Semantic MBD Workflows with QIF

Daniel Campbell
Director of Business Development
Capvidia
www.capvidia.com
dc@capvidia.com

GLOBAL PRODUCT DATA
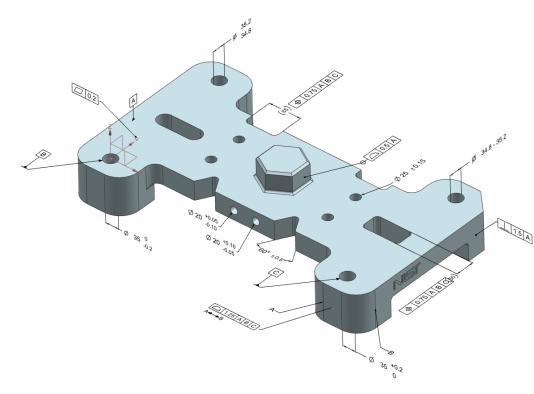INTEROPERABILITY
SUMMIT
2019

Daniel Campbell – Biography

Mr. Daniel Campbell is the Director of Business Development at Capvidia. He has more than 15 years of experience in the field of digital metrology. Before Capvidia, Daniel was a Principal and the Software Director at Metrosage, where he had the primary responsibility for the design and development of the Pundit CMM measurement uncertainty simulation software. Since then, Pundit CMM has become a part of the Capvidia suite of solutions. Daniel has a solid foundation in software design and dimensional metrology. His interests in metrology have led him to lead various working groups on standards in this area for ANSI QIF. Daniel is currently the Chair of the ANSI QIF Working Group, and a member of the Board of Directors of the Dimensional Metrology Standards Consortium (DMSC). Daniel has a Bachelor of Science in Computer Science with a minor in Mathematics from the University of San Francisco.

CAPVIDIA

www.capvidia.com

Why MBD –
Model Based Definition:
Why is it Important?

Looking to the Future:
What is the Value of MBD?
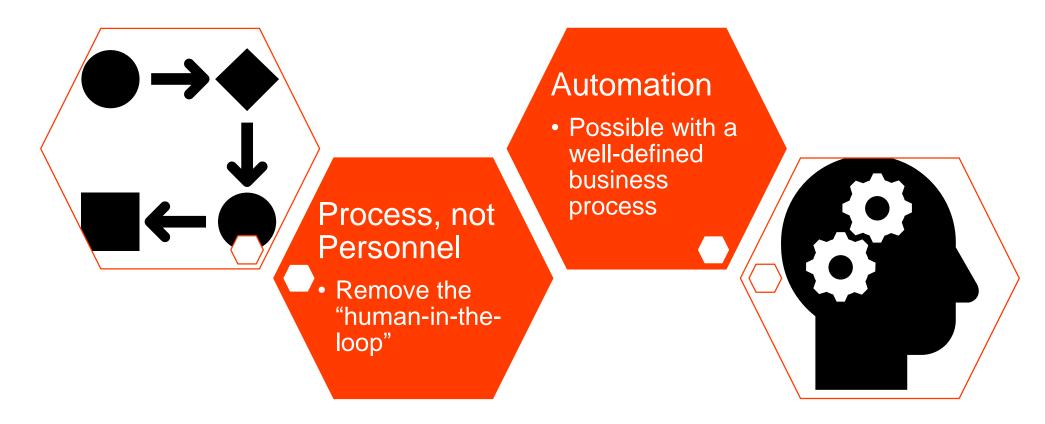Global Product Data Interoperability Summit | **2019**

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?
Global Product Data Interoperability Summit | **2019**
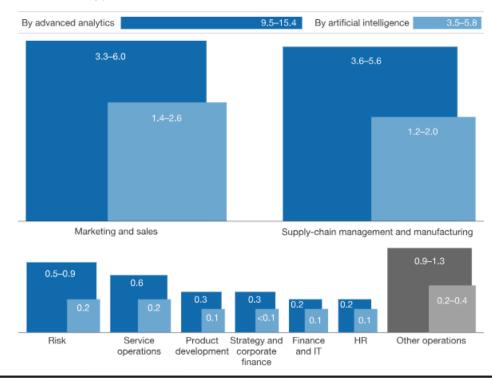
Value of Manufacturing Data

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*
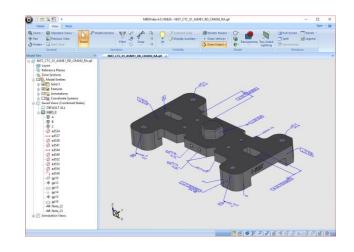

Artificial intelligence's impact is likely to be most substantial in marketing and sales as well as supply-chain management and manufacturing, based on our use cases.

