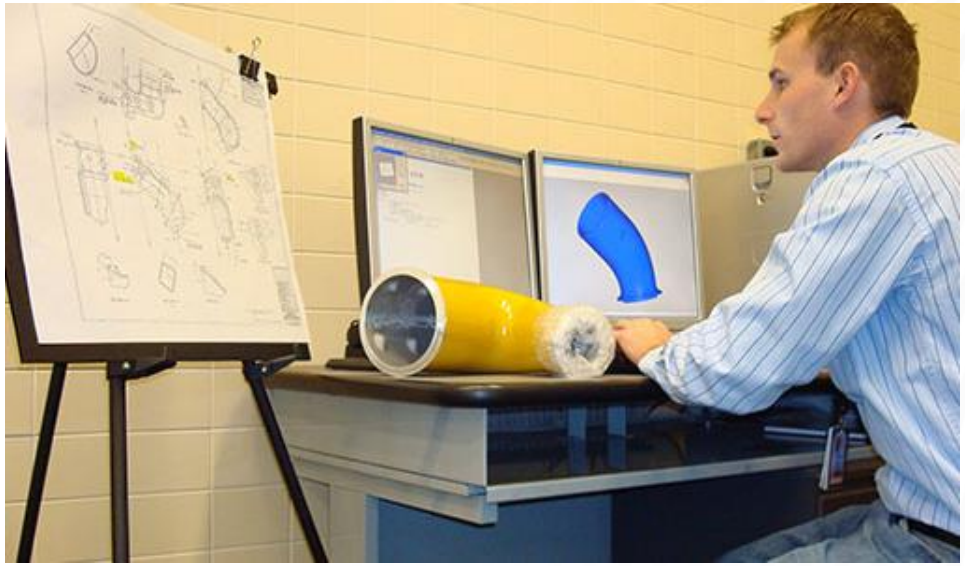
Workflow: Current State

Dependence on personnel:

- Manual transcription of GD&T / PMI
- Translation and interpretation errors
- Requires a skilled CMM technician
- Personnel and machine dependent
- Labor intensive

Enterprise measurement data is siloed:

- Multiple, proprietary data formats
- Not mapped to “single source of truth”



Future State: MBD-Based CMM

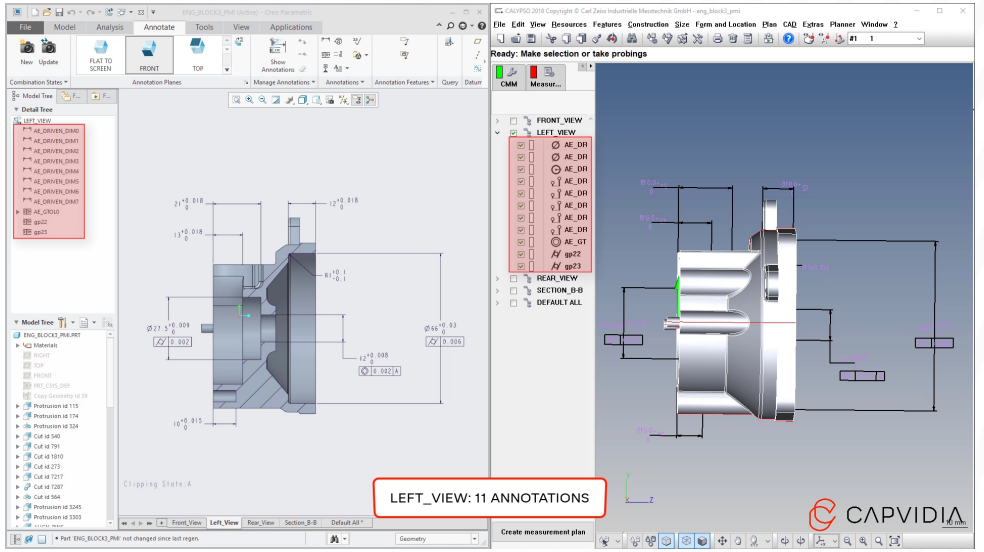
MBD Approach

Process-based:

- Transcription errors eliminated
- Encoded design knowledge
- Process repeatability
- Frees up skilled engineers
- Reliance on process over personnel
- Drastic reduction of labor time

Unleash your data:

