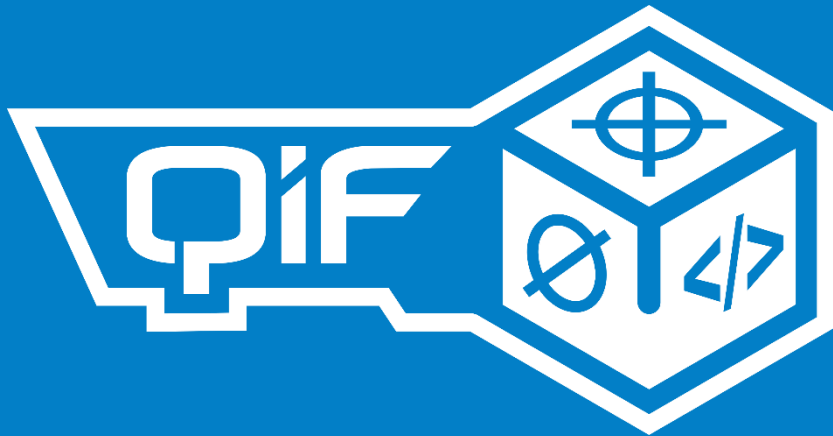


**DMSC Coffee Chat Sessions**

March 18, 2025

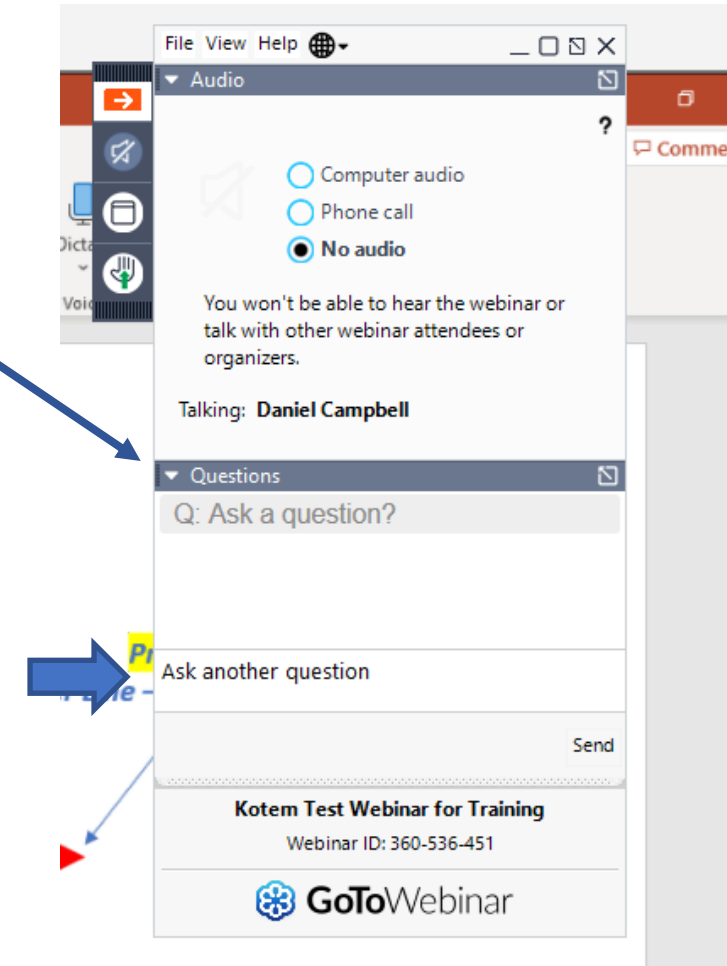


# From Engineering Drawings to QIF: QIF for the 2D World

By Daniel Campbell, [Rubypoint](#)  
& Sam Gambrell, [Lockheed Martin](#)

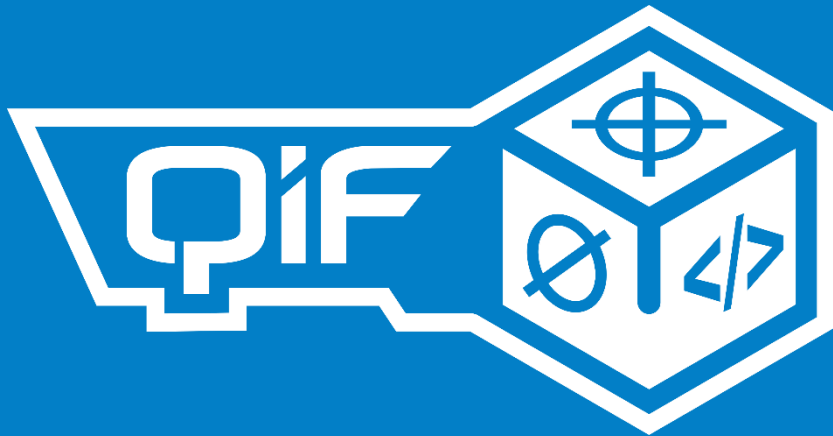
# Housekeeping

- 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.