Value unlocked, $ trillion

By advanced analytics 9.5–15.4   By artificial intelligence 3.5–5.8

3.3–6.0	3.6–5.6
1.4–2.6	1.2–2.0
Marketing and sales	Supply-chain management and manufacturing

Risk	Service operations	Product development	Strategy and corporate finance	Finance and IT	HR	Other operations
0.5–0.9	0.6	0.3	0.3	0.2	0.2	0.9–1.3
0.2	0.2	0.1	<0.1	0.1	0.1	0.2–0.4

Note: Figures may not sum to 100%, because of rounding.

McKinsey&Company | **Source:** McKinsey Global Institute analysis

Data for Analytics

www.capvidia.com

Why QIF –
Quality Information Framework:
Why is it Important?

These are all about using **DATA** to solve business problems

(Data, not software)
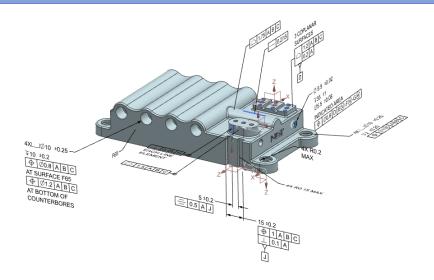
It's all about **DIGITAL TRANSFORMATION**

Model Based Definition (MBD)

Model Based Enterprise (MBE)

Industry 4.0

Digital Enterprise

Advanced Manufacturing Enterprise

Digital Twin

Digital Thread

Digital Tapestry

Not all data is created equal. Consider:

dat   txt   tif   csv   xls
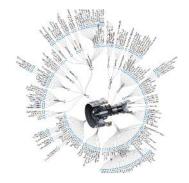
pdf   xml   prt   stp   jt

What is QIF?

Model and Feature-Based Ontology of Manufacturing Quality Metadata

XML Technology: Simple Implementation and Built-In Code Validation

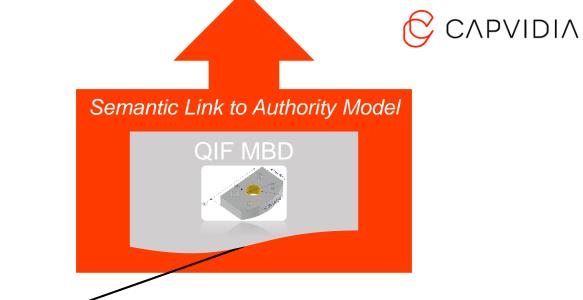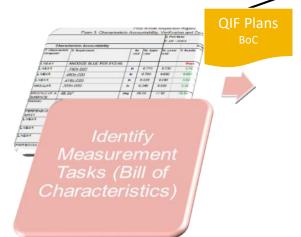Data semantically linked to Model for full data traceability to CAD
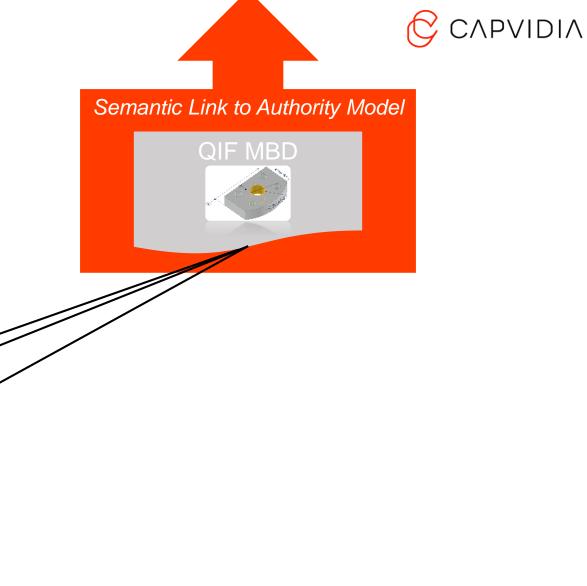
Workflow Example