- Universally accessible data
- Data mapped to design model



PTC Creo Parametric

ZEISS CALYPSO

Workflow Comparison

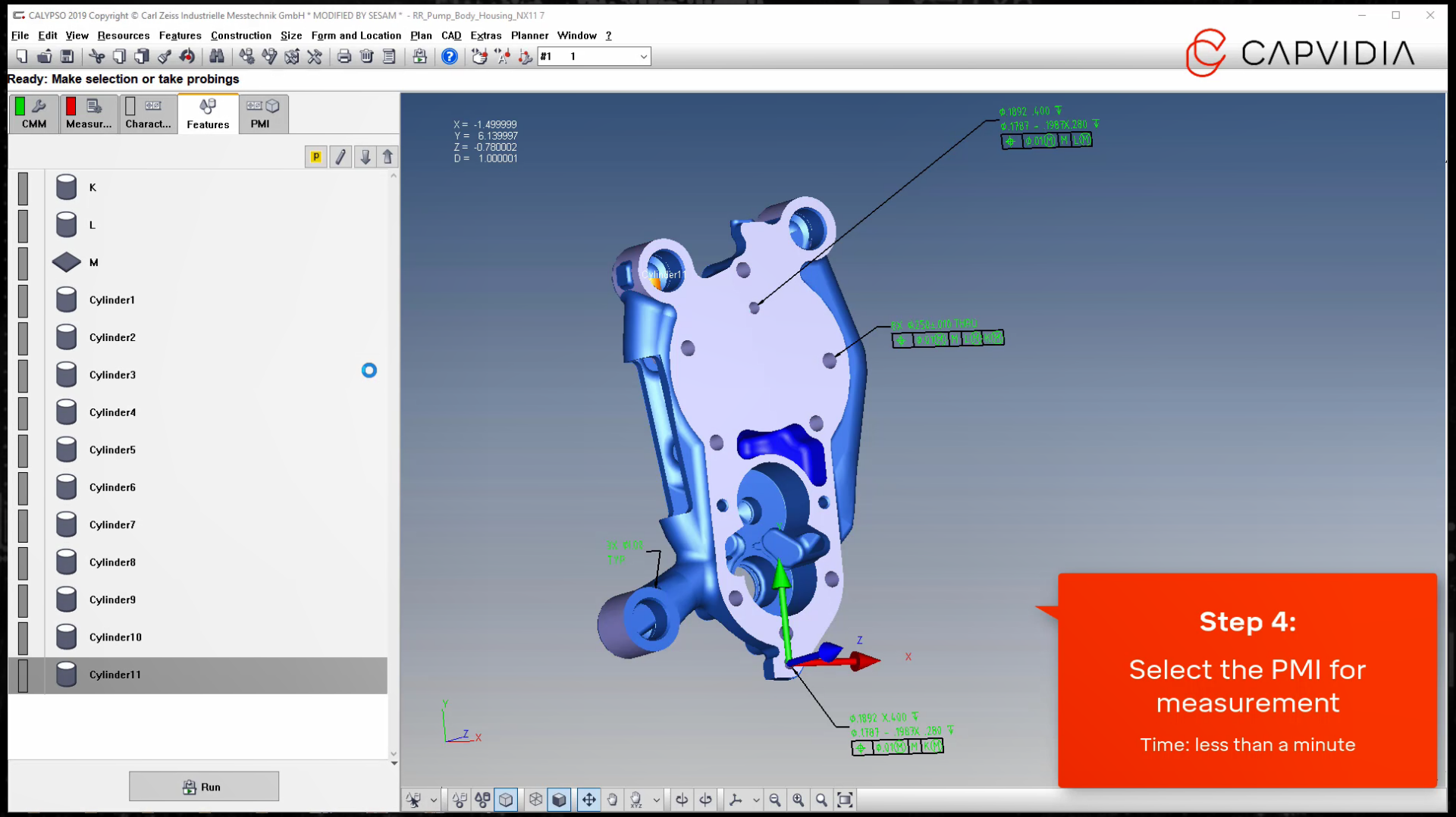
Manual CMM Programming

Tasks:

