Implementing Model-Based Design in Real-World Scenarios using QIF

Rudy Lozano
CAPVIDIA

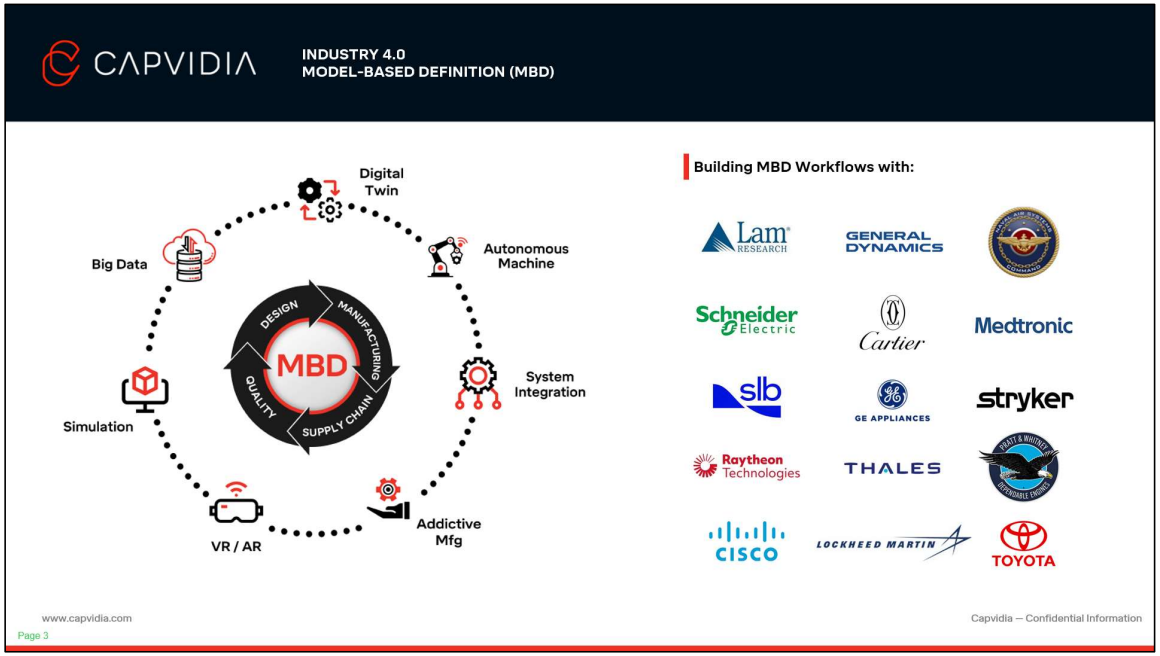
GLOBAL PRODUCT DATA INTEROPERABILITY SUMMIT 2024

BOEING ELYSIUM NORTHROP GRUMMAN Parker PDES, Inc.® Connecting the Digital Enterprise

Presenters Bio

CAPVIDIA

- Account Manager Capvidia
- 23 years of experience in Aerospace
  - Design
  - Manufacturing (Composites)
  - Quality
- Supporting all major Aerospace accounts with MBD and Quality workflow implementation



A NIST Study Shows that Digital Transformation Techniques Could Save Manufactures $57.4 Billion Annually…

Key Enablers:

- **Improved Interoperability of Engineering Data**
- Enhanced Sensing and Monitoring in Manufacturing
- Improved Transmission of Digital Information
- Advances in Data Analytics and Identifying Trends
- Faster Communication of Information
- Improved Reaction and Implementation Time

Source: Economic Analysis of Technology Infrastructure Needs for Advanced Manufacturing Smart Manufacturing. https://nvlpubs.nist.gov/nistpubs/gcr/2016/NIST.GCR.16-007.pdf

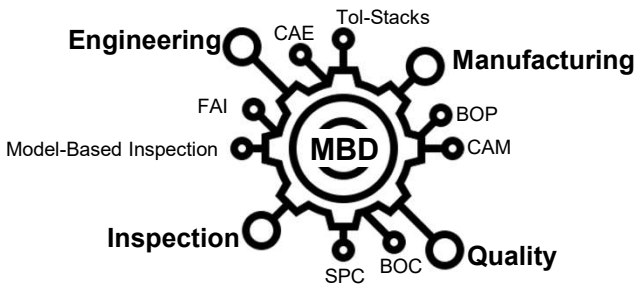
What is Interoperability?

Interoperability

The ability for computer systems or software to exchange and make use of information

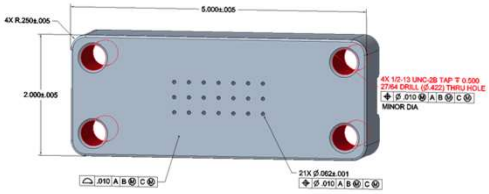
Source: Oxford Languages

INTEROPERABILITY OF MBD

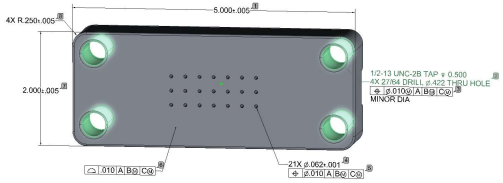


Common Challenge: Interoperability of Engineering Data…

CAD/MBD → QIF → Enterprise / Supply-Chain
Software and Systems



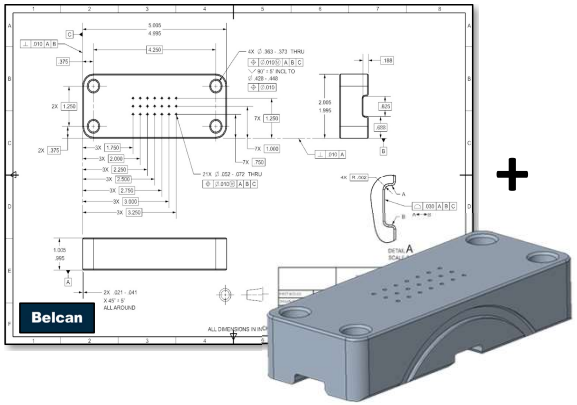
MBD



QIF MBD

The Importance of Model-Based Definition (MBD)

2D Drawing + 3D CAD Model



3D Model-Based Definition (MBD)

2D Drawing + 3D CAD model

- Design Authority is split across two sources
  - 2D Dwg is authority for PMI
  - 3D CAD is authority for geometry (or is reference)
- 2D Dwg is human-readable Only
- Ambiguity of 2D product definition

Model-Based Definition (MBD)

- MBD Is the design authority for PMI and geometry
- MBD is human and machine-readable
- Clear interpretation of product definition through semantic reference
- Single source of truth for downstream consumption and reuse
- Interoperability of MBD allows data traceability back to design authority

WHAT IS QIF?