**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](#)

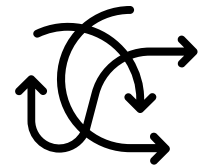
# How did we get here?

- 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

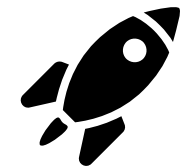
Step 1



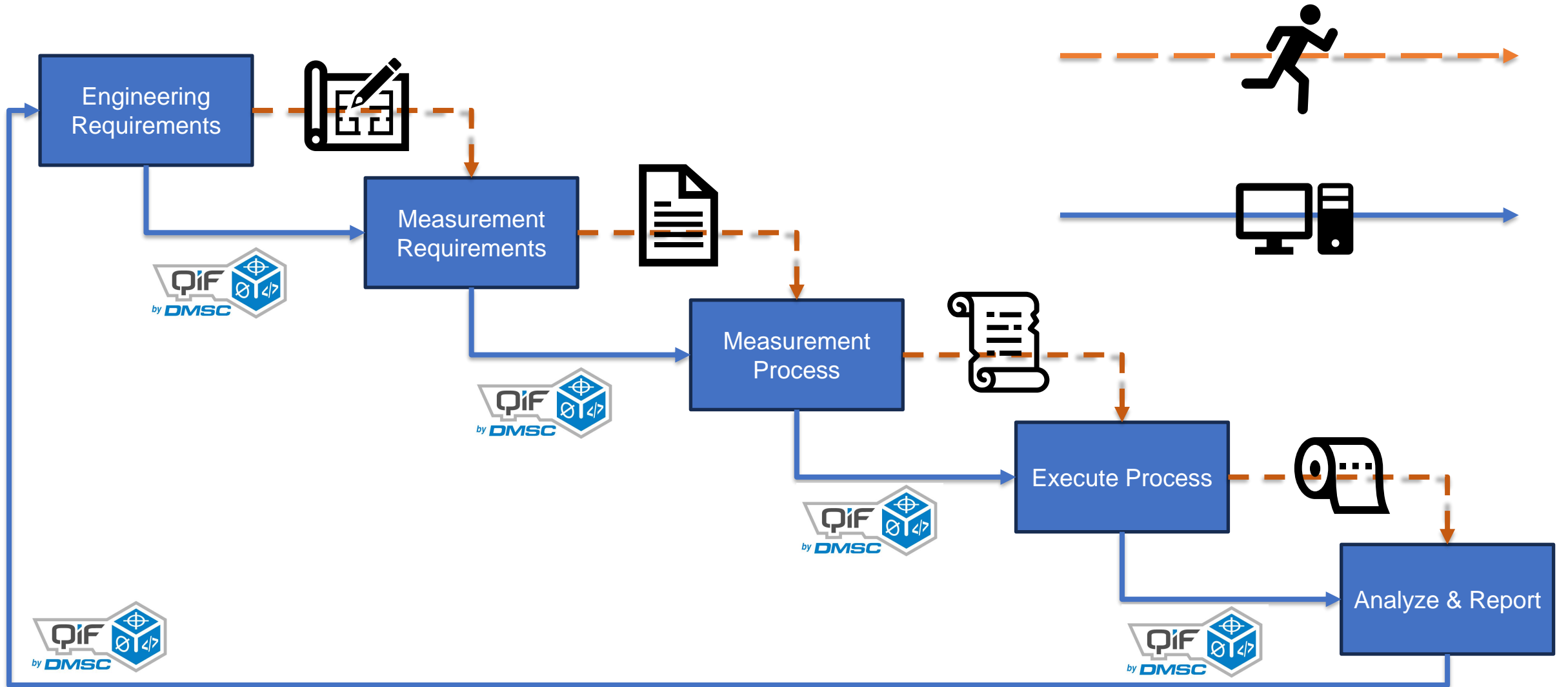
Step 2



Step 3



# Current State VS Future State



# How will I benefit without MBD?

2D Engineering  
Requirements

Measurement  
Requirements

FAI Forms

Measurement  
Process

Control Plan

Execute Process

CMM Program

Analyze & Report

*Redundant data entry*

FINAL INSPECTION

INSPECTION REPORT FOR JOBS

Proto-1 Form #10022

CUSTOMER: DIE INSERT

JOB #: 25744-02

PRINT #: 18764-02-0202

DESCRIPTION: 3.6MM x 5.8MM PUNCH TOOL

REV. #: 0

TOTAL QTY: 10

PUNCH MACHINE

QTY. INSPECTED: 10

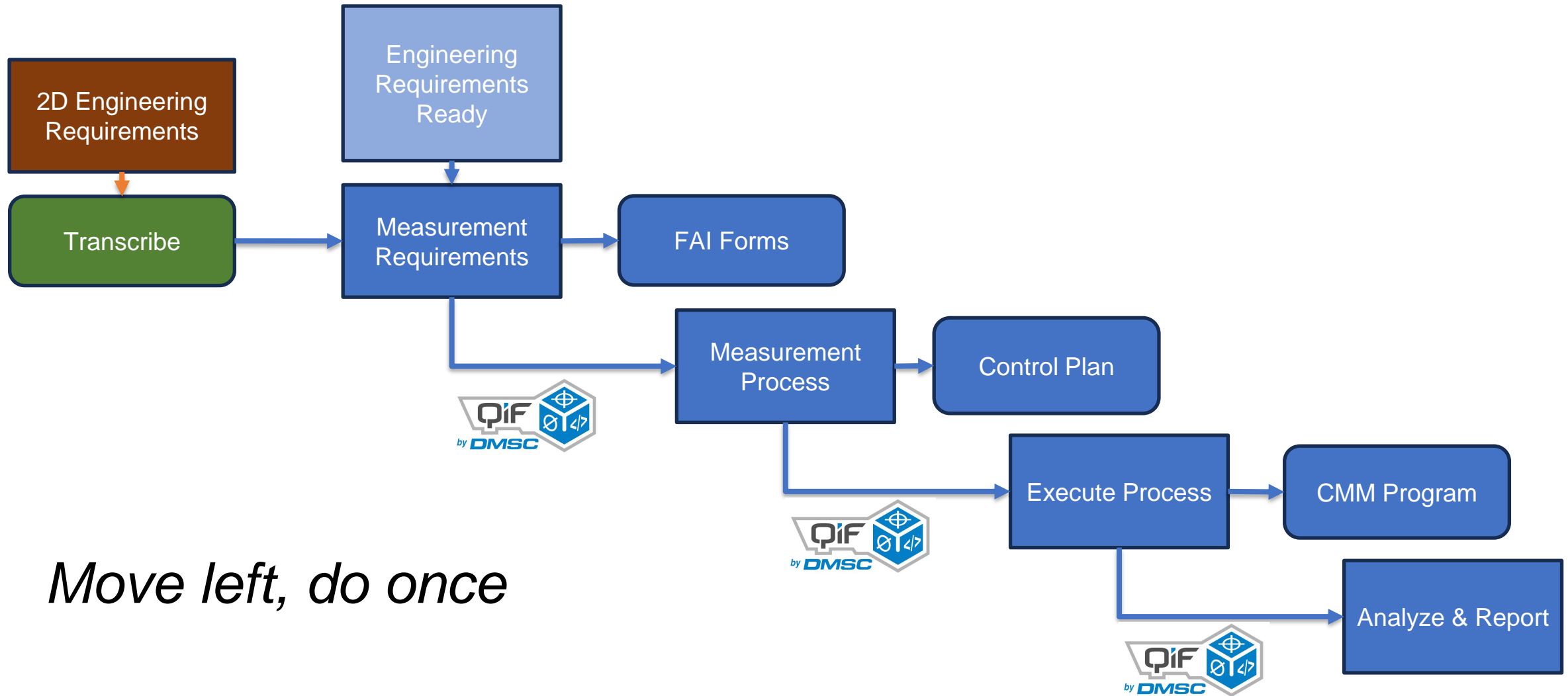
EMPLOYEE #: 345

PRINT SIZE	1	2	3	4	5	6	7	8	9	METHOD OF INSPECTION
5x	.050 x .45	.050 x .45	.050 x .45	.050 x .45	.050 x .45	.050 x .45	.050 x .45	.050 x .45	.050 x .45	DEPTH
.215	.2135	.2130	.2130	.2130	.2125	.2115	.2105	.2100	.2100	MIC
.215	.2150	.2125	.2140	.2150	.2140	.2135	.2130	.2125	.2120	HEIGHT
