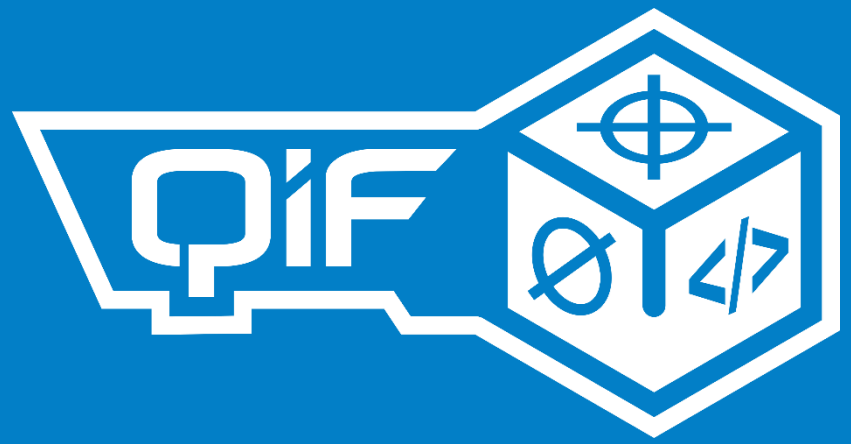


Digital Metrology Standards Consortium DMSC

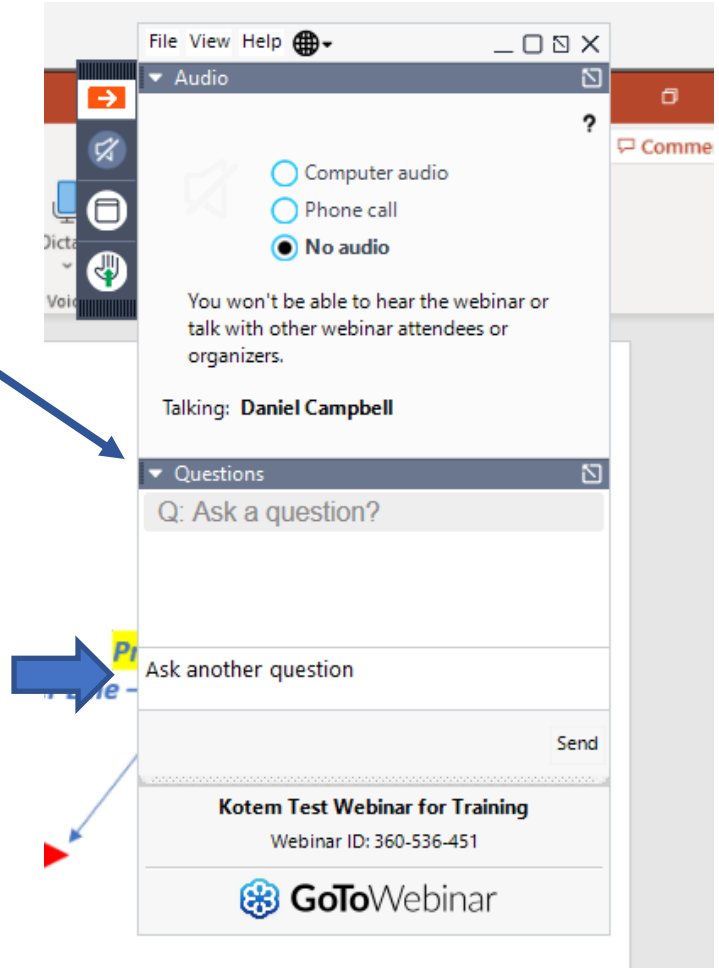
DMSC Coffee Chat Sessions
March 18, 2025

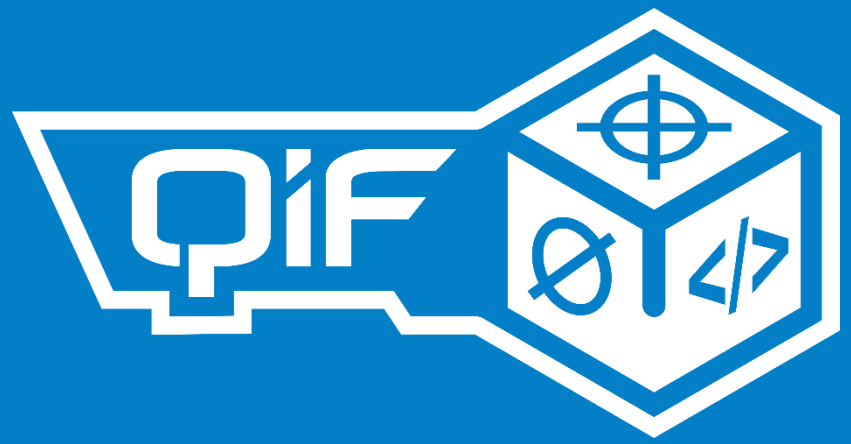
From Engineering Drawings to QIF: QIF for the 2D World

By Daniel Campbell, Rubypoint
& Sam Gambrell, Lockheed Martin

Housekeeping

- You will have the opportunity to submit text questions to today's presenter by typing your questions into the Questions pane of the control panel.
- You may send in your questions at any time during the presentation; we will collect these and address them during the Q&A session at the end of today's presentation.
- All participants will receive an email (tomorrow) with a link to today's QIF Coffee Chat presentation on video.