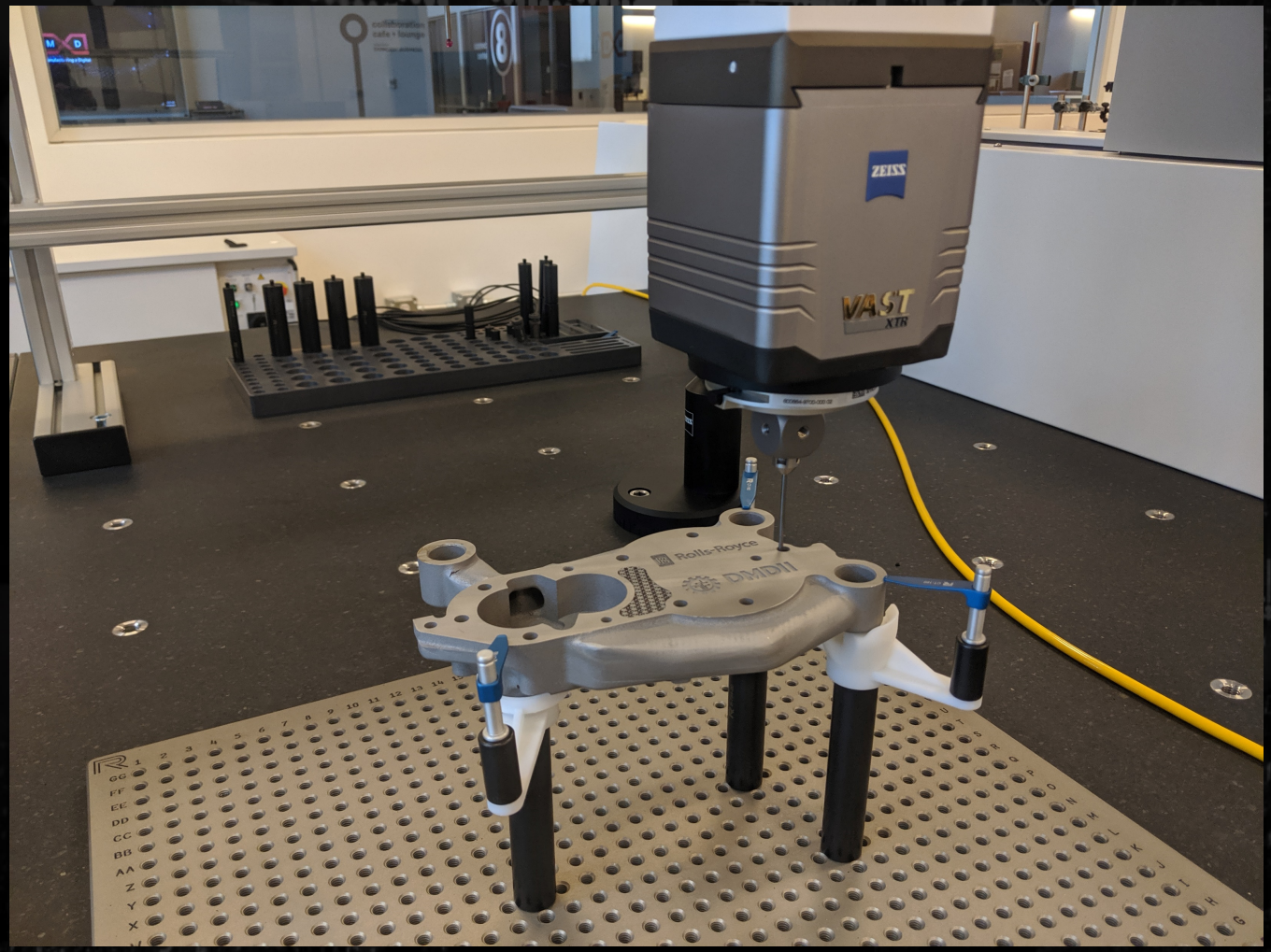
- Manipulate CAD model
- Define features to measure
- Define filters
- Correlate features
- Define scanning paths, probing points and parameters
- Define feature frames and tolerances for output
- Simulate for collision detection
- Output

TOTAL	5 hours

Video Demonstration – Offline Program Preparation



Demonstration – Live CMM Measurement



Workflow Comparison

Manual CMM Programming	
Tasks: • Manipulate CAD model • Define features to measure • Define filters • Correlate features • Define scanning paths, probing points and parameters • Define feature frames and tolerances for output • Simulate for collision detection • Output	
TOTAL	**5 hours**

MBD-Based Programming	
Open NX model	A few seconds
Export NX to QIF MBD	A few seconds
Open QIF in CALYPSO	A few seconds
Select the PMI for measurement	Less than a minute
Create measurement program	2 minutes
Cleanup measurement program	5 minutes
TOTAL	**10 minutes**