.3437	.3437	.3448	.3445	.3439	.3444	.3447	.3438	.3435	.3430	HEIGHT
.787	.7880	.7882	.7883	.7880	.7875	.7875	.7875	.7875	.7880	HEIGHT
.1209 (2)	.1209	.1205	.1205	.1205	.1205	.1205	.1205	.1205	.1205	HEIGHT
.1502	.1510	.1510	.1510	.1510	.1510	.1510	.1510	.1510	.1510	HEIGHT
.2407	.241	.241	.241	.241	.241	.241	.241	.241	.241	HEIGHT
.2417	.241	.241	.241	.241	.241	.241	.241	.241	.241	HEIGHT
R.0756	.0755	.0755	.0755	.0755	.0755	.0755	.0755	.0755	.0755	HEIGHT
.001	.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004	.0004	HEIGHT
.7000	.7000	.7000	.7000	.7000	.7000	.7000	.7000	.7000	.7000	HEIGHT
.614	.6085	.6080	.6075	.6065	.6105	.6075	.611	.6085	.6085	HEIGHT
.345	.346	.3465	.346	.346	.346	.3455	.346	.3455	.346	HEIGHT
.310	✓	✓	✓	✓	✓	✓	✓	✓	✓	CALIPER

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

INSPECTION REPORT FOR JOBS

# Move as far left as possible



# 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.

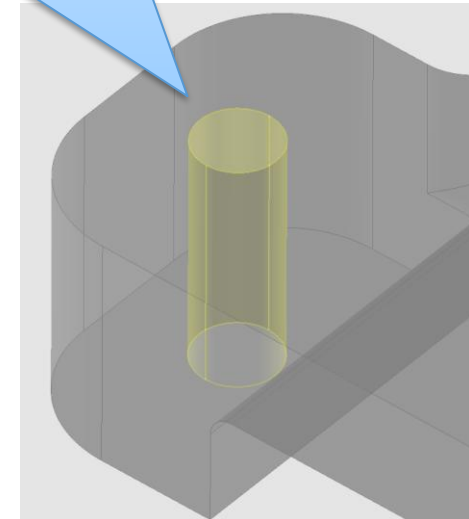
**In MBD, this means:**

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!



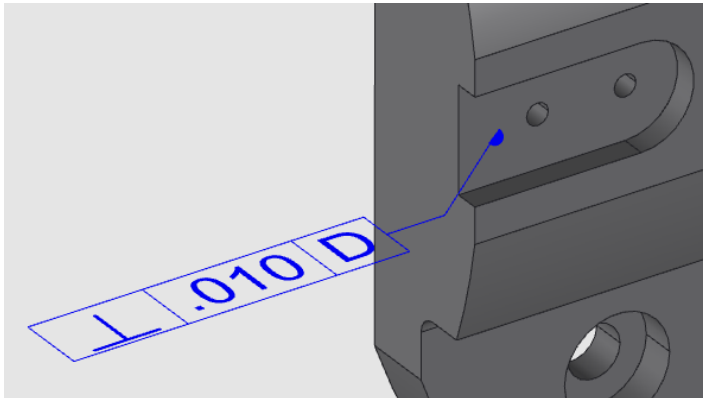
# Major QIF Elements

## Library: Characteristics



A control placed on a Feature.