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From Engineering Drawings to QIF: QIF for the 2D World

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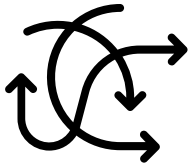
How did we get here?

- Why focused on fully semantic MBD from engineering?
  - Requires a digital solution from Quality to process information
  - Allows for the digital thread to be traced back to design and manufacturing
  - Eliminates the need to transcribe information by Quality

- Can QIF help me if I'm not using fully semantic MBD?
  - Don't worry, fully semantic MBD isn't common yet
  - Yes, the QIF standards was designed to also support non-semantic data
  - Yes, there are still benefits to be gained without semantic MBD

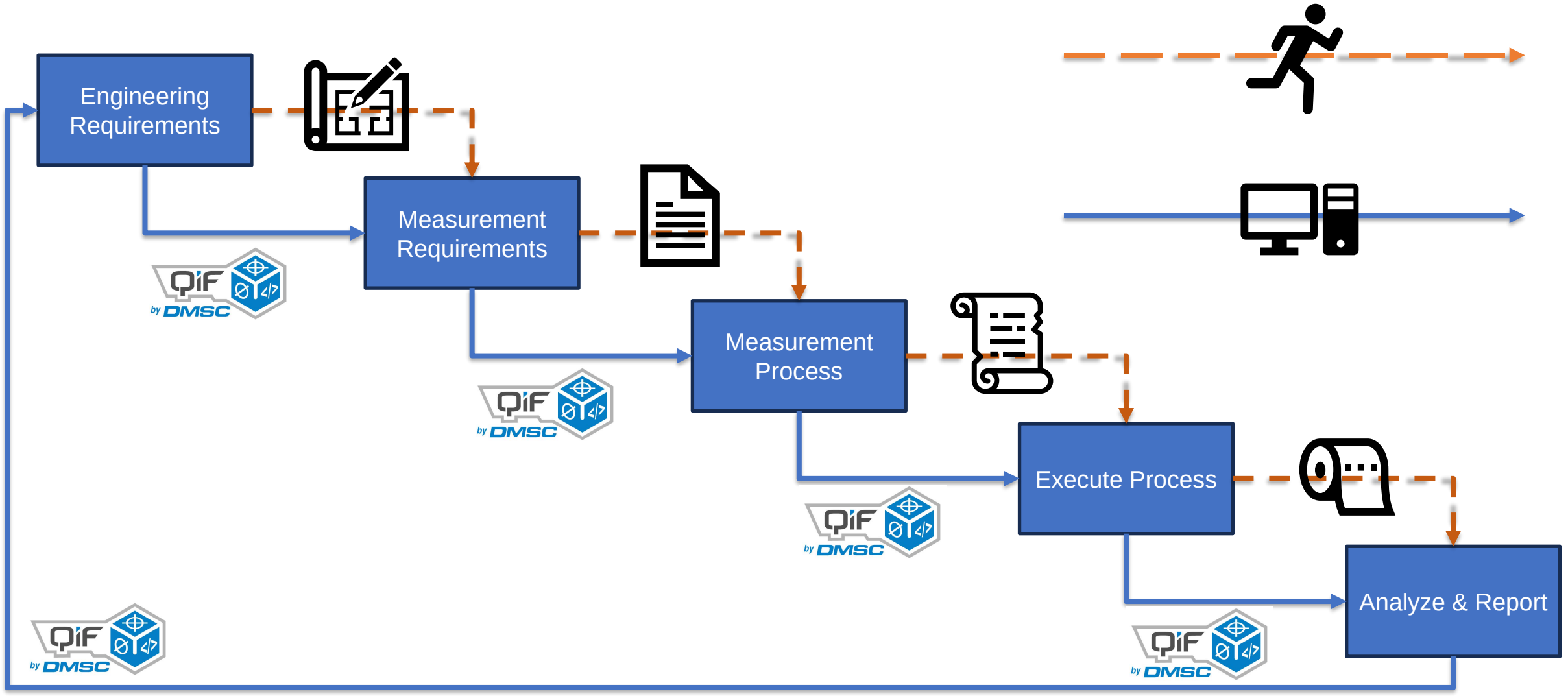
Step 1

Step 2



Step 3

Current State VS Future State



How will I benefit without MBD?