97% REDUCTION IN TIME

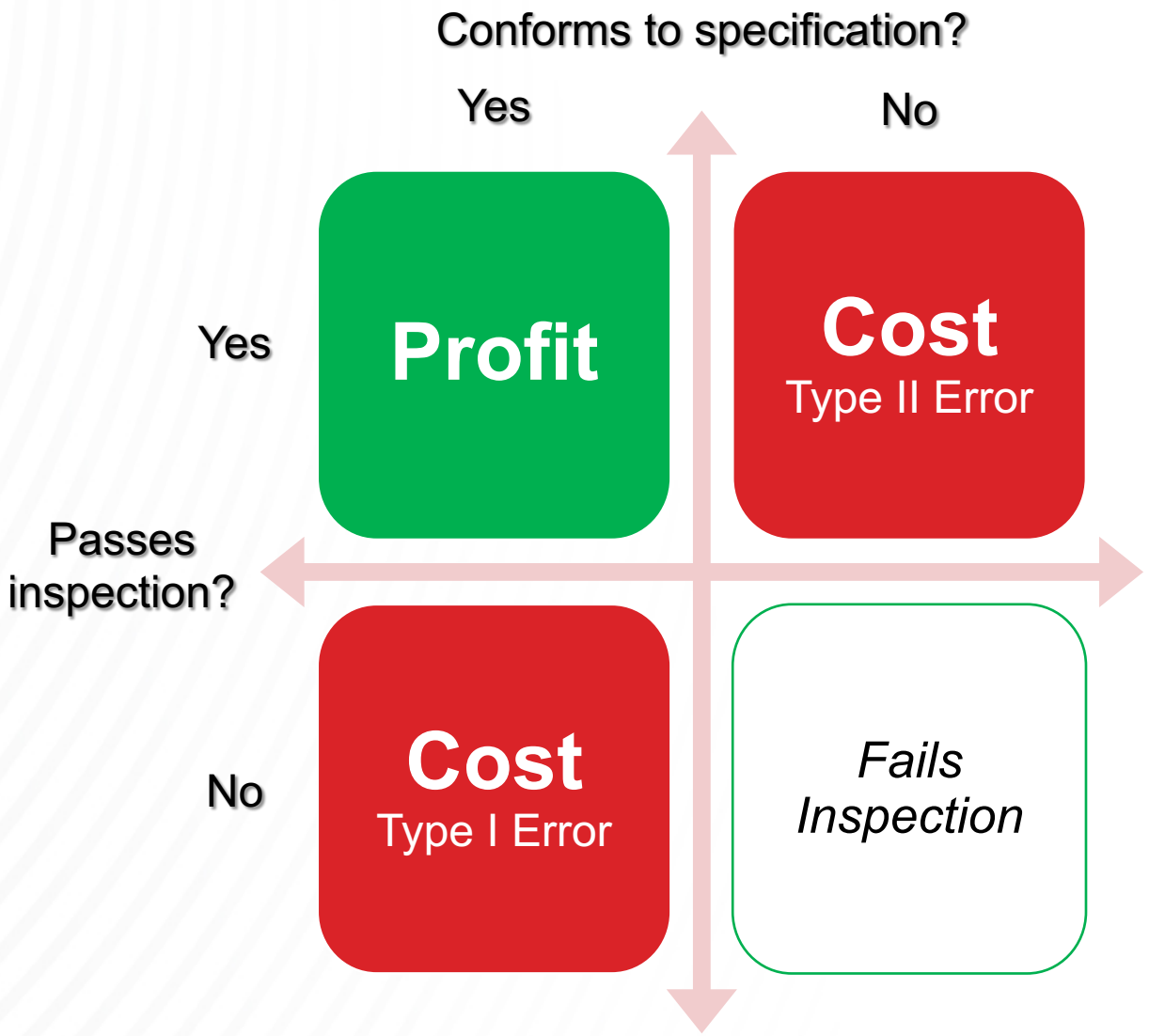
Optimization: Capvidia + NX CMM

Measurement optimization based on uncertatinty simulation – powered by MBD

CAPVIDIA

SIEMENS

Costs of Measurement Error



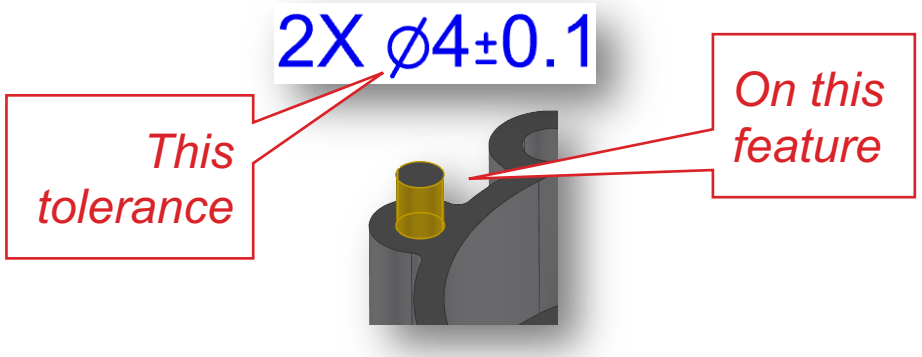
Measurement error is a significant source of cost

By controlling your levels of acceptable measurement error, you can turn your quality department into a ***profit center****, rather than a cost center*

Task-specific measurement uncertainty: What is it?