Process Stage 1:

Search the PMI applied to the QIF MBD model, and identify the necessary measurement tasks. This list of tasks is called a Bill of Characteristics
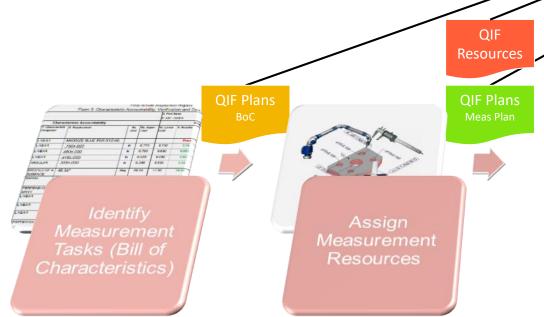
Semantic Link to Authority Model

QIF MBD

QIF Plans
BoC

Identify Measurement Tasks (Bill of Characteristics)
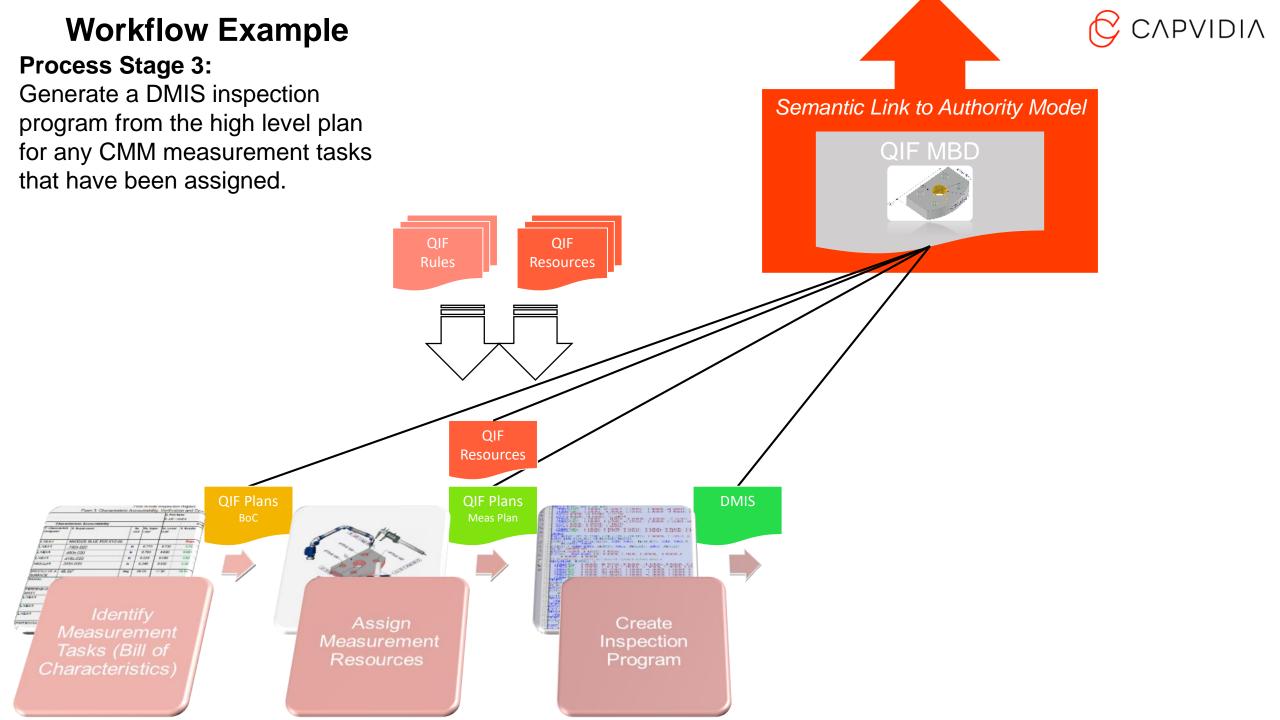
Workflow Example

Process Stage 2:
Using a set of organizational Measurement Rules and a list of available Measurement Resources, assign measurement resources to measurement tasks.