ISO QIF

- ISO 23952:2020 – Quality Information Framework
- MBD + Quality Plans + Quality Results

Wide Support for ISO QIF Format

ZEISS
RENISHAW apply innovation™
VK metrology
PolyWorks By InnovMetric Software Inc.
HEXAGON MANUFACTURING INTELLIGENCE
KOTEM
metrologic group
Mitutoyo
ogp
Origin

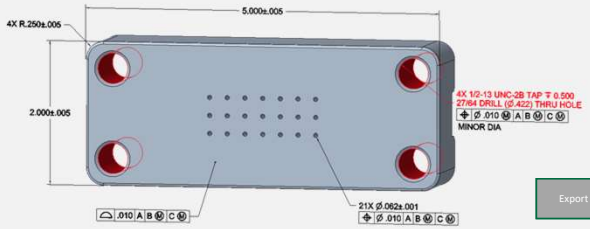
DMSC Members

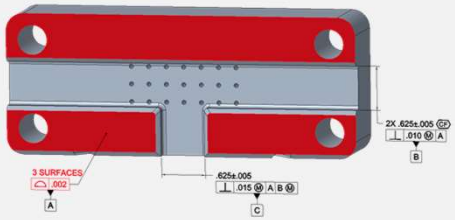
ACTION ENGINEERING
CAPVIDIA
Deere & Company
AAT3D
NIST
ELYSIUM
Origin
ZEISS
innovmetric
Los Alamos NATIONAL LABORATORY
Schneider Electric
TechAzu1
Mitutoyo
RENISHAW
ITI
KOTEM
metrologic group
SAMWELL GROUP
LOCKHEED MARTIN
Sigmetrix
SPD SMART PRODUCT DEVELOPMENT
UNIVERSITY OF NORTH CAROLINA CHARLOTTE
HIGH QUALITY AUTOMATION
Honeywell
METROSAGE
PURDUE UNIVERSITY
ogp
2B MOBILE
Pratt & Whitney
innovalia METROLOGY

WHAT IS QIF?

MBD

- Master CAD
- Machine-Readable MBD





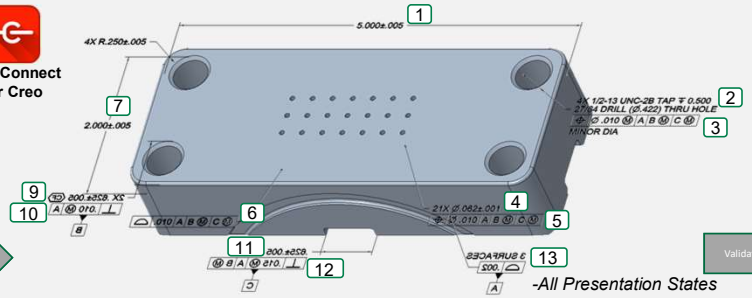
Export QIF

QIF Export

Data Harvesting from Master Model

- Geometry
- PMI Annotation
- Presentation States
- Attributes

MBDConnect for Creo



-All Presentation States
-Attributes

Bill Of Characteristics (BOC)

MBDVidia

Tag	Saved View	Feature Name	Annotation Name	GD&T	(-)	/	(+)	DRF
↔ 1	01_TOP	Opposite Planes 2440	ad132	5.000 ±.005	-.005	5.000	.005	-
∅ 2.1	01_TOP	Cylinder 2476	ad65	1/2-13 UNC-2B TAP ↧ 0.50027/64 DR_	-.010	.422	.010	-
∅ 2.2	01_TOP	Cylinder 2473	ad65	1/2-13 UNC-2B TAP ↧ 0.50027/64 DR_	-.010	.422	.010	-
∅ 2.3	01_TOP	Cylinder 2475	ad65	1/2-13 UNC-2B TAP ↧ 0.50027/64 DR_	-.010	.422	.010	-
∅ 2.4	01_TOP	Cylinder 2474	ad65	1/2-13 UNC-2B TAP ↧ 0.50027/64 DR_	-.010	.422	.010	-
⌖ 3.1	01_TOP	Cylinder 2476	gp3	⌖ Ø.010Ⓜ A BⓂ CⓂ MINOR DIA	-	-	.010	A/BⓂ/CⓂ
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∅ 4.1	01_TOP	Cylinder 2417	ad70	Ø.062 ±.001	-.001	.062	.001	-
∅ 4.2	01_TOP	Cylinder 2418	ad70	Ø.062 ±.001	-.001	.062	.001	-
∅ 4.3	01_TOP	Cylinder 2432	ad70	Ø.062 ±.001	-.001	.062	.001	-
∅ 4.4	01_TOP	Cylinder 2435	ad70	Ø.062 ±.001	-.001	.062	.001	-
∅ 4.5	01_TOP	Cylinder 2421	ad70	Ø.062 ±.001	-.001	.062	.001	-
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∅ 4.9	01_TOP	Cylinder 2422	ad70	Ø.062 ±.001	-.001	.062	.001	-

Validate QIF

Validate QIF Translation

- CompareVidia Tool
- Validate QIF back to Master CAD

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WHAT IS QIF?