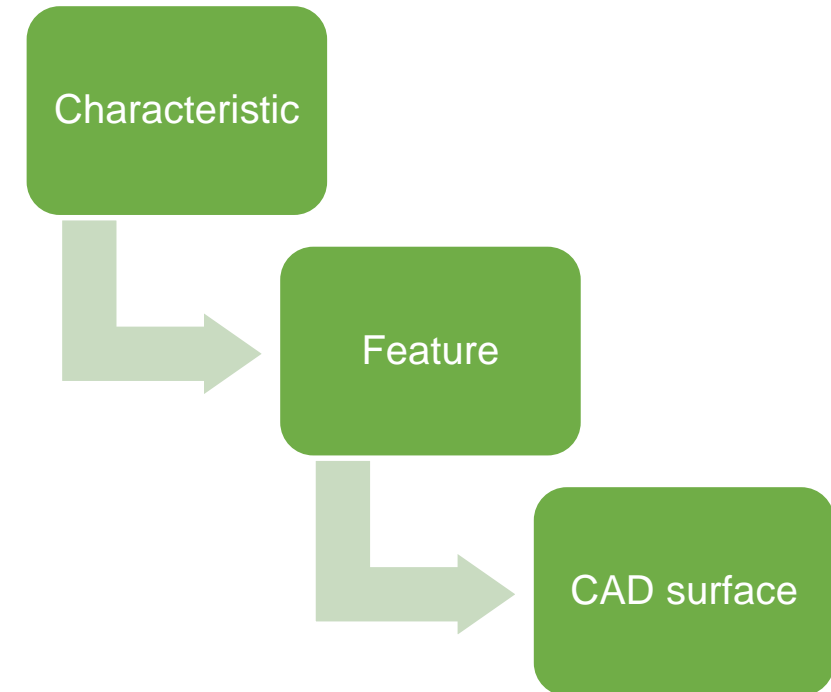
For example, a Size/Form/Orientation /Location tolerance, a Surface Finish, a Weld specification, etc.