CAPVIDIA

Semantic Link to Authority Model

QIF MBD

QIF Rules

QIF Resources

QIF Resources

QIF Plans
BoC

QIF Plans
Meas Plan

Identify Measurement Tasks (Bill of Characteristics)

Assign Measurement Resources

Workflow Example

Process Stage 3:
Generate a DMIS inspection program from the high level plan for any CMM measurement tasks that have been assigned.

Workflow Example

Process Stage 4:
Evaluate the point clouds from the CMM or other dimensional measurement equipment against the GD&T assigned to each feature.

Semantic Link to Authority Model

QIF MBD

QIF
Rules

QIF
Resources

QIF
Resources

QIF Plans
BoC

QIF Plans
Meas Plan

DMIS

QIF
Results

Identify
Measurement
Tasks (Bill of
Characteristics)

Assign
Measurement
Resources

Create
Inspection
Program

Calculate
Results

Workflow Example

Process Stage 5:
Carry out statistical analysis of a set of measurement results according to organizational procedures.

All QIF data generated throughout the entire process is linked to the authority model.
This fulfills traceability requirements, and provides fertile opportunities for data mining.

Semantic Link to Authority Model

QIF MBD

QIF Rules

QIF Resources

QIF Resources

QIF Plans
BoC

Identify Measurement Tasks (Bill of Characteristics)

QIF Plans
Meas Plan

Assign Measurement Resources

Create Inspection Program

DMIS

Calculate Results

QIF Results

Analyze Results

QIF Statistics

Data

2935: 9.046

2935: 9.046

Data
with
context

Information

Data

Applied Information

Data with context

Knowledge

Information

Data

"This hole size is out of tolerance; the mating pin will not fit into this hole during assembly"

2935: 9.046

MBD Workflow –
CMM Program
Generation from MBD

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
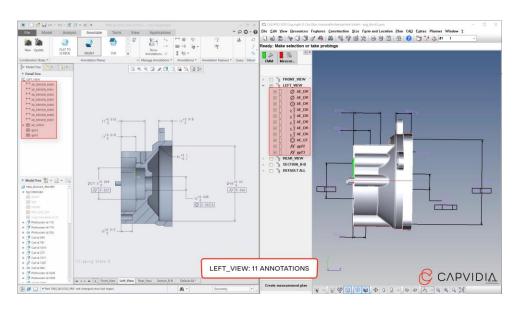- Not mapped to "single source of truth"

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

MBD-Based CMM Workflow

Watch the workflow here

Creo:
MBDVidia for Creo Plugin

CAPVIDIA

1. Starting point: MBD model in Creo
2. Export to Quality Information Framework (QIF) standard using "MBDVidia for Creo" plugin (Capvidia)

Less than 1 minute

MBDVidia

CAPVIDIA

1. Load the QIF MBD model
2. Check and heal the PMI – make sure that it is *machine readable*

5 minutes (but can be automated)

CheckMate

Origin

1. Import the machine-readable QIF MBD model
2. Enter essential information: probe configurations, CMM setup, etc.
3. Auto-generate the CMM program
4. Clean up and verify

Less than 3 hours – pilot processed can be drastically streamlined from this baseline effort

Simple ROI Analysis

Current Workflow

Total hours, existing manual workflow	**16 Hours**

New MBD Workflow

MBDVidia	5	Minutes
FormatWorks import of Creo file	5	Minutes
Checkmate Setup Parameters	5	Minutes
Checkmate Auto Programming		
Accessibility	15	Minutes
Sorting for dependencies	1	Minutes
Auto Coordinate Systems	1	Minutes
Probe moves/rotations	1	Minutes
Collision detection	20	Minutes
Manual editing (estimate)	120	Minutes
Post process program	5	Minutes
Total, New MBD Workflow	178	Minutes
Total, New MBD Workflow	**2.97**	**Hours**

81% Reduction in Time

Today's traditional, manual workflow for this part is estimated at about 16 hours.

The MBD pilot workflow took less than 3 hours.