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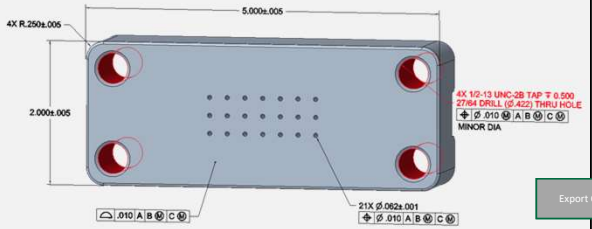
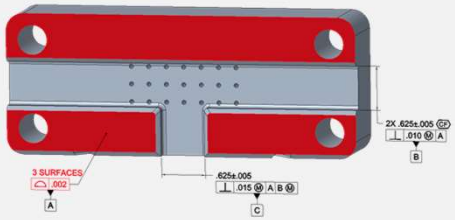
Creo Parametric

creo®

- Master CAD
- Machine-Readable MBD





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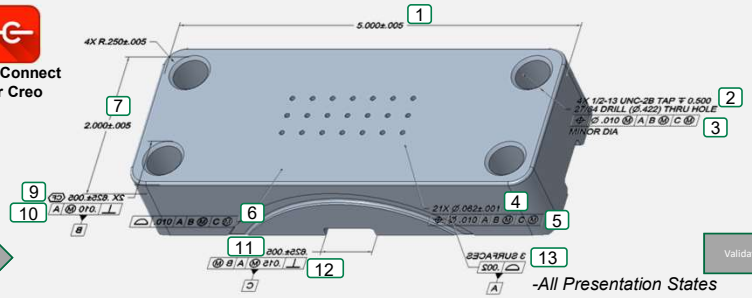

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CIV

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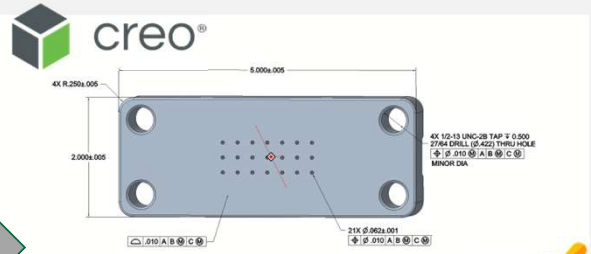
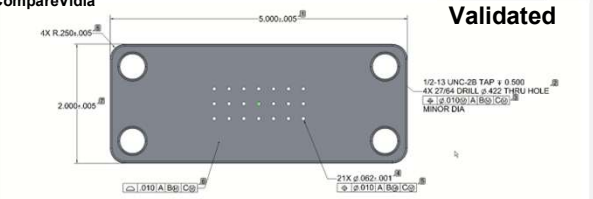


CAD

Validated

CIV

CompareVidia



Creo MBD + QIF

MBD Ballooning and Inspection Reporting

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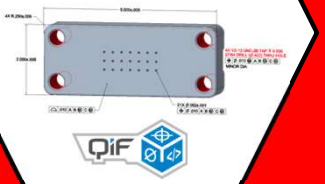
QIF MBD



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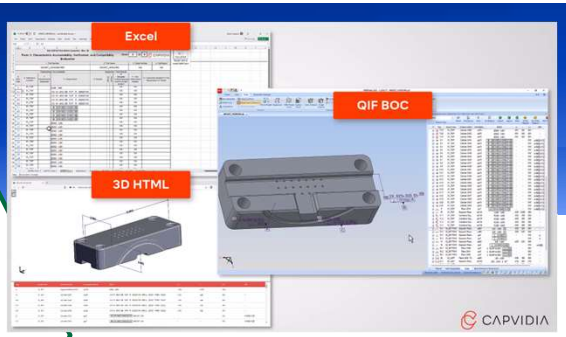
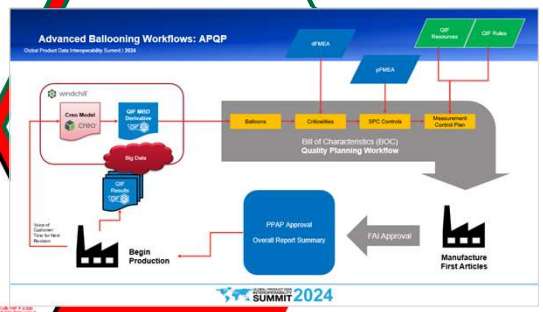
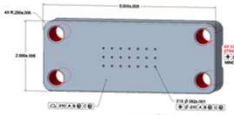
Ballooning and Inspection Reporting





QIF MBD



Advanced Ballooning Workflows: APQP

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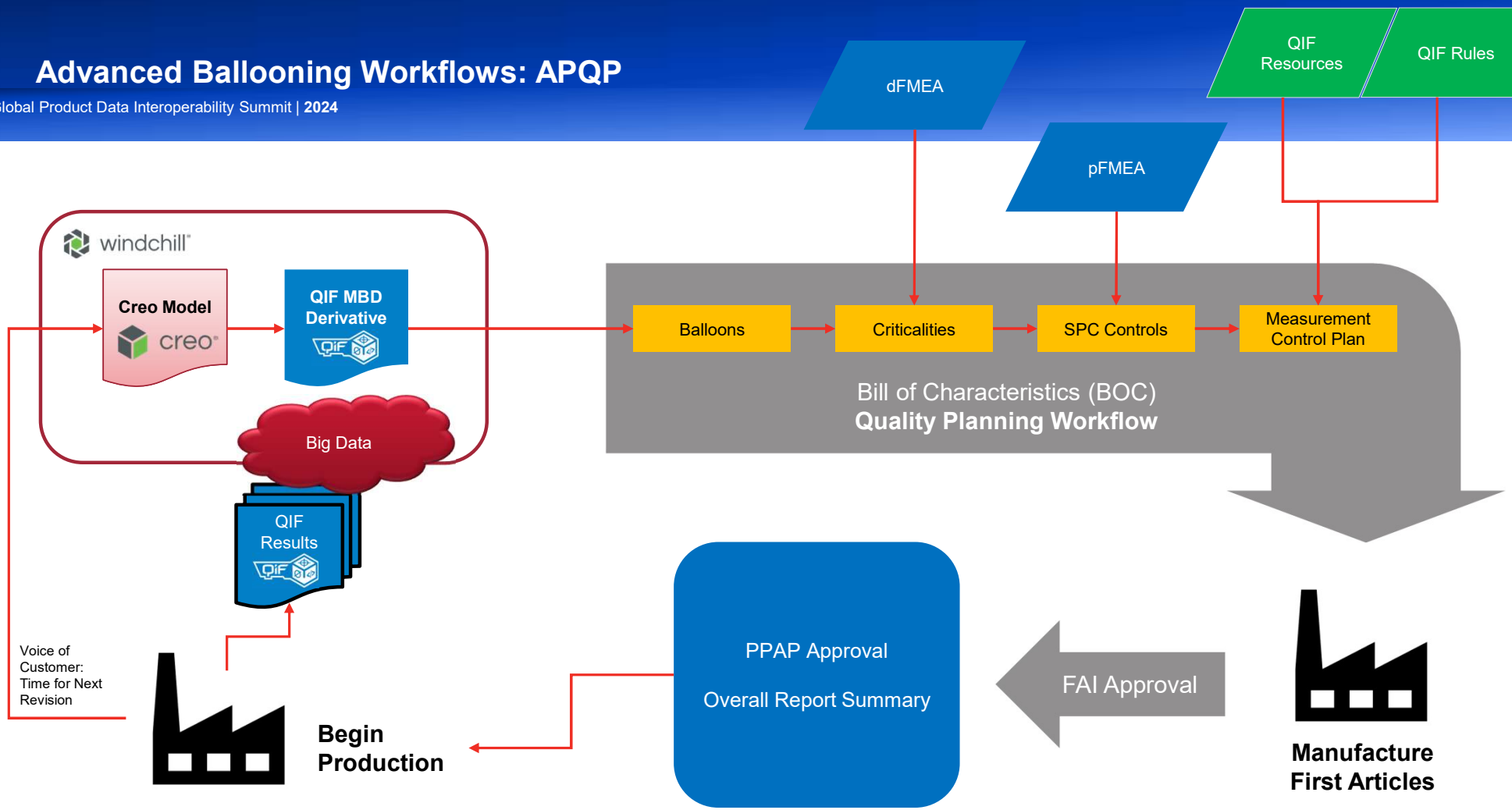
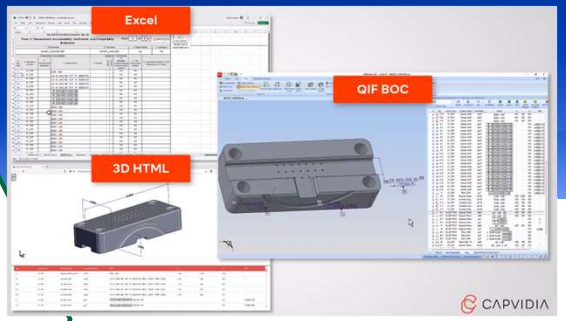