*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



### Features:

Automated from model



### Characteristics:

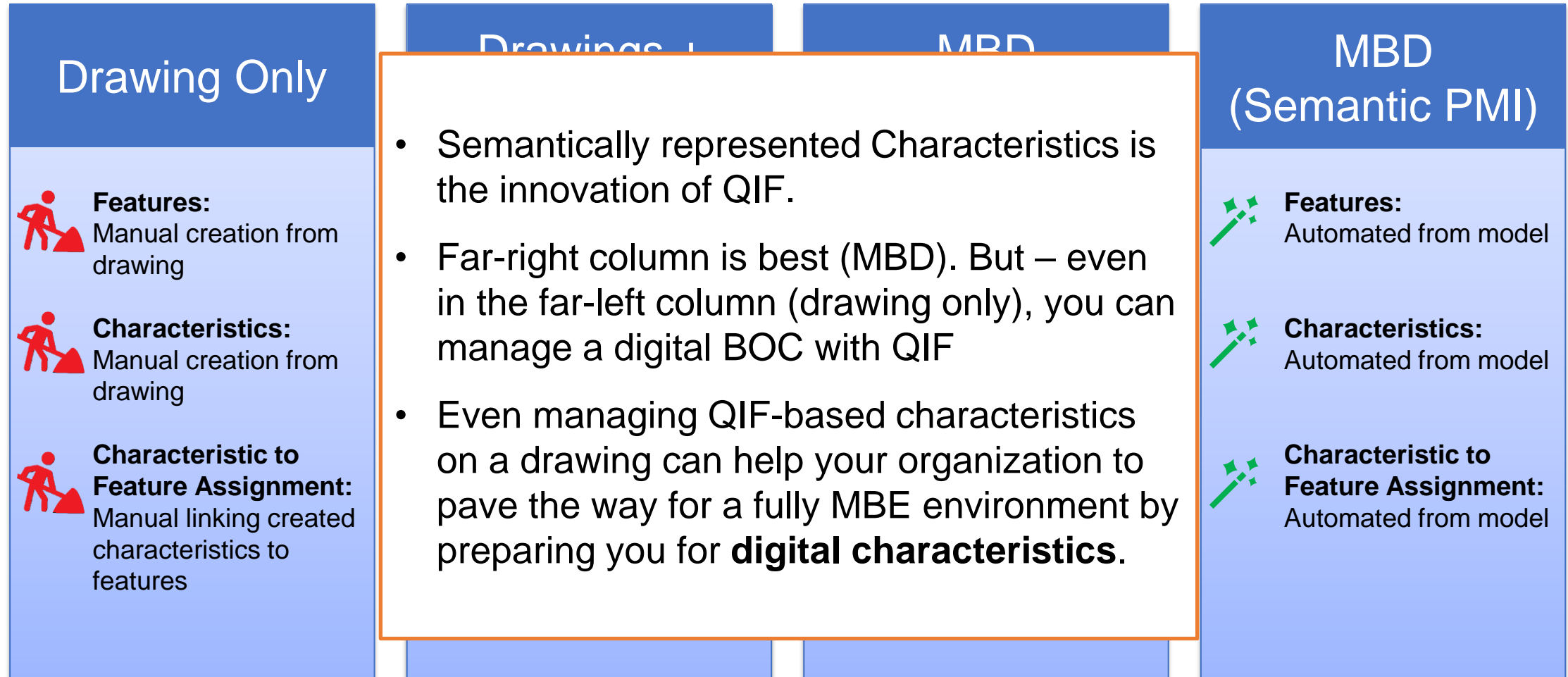
Automated from model



### Characteristic to Feature Assignment:

Automated from model

# Product Data: Path to Digital with Features & Characteristics



# QIF Characteristic Architecture for 2D

## Quality Data

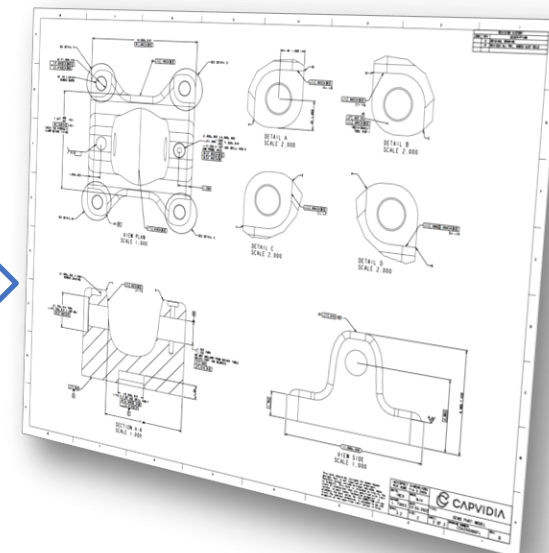
### CharacteristicItem

- 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

**Characteristic Nominal: 22**

**Characteristic Item #1: 22.1**

**Characteristic Item #2: 22.2**

**Characteristic Item #3: 22.3**

**Drawing Zone: the reference to the underlying "Product"**

Bill of Materials Demo.qif

Properties

General

ID: 172

Label: 172

Type: Diameter...

Parent: Model E...

UUID: b16c4df9...

Diameter Nominal

Parameters

Nominal Value: 10.00

Upper Tolerance: 0.01

Bottom Tolerance: -0.01

Table

Grade

Statistical Tolerance

Free State

Dynamic Profile

Dimension Type

Revision

Criticality

Criticality Area

Measurement Device

Accepted Quality Level

Units

Text Around

Text Above

Text Below

Prefix: 3X

Suffix

ISO-Defined Parameters

Common Zone

Bill of Materials Demo.qif

Length Units: inch