Pundit calculates a **task-specific uncertainty** for each measurand

For Example:



Measured with a given sampling pattern, using a given CMM, etc.

What are we not talking about:

- The **resolution** of my CMM
- The **accuracy** of my CMM
- If I measure ***so-and-so* many points**, then my measurement uncertainty will always be acceptable

These are poor indicators for process control

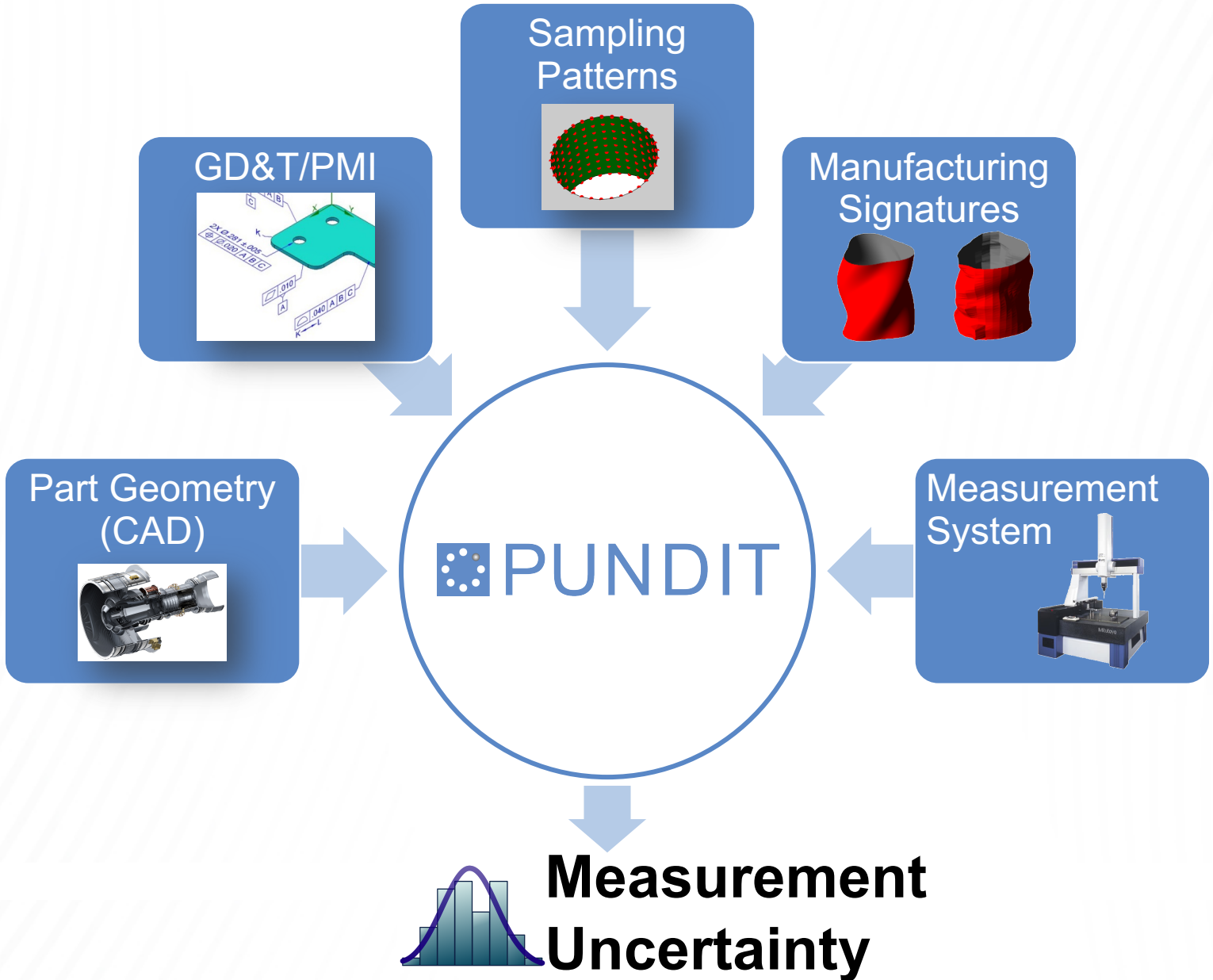
Control measurement uncertainty for each tolerance on your model