Creo MBD + QIF

Ballooning and Inspection Reporting



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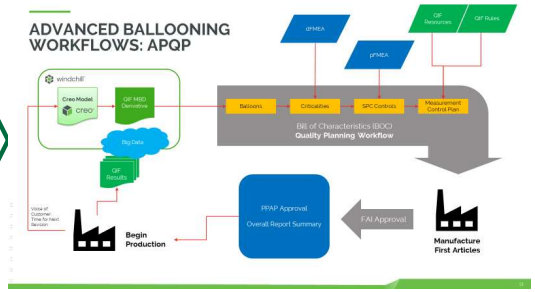

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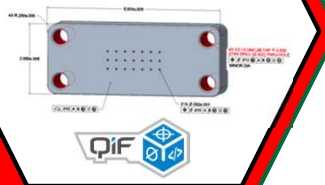
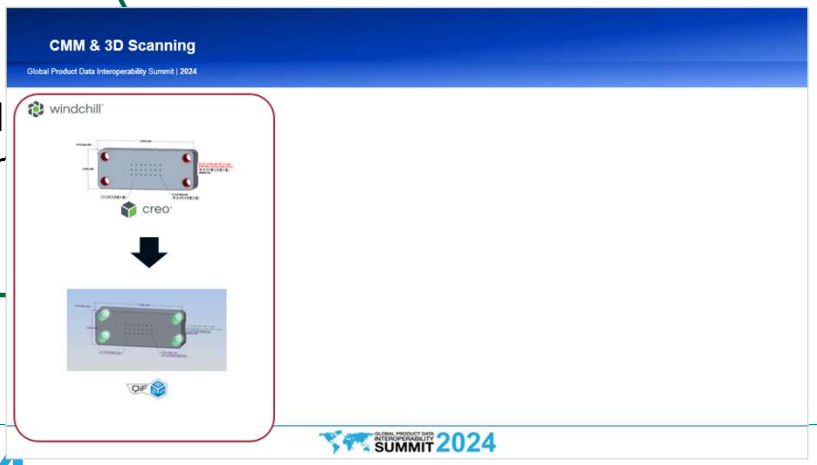
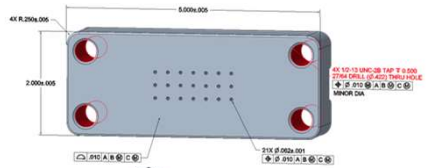


CMM & Scanning

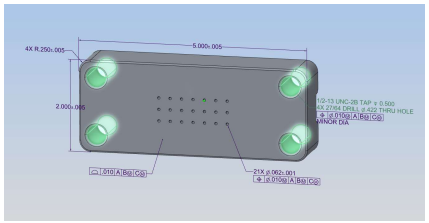


CMM & 3D Scanning

windchill®



creo®



QIF

CMM & 3D Scanning

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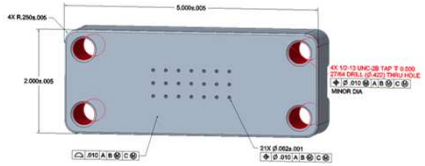

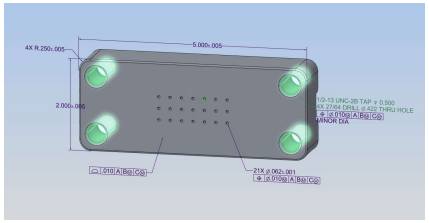

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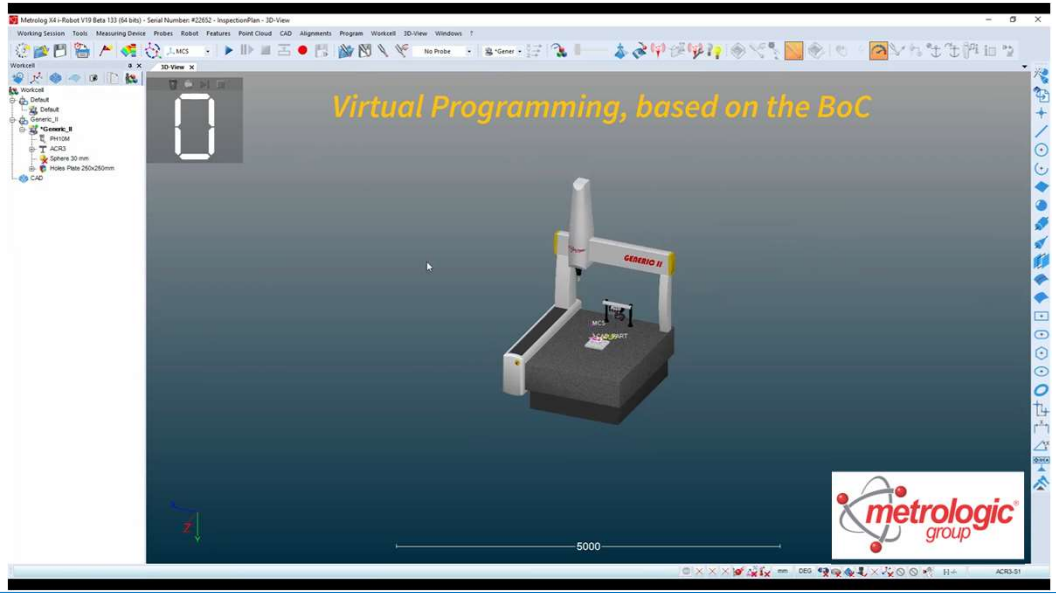