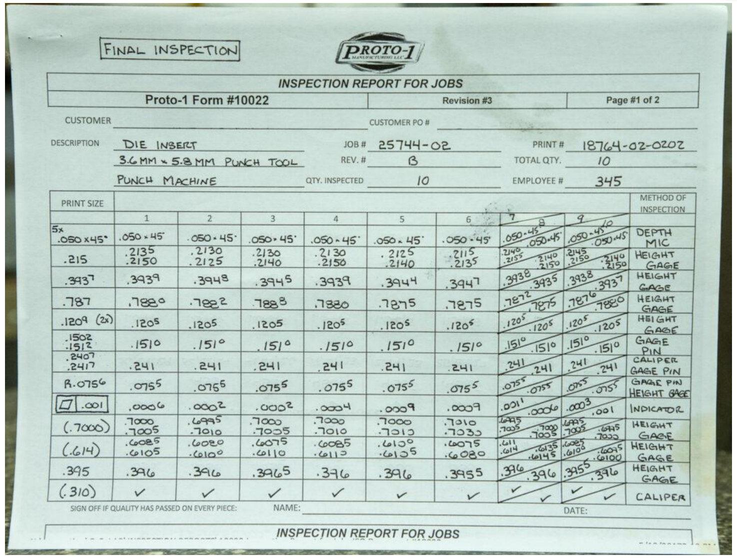
2D Engineering Requirements → Measurement Requirements → FAI Forms

Measurement Requirements → Measurement Process → Control Plan

Measurement Process → Execute Process → CMM Program

Execute Process → Analyze & Report

Redundant data entry



FINAL INSPECTION

PROTO-1 MANUFACTURING LLC

INSPECTION REPORT FOR JOBS

Proto-1 Form #10022 | Revision #3 | Page #1 of 2

CUSTOMER ______ CUSTOMER PO # ______

DESCRIPTION: DIE INSERT, 3.6MM x 5.8MM PUNCH TOOL, PUNCH MACHINE
JOB #: 25744-02 | REV. #: B | QTY. INSPECTED: 10
PRINT #: 18764-02-0202 | TOTAL QTY.: 10 | EMPLOYEE #: 345

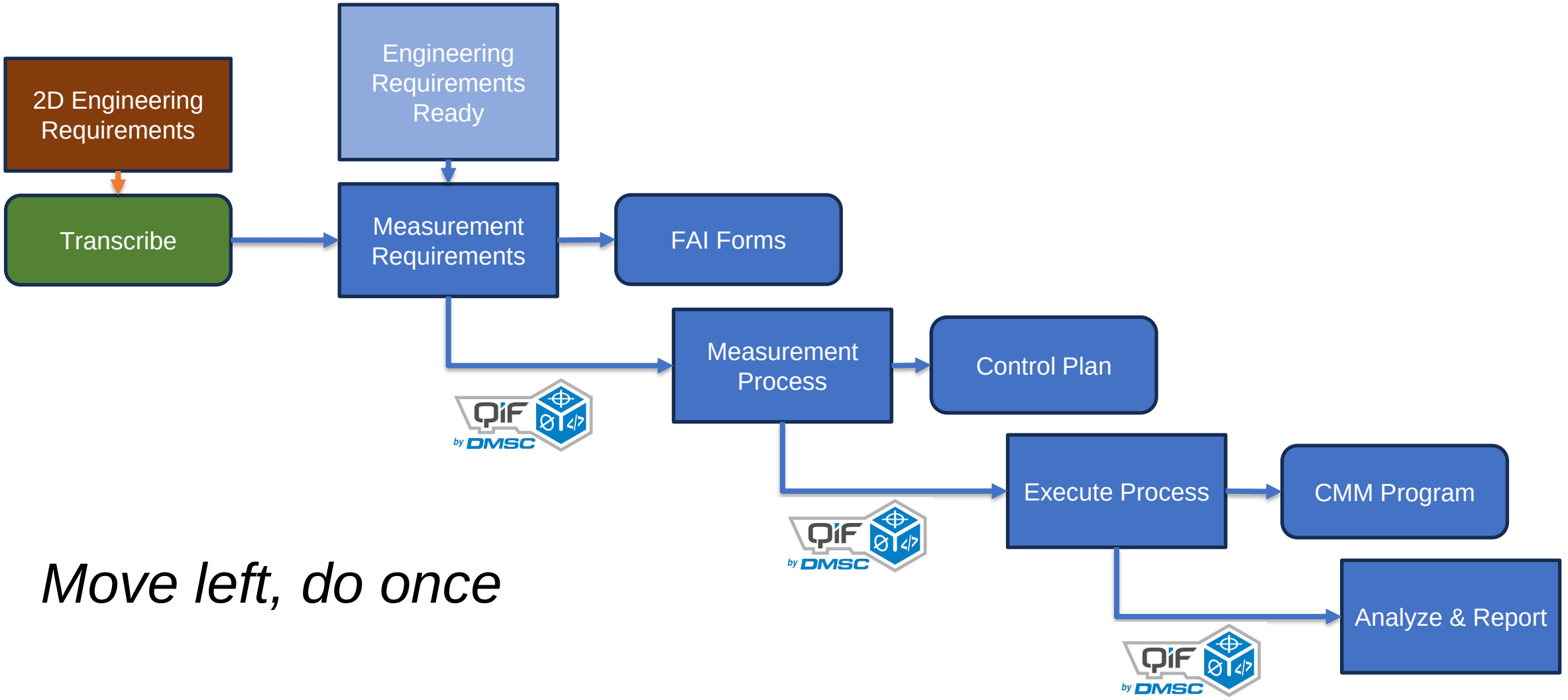
PRINT SIZE	1	2	3	4	5	6	7	8	9	10	METHOD OF INSPECTION
5x .050x45°	.050x45°	.050x45°	.050x45°	.050x45°	.050x45°	.050x45°	.050-45	.050-45	.050-45	.050-45	DEPTH MIC
.215	.2135 .2150	.2130 .2125	.2130 .2140	.2130 .2150	.2125 .2140	.2115 .2135	.2140 .2155	.2140 .2150	.2145 .2150	.2140 .2150	HEIGHT GAGE
.3937	.3939	.3948	.3945	.3939	.3944	.3947	.3938	.3935	.3938	.3937	HEIGHT GAGE
.787	.7880	.7882	.7888	.7880	.7875	.7875	.7872	.7875	.7876	.7880	HEIGHT GAGE
.1209 (2x)	.1205	.1205	.1205	.1205	.1205	.1205	.1205	.1205	.1205	.1205	HEIGHT GAGE
.1502 .1512	.1510	.1510	.1510	.1510	.1510	.1510	.1510	.1510	.1510	.1510	GAGE PIN
.2407 .2417	.241	.241	.241	.241	.241	.241	.241	.241	.241	.241	CALIPER GAGE PIN
R.0756	.0755	.0755	.0755	.0755	.0755	.0755	.0755	.0755	.0755	.0755	GAGE PIN HEIGHT GAGE
⏥ .001	.0006	.0002	.0002	.0004	.0009	.0009	.0011	.0006	.0003	.001	INDICATOR
(.7000)	.7000 .7005	.6995 .7010	.7000 .7005	.7000 .7010	.7000 .7010	.7010 .7030	.6995 .7005	.7000 .7005	.6995 .7005	.6995 .7000	HEIGHT GAGE
(.614)	.6085 .6105	.6020 .6100	.6075 .6110	.6085 .6110	.6100 .6105	.6075 .6080	.611 .614	.6135 .6145	.6085 .6100	.6095 .6100	HEIGHT GAGE
.395	.396	.396	.3965	.396	.396	.3955	.396	.396	.3955	.396	HEIGHT GAGE
(.310)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	CALIPER