Task-specific measurement uncertainty: Why does it matter?

What percentage of a tolerance's bandwidth is consumed by measurement uncertainty?

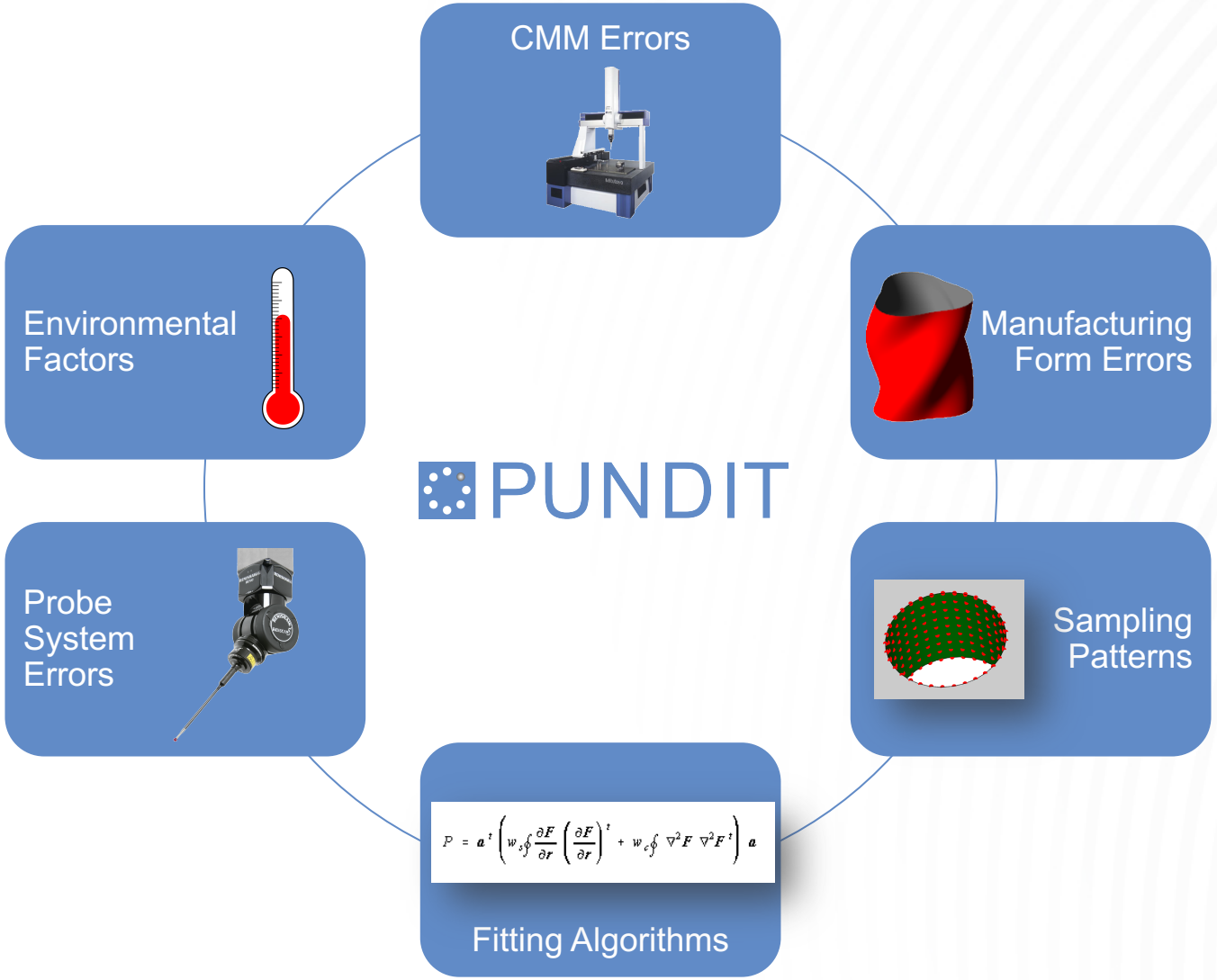
What percentage is acceptable?