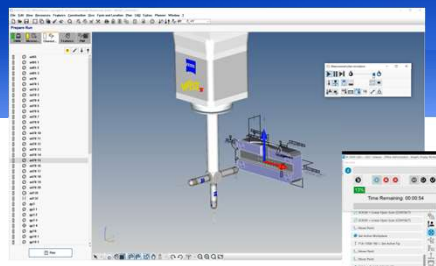

ZEISS

DCS

HEXAGON MANUFACTURING INTELLIGENCE

ogp

Mitutoyo

RENISHAW apply innovation™

KOTEM

Origin

PolyWorks By InnovMetric Software Inc.

LK metrology

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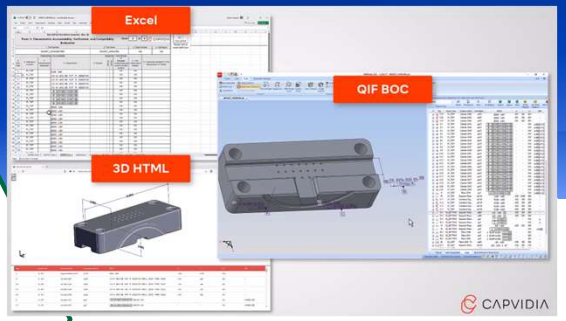
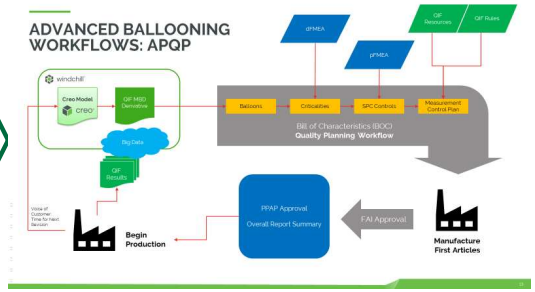
Creo MBD + QIF

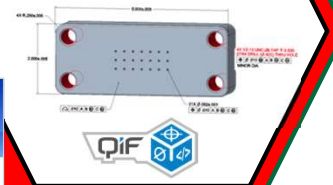
Ballooning and Inspection Reporting



Advanced Ballooning Workflows



QIF MBD



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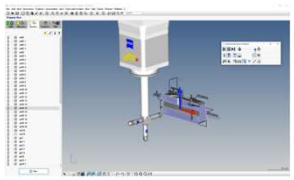
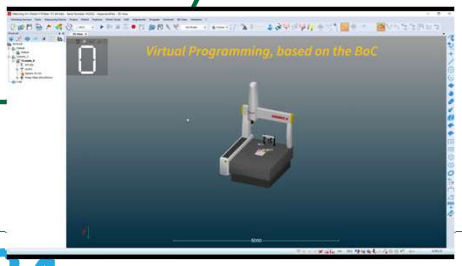
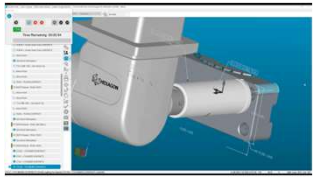






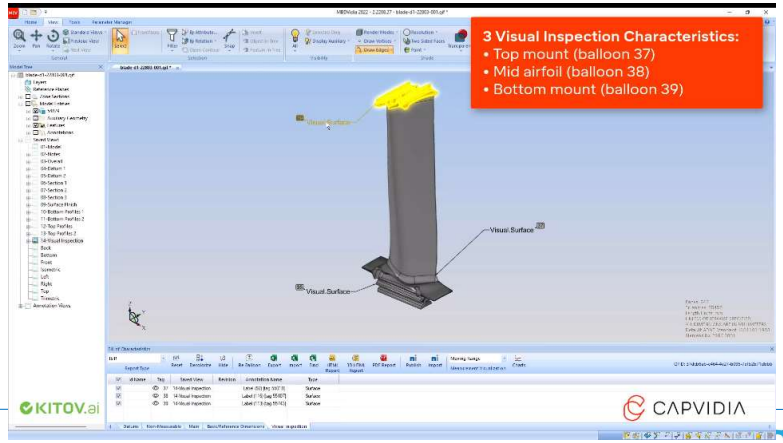
Visual Inspection

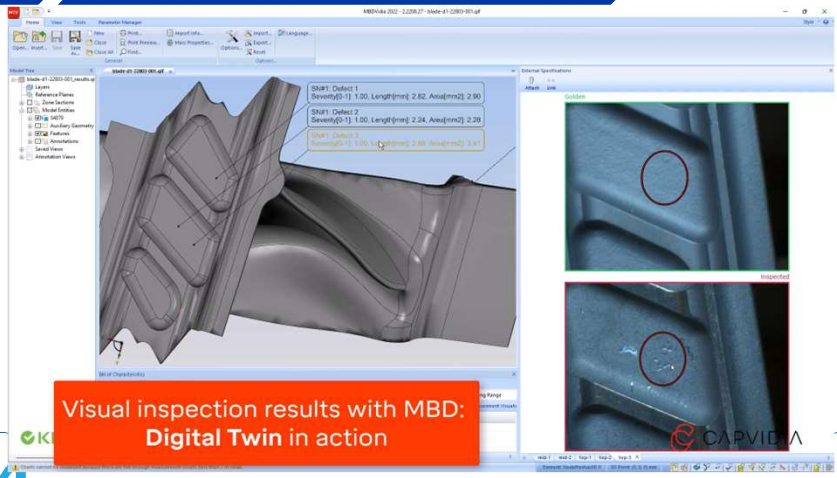
Visual Inspection

1 Define Inspections with Creo MBD

2 Automated Inspection

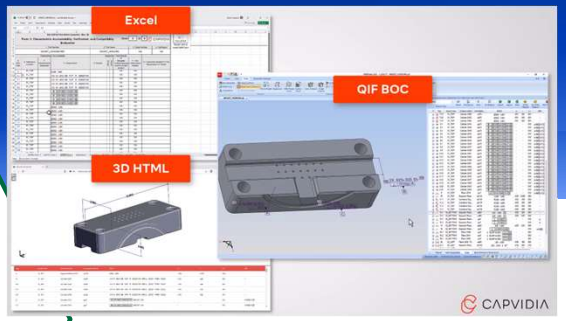
3 Digitally Traceable Results to Creo MBD