SIGN OFF IF QUALITY HAS PASSED ON EVERY PIECE: NAME: ______ DATE: ______

INSPECTION REPORT FOR JOBS

https://proto1mfg.com/2020/10/08/proto-1-goes-paperless/

Move as far left as possible



Move left, do once

Value of QIF for 2D

Automation

- For example, FAI, Control Plan, SPC, CMM (to some extent)
- However, less automation than is possible with MBD

Characteristic Management

- Tracing product characteristics throughout an enterprise
- The “MBC” standard applies to drawings too!

Transition to MBD

- 2D QIF provides immediate benefit (automation) while also building the bridge to future MBD
- Strategies for Characteristic Management are at the core of a good MBD implementation. Thinking digital with 2D characteristics helps build this strategy.

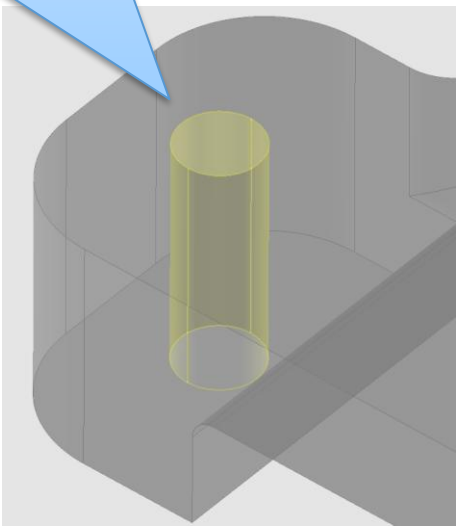
Major QIF Elements
Library: Features

An abstraction for referencing a portion of a part.
In MBD, this means:
A container for referencing one or more geometrical entities on the model

There are lots of feature types! Some examples:

- Cylinder
- Plane
- Cone
- Opposite Parallel Planes (slot)
- Freeform (generic)
- Circles
- Lines
- Ellipse
- Compound Features
- Pattern Features
- Etc.

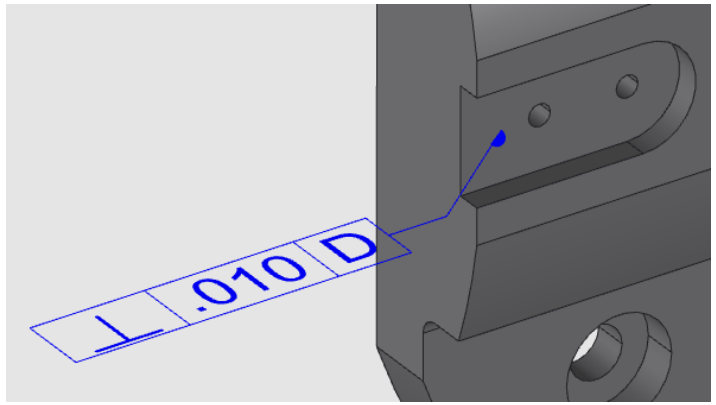
This Cylinder feature is made up of 2 CAD surfaces. (Pretty typical.)
But the CAD's mathematical representation of this geometry is irrelevant – this is a functional hole, and needs to be treated as such!