ROI Analysis

Time reduction

MBD Workflow time vs. Manual Workflow Time	19%
MBD Workflow decreases total time by:	**81%**
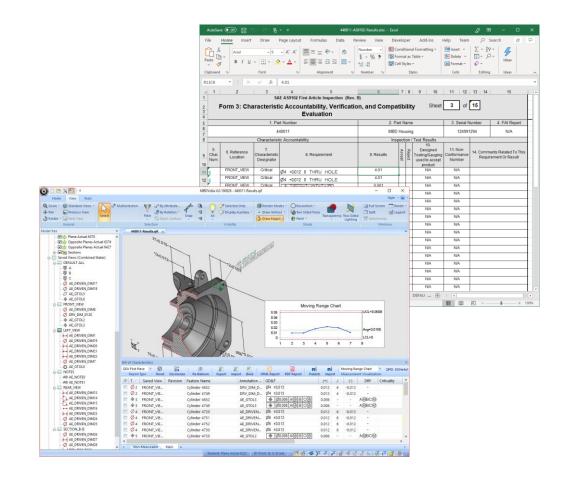
ROI Analysis

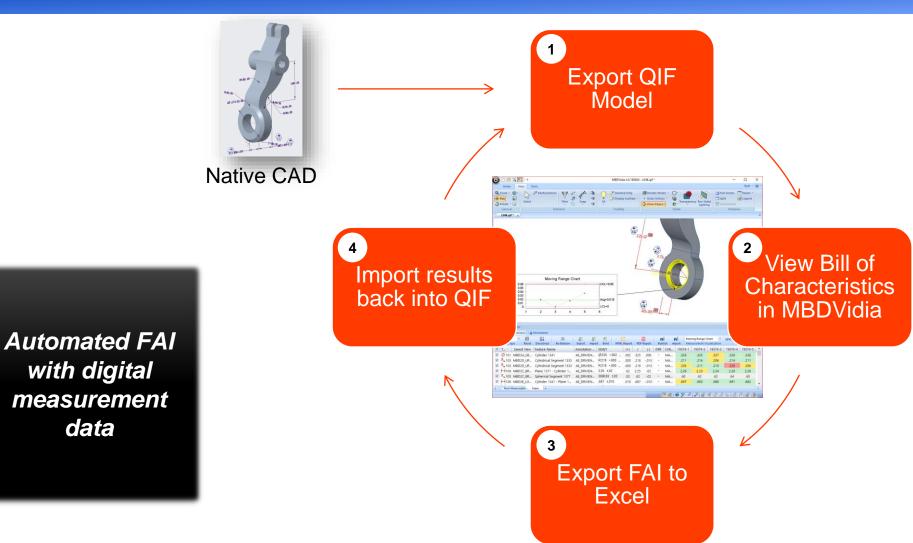|	
Hours saved on MBD Workflow	13.03
Number of parts programmed per year	80
Total yearly labor reduction	**1,042 hours**

MBD Workflow –
First Article Inspection (FAI) Report Generation from MBD

Automated Digital FAI from MBD – How It Works

Native CAD

Automated FAI with digital measurement data

1. Export QIF Model
2. View Bill of Characteristics in MBDVidia
3. Export FAI to Excel
4. Import results back into QIF
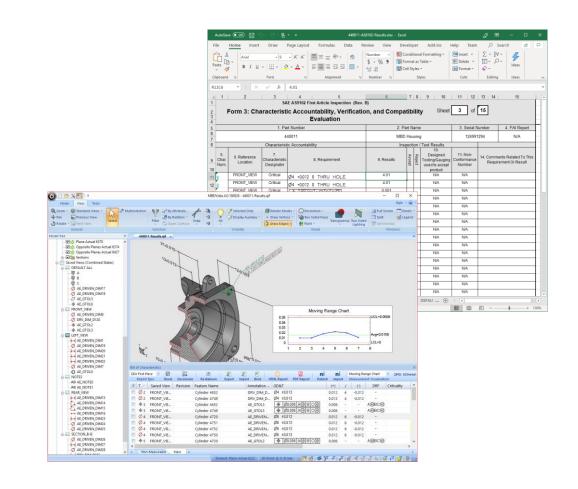
MBDVidia
Automated Digital FAI

CAPVIDIA

Click here to watch video

Conclusions –
Making the Jump to MBD

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

How to Start

Digital FAI

Easiest way to show ROI on semantic MBD workflows

MBD CMM

Requires good quality MBD data

Let us help!

*Capvidia is a thought leader in the area of **making use of your semantic CAD PMI**. We are constantly working on helping people achieve ROI on their MBD implementation. We can help.*

Get in touch with us to talk about how

Thanks!
Any questions – contact us!

Daniel Campbell
Director of Business Development
www.capvidia.com
dc@capvidia.com