Creo MBD + QIF

Ballooning and Inspection Reporting



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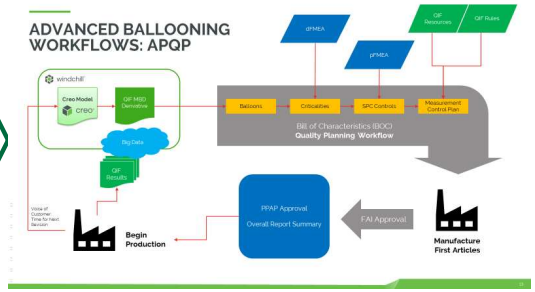
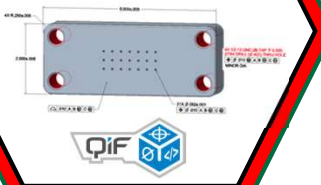
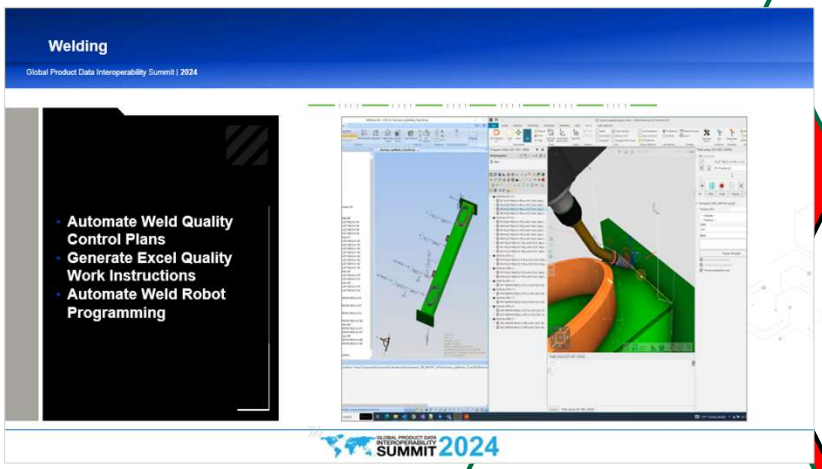