Pundit Simulation

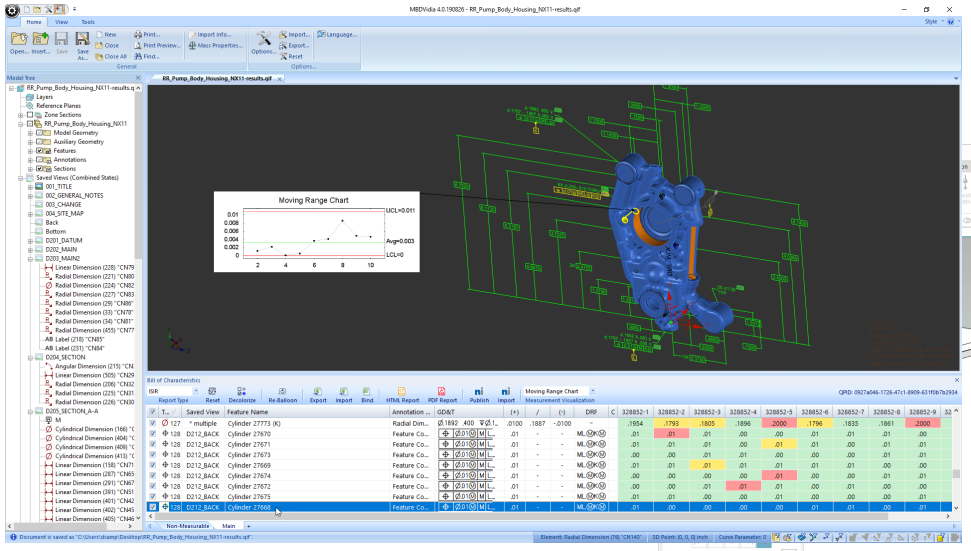


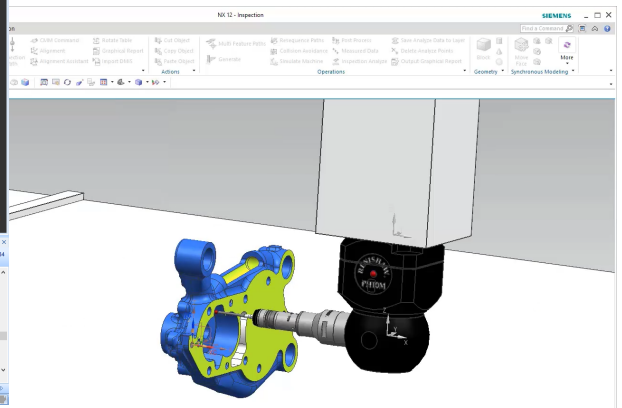
Error Influence Quantities

The Pundit simulation accounts for all typical first-order error sources of measurement error



Optimized CMM Program





Conclusions

The Value of MBE

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Value of MBD Measurement

Reduce inspection costs

Inspection planning is a laborious task involving skilled technicians – automation decreases its cost significantly

Faster time-to-inspection

Faster product delivery. Inspection is typically a bottleneck in production – this approach can streamline manufacturing processes

Increase inspection quality

- Utilize measurement uncertainty simulation
- Implement organizational guidelines — rely on corporate process, not personnel

Bring measurement data into the digital thread

Measurement data has immense value – don't use it for PASS/FAIL inspection and then discard. MBD traceable data is ready for analytics

Lower risk for transcription & interpretation errors

Software automation lowers the risk of transcription or interpretation errors of data, and creates opportunities for validation of data

Thank you. Any Questions?

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