Major QIF Elements
Library: Characteristics

A control placed on a Feature.

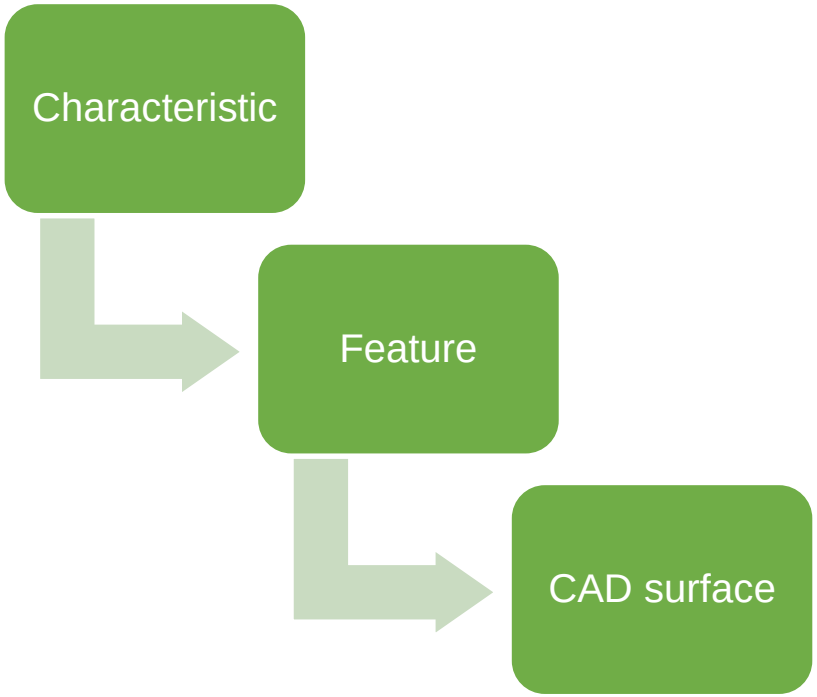
For example, a Size/Form/Orientation /Location tolerance, a Surface Finish, a Weld specification, etc.



With QIF MBD, it is also possible for a Characteristic to have a 3D presentation element (e.g., an annotation). But that's for human consumption.

How is a Characteristic connected to the MBD?

A Characteristic points to a Feature, and a Feature points to CAD geometry.



Product Data: Path to Digital with Features & Characteristics

Drawing Only

Features:
Manual creation from drawing

Characteristics:
Manual creation from drawing

Characteristic to Feature Assignment:
Manual linking created characteristics to features

Drawings + Model

Features:
Semi-automated from model

Characteristics:
Manual creation from drawing

Characteristic to Feature Assignment:
Manual linking created characteristics to features

MBD (Graphical PMI)

Features:
Automated from model

Characteristics:
Manual creation from model

Characteristic to Feature Assignment:
Manual linking created characteristics to features

MBD (Semantic PMI)

Features:
Automated from model

Characteristics:
Automated from model

Characteristic to Feature Assignment:
Automated from model

Product Data: Path to Digital with Features & Characteristics

Drawing Only

Features:
Manual creation from drawing

Characteristics:
Manual creation from drawing

Characteristic to Feature Assignment:
Manual linking created characteristics to features

Drawings +

MBD

- Semantically represented Characteristics is the innovation of QIF.
- Far-right column is best (MBD). But – even in the far-left column (drawing only), you can manage a digital BOC with QIF
- Even managing QIF-based characteristics on a drawing can help your organization to pave the way for a fully MBE environment by preparing you for **digital characteristics**.

MBD (Semantic PMI)

Features:
Automated from model

Characteristics:
Automated from model

Characteristic to Feature Assignment:
Automated from model

QIF Characteristic Architecture for 2D

Quality Data

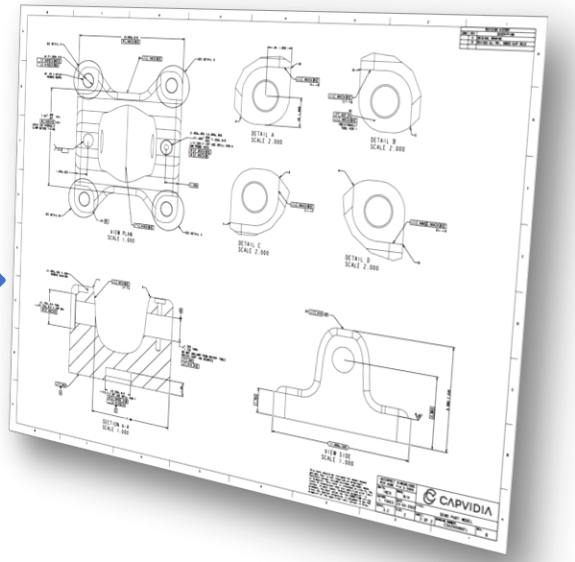
CharacteristicItem

- Characteristic Designator (i.e., “bubble”, “balloon”) (per-feature level)
- Reference to CharacteristicNominal