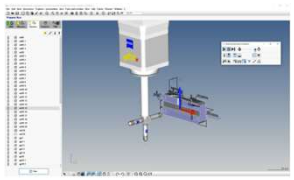
QIF MBD

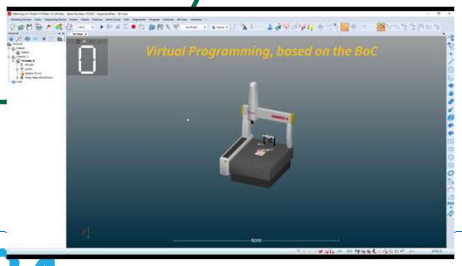


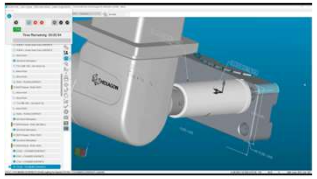
Welding



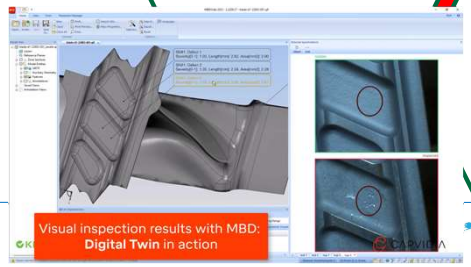
CMM & 3D Scanning





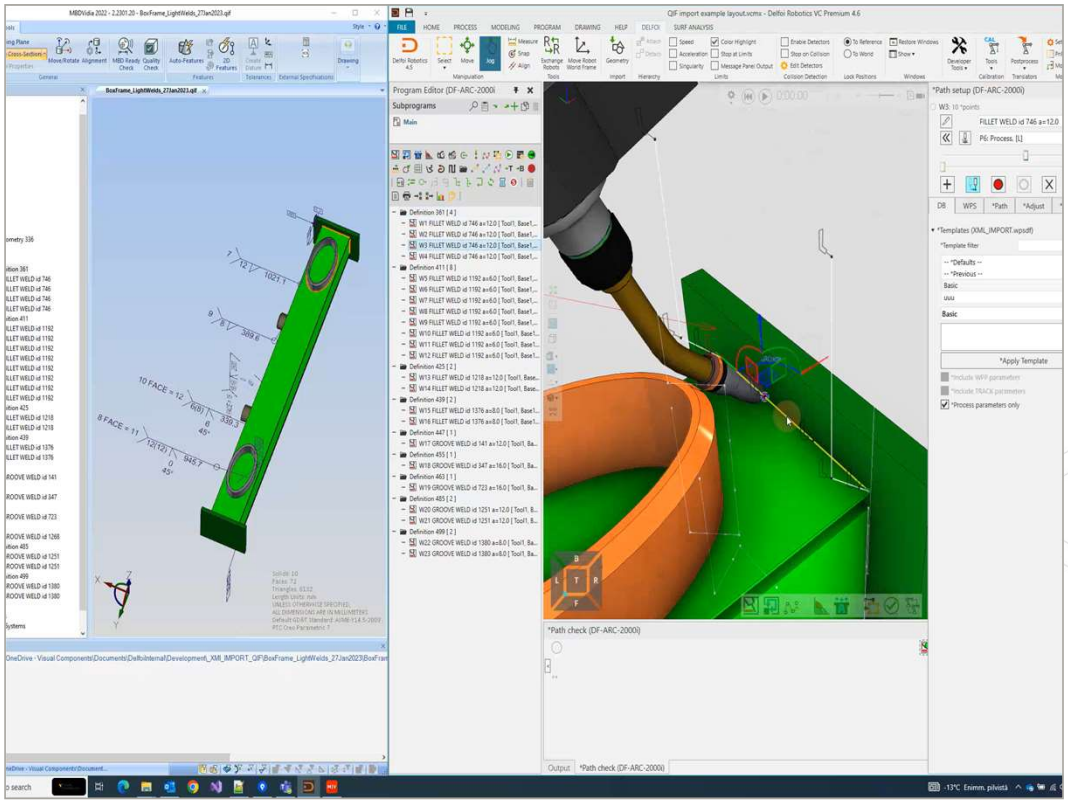


Visual Inspection

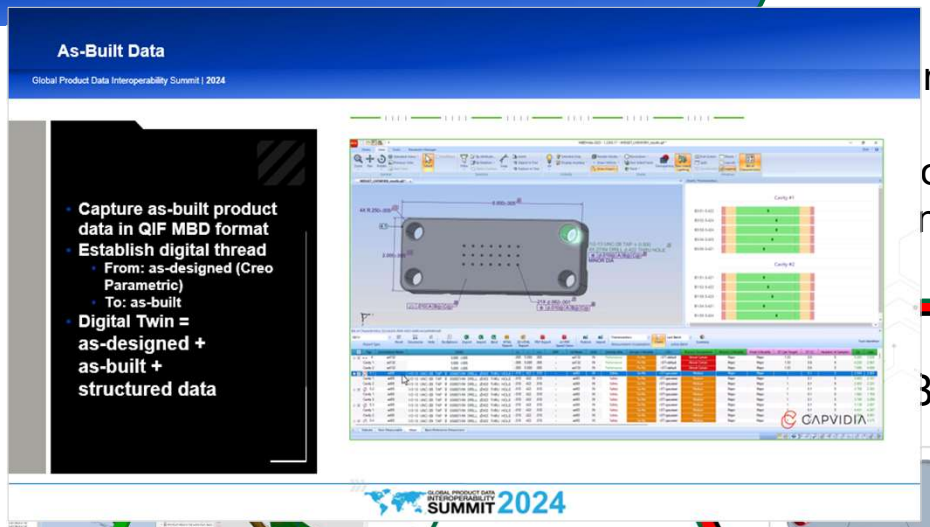


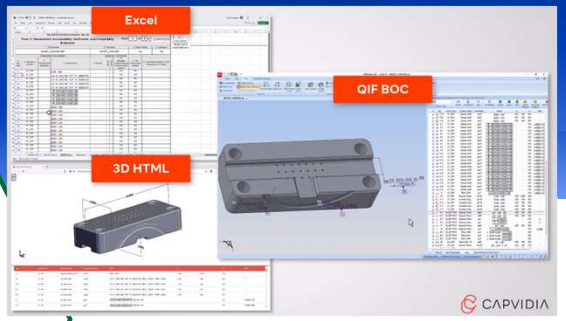
Welding

- **Automate Weld Quality Control Plans**
- **Generate Excel Quality Work Instructions**
- **Automate Weld Robot Programming**