UNLESS OTHERWISE SPECIFIED,  
ALL DIMENSIONS ARE IN INCHES

Default GD&T Standard: ASME-Y14.5-2009

Bill of Materials Demo.qif

Information

Bill of Characteristics [d4eefc24-196c-4805-97cc-e29e596fdb28]

Report Type

Report Camera

Reset

Decolorize

Hide

Re-Balloon

Export

Import

Bind

HTML Report

3D HTML Report

PDF Report

Net-Inspect

Thermometers

Measurement Visualization

Charts

Tag	View	Dwg. Zone	Annotation Name	/	(-)	(+)	GD&T	DRF	Criticality	Measurement Device
21.1	View PLAN	S2-H8	176	-	-	0.002	⊕ 1.002 A/B/C	A/B/C	Critical	Gage Block
21.2	View PLAN	S2-H8	176	-	-	0.002	⊕ 1.002 A/B/C	A/B/C	Critical	Gage Block
21.3	View PLAN	S2-H8	176	-	-	0.002	⊕ 1.002 A/B/C	A/B/C	Critical	Gage Block
22.1	View PLAN	S2-H8	172	10.00	-0.01	0.01	⊕ 10.00 ± 0.01	-	Critical	Gage Block
22.2	View PLAN	S2-H8	172	10.00	-0.01	0.01	⊕ 10.00 ± 0.01	-	Critical	Gage Block
22.3	View PLAN	S2-H8	172	10.00	-0.01	0.01	⊕ 10.00 ± 0.01	-	Critical	Gage Block
25	View TOP	S2-F1	155	42.000	-0.010	0.010	42.000 ± 0.010	-	-	-
26	View TOP	S2-F2	180	63.000	-0.010	0.010	63.000 ± 0.010	-	-	-



# QIF for 2D Example: Capvidia

MBDVideo 2024 - 4.2501.22 - Bill of Materials Demo.qif \*

Home View Tools

Open... Insert... Save Save As... Close Close All Find... Print... Print