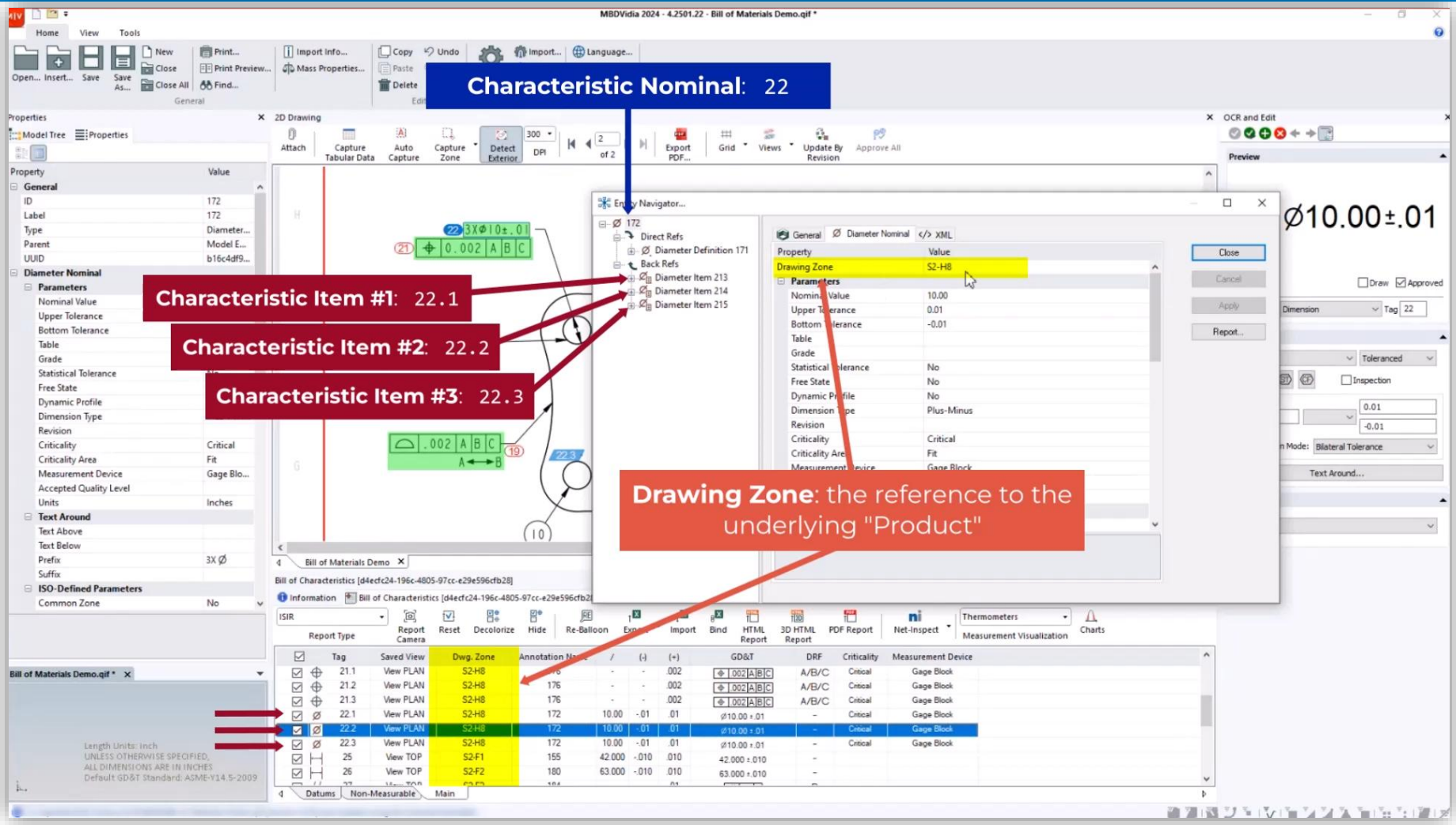
Engineering Data

CharacteristicNominal

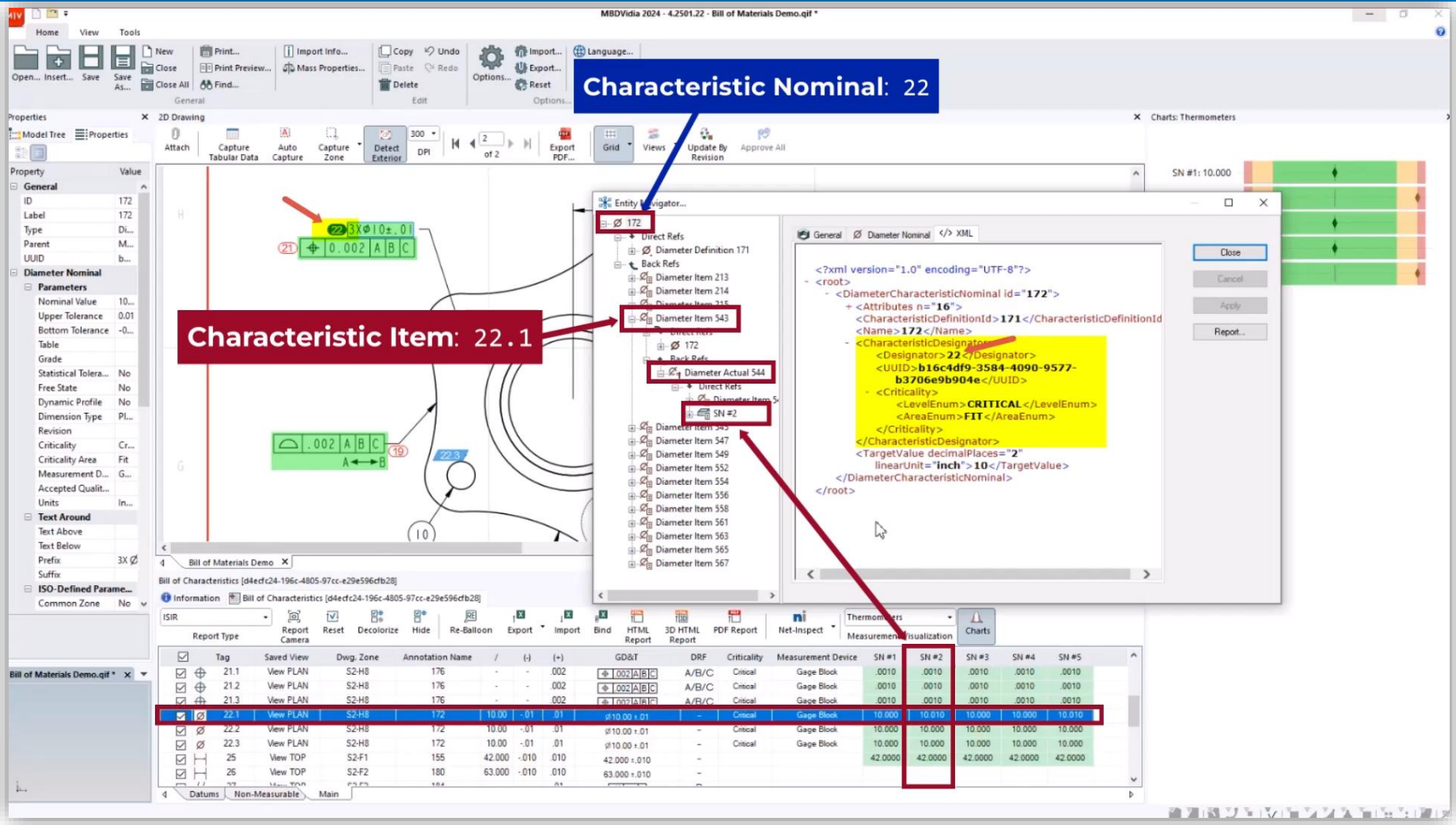
- Characteristic Designator (i.e., “bubble”, “balloon”) (per-characteristic level)
- Drawing ID, Sheet Number, Drawing Zone