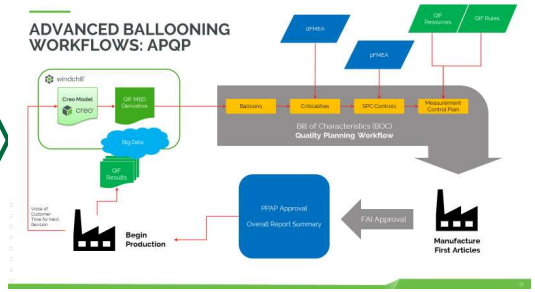


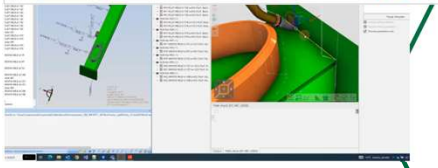
Creo MBD + QIF



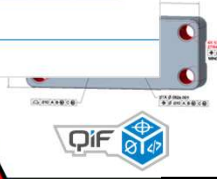


Advanced Ballooning Workflows

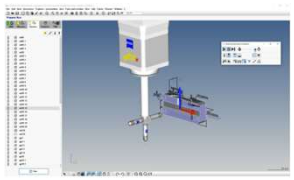


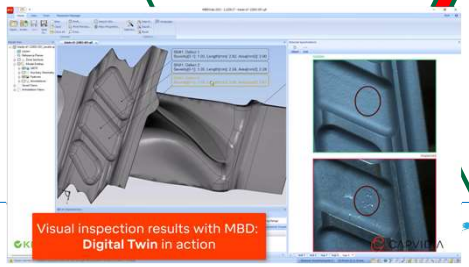


Welding

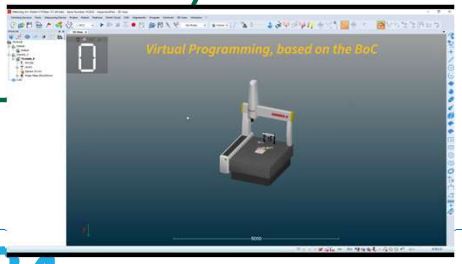


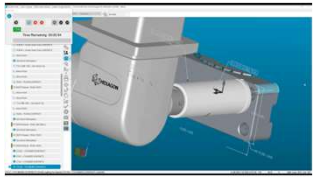
CMM & 3D Scanning





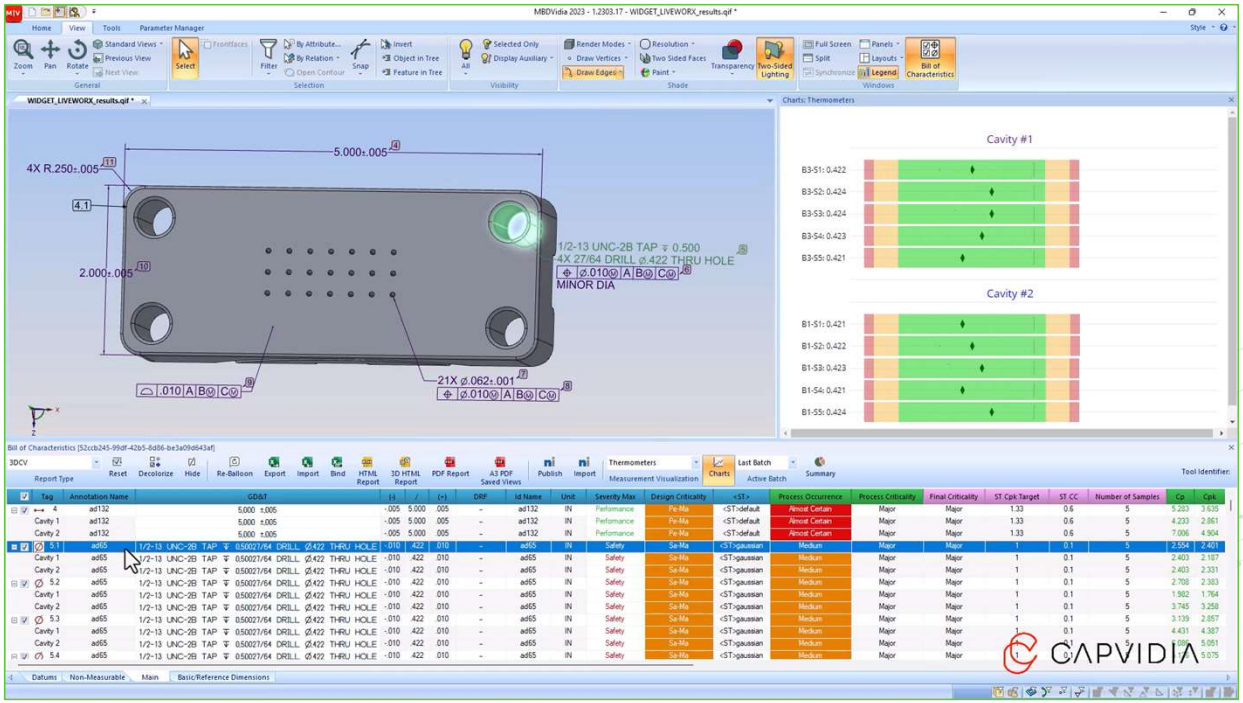
Visual Inspection





As-Built Data

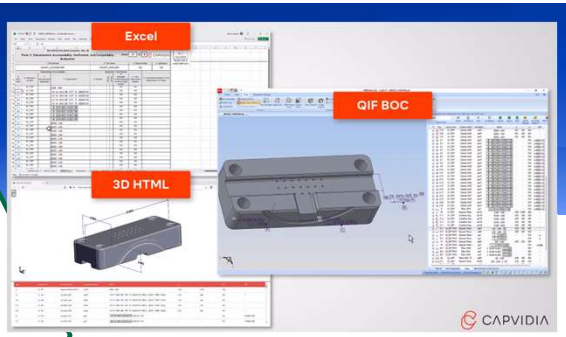
- Capture as-built product data in QIF MBD format
- Establish digital thread
  - From: as-designed (Creo Parametric)
  - To: as-built
- Digital Twin = as-designed + as-built + structured data



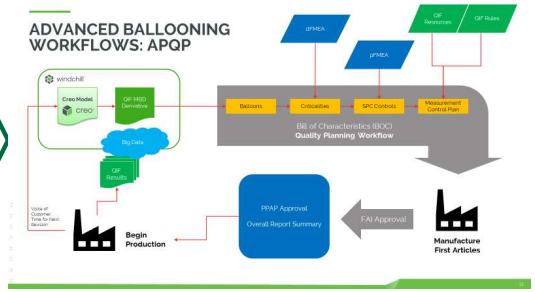
Creo MBD + QIF

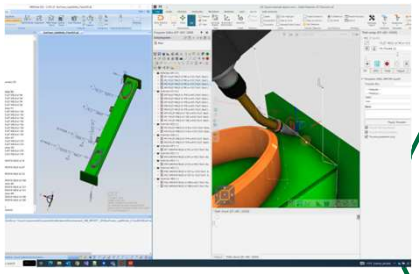
As-Built Data

Ballooning and Inspection Reporting

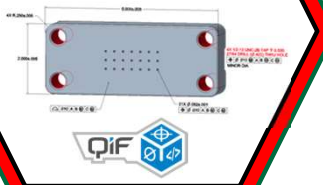


Advanced Ballooning Workflows

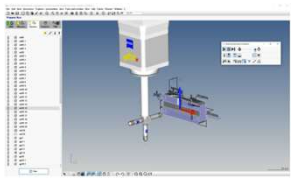




QIF MBD



Welding



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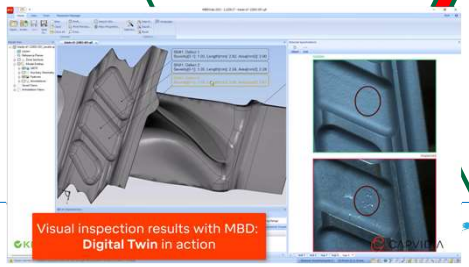

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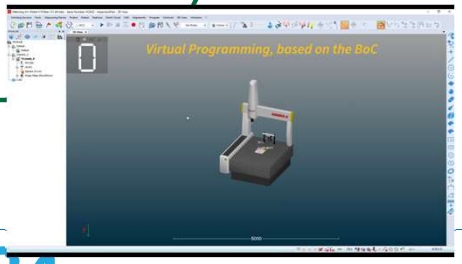

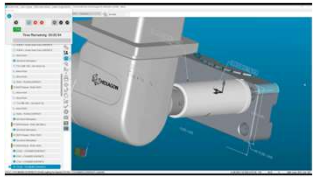

Proven ROI from MBD Users

Metrology: 20% faster CMM workflow in production system	FAI/PPAP: 17.5 hours to 2 hours for full FAI – 88% reduction	Design Engineering: > 80% reduction in MBD errors with MBD Ready Check
Design Engineering: 10% MBD authoring time savings	FAI/PPAP: Automates inspection documentation by up to 80%	Metrology: 81% reduction in CMM programming time (20 to 3 hours)
Metrology: 97% reduction in CMM programming time and 75% reduction in measurement uncertainty	FAI/PPAP: 60%+ PPAP time savings, survey of 2,400 parts processed	Design Engineering: 15-20% design time reduction using MBD vs. drawings

Starting your Digital Transformation Journey

- Understand downstream for MBD re-use
- Establish a cross-functional team
- Run pilots to prove value
- Join industry working groups
- Secure leadership support
- YOU ARE NOT ALONE
  - Work Closely with trusted SMEs

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