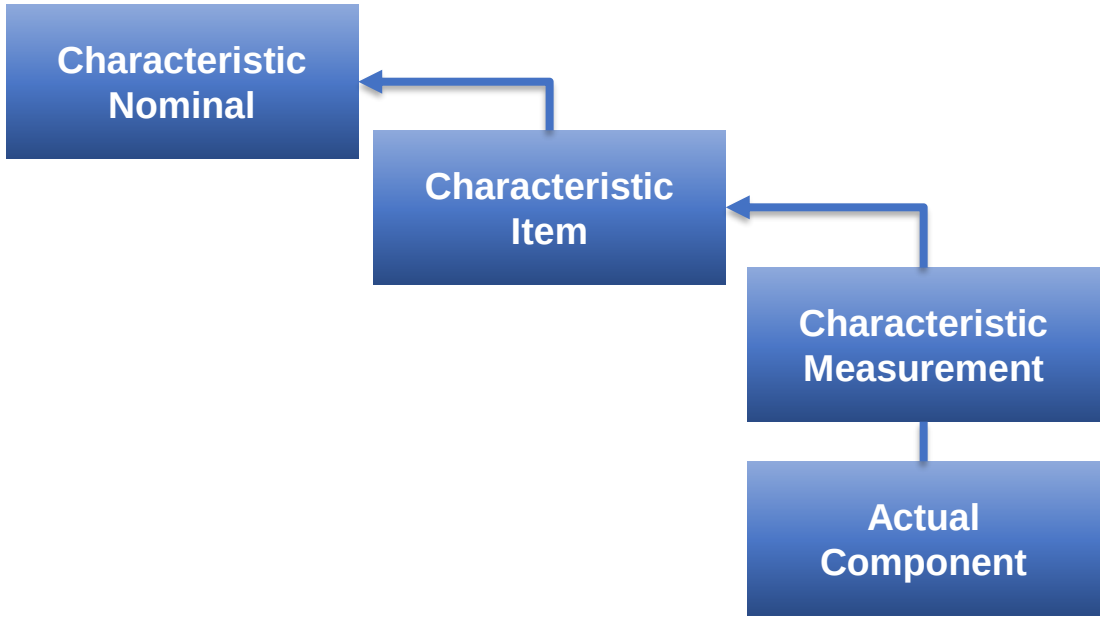
QIF for 2D Example: Capvidia

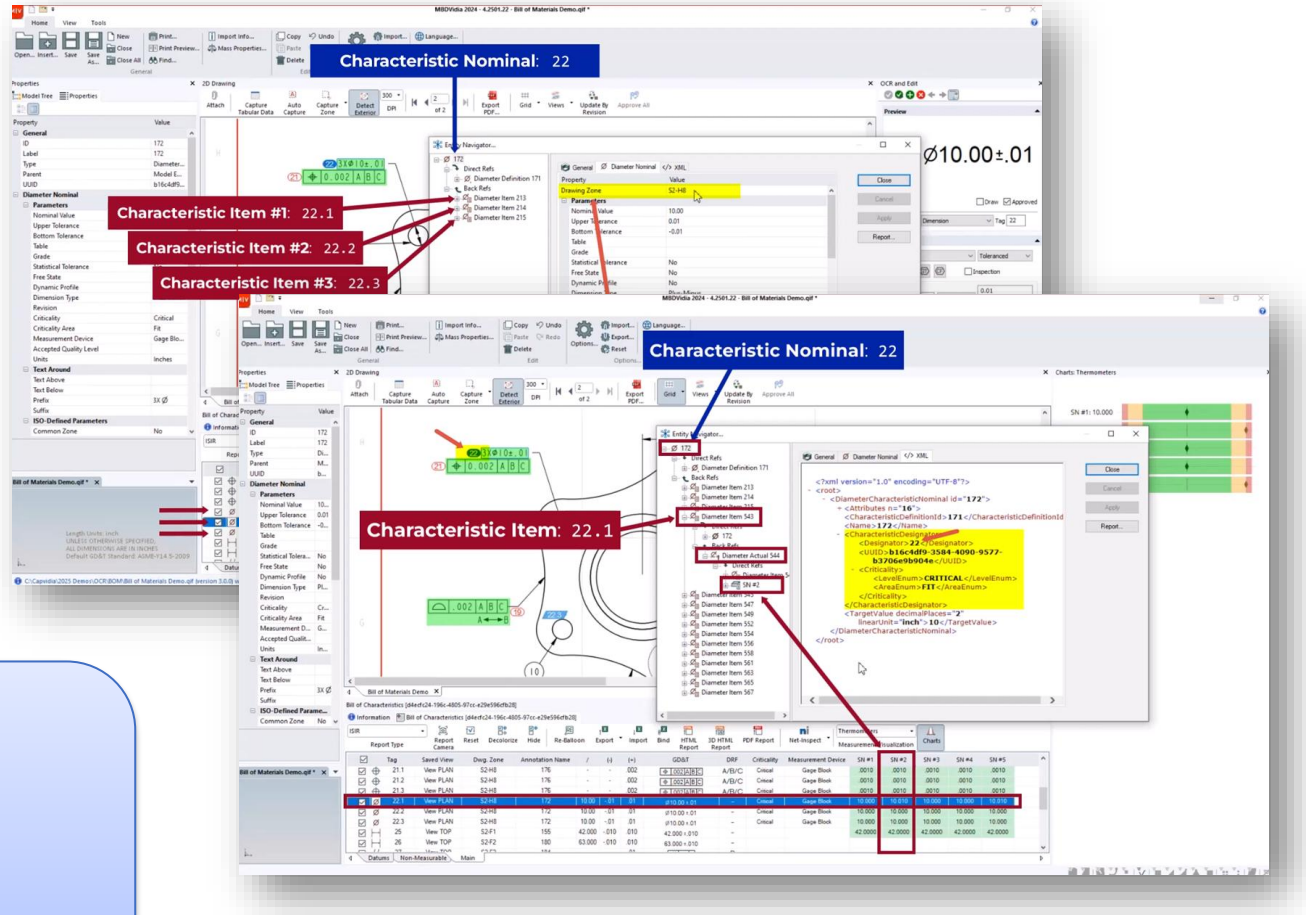


QIF for 2D Example: Capvidia



QIF for 2D Example: Capvidia





Even though we aren't MBD, there is still lots of value. We have:

- BOC,
- quality plan,
- and quality results

in an easy-to-use digital format.

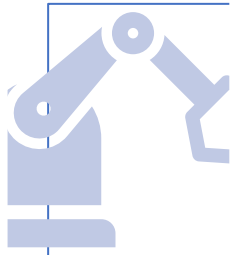
And once you transition to MBD, you can use the same BOC-based business systems with your MBD data, because it's the same QIF!

It's a bridge to MBE.

Low Hanging Fruit with 2D QIF

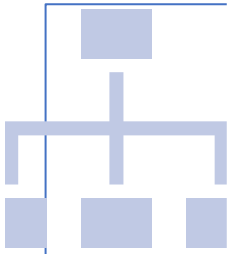
Digital Characteristic Management

- DFMEA
- FAI
- PFMEA
- Control Plans
- SPC



Digital Characteristics for CMM

- Pursue technology to insert digital characteristics into CMM workflows
- Partial progress towards CMM automation



Characteristic Management in PLM

- You can manage characteristics in PLM even in a drawing-based environment.
- Start thinking about digital characteristics throughout your enterprise

Open Discussion and General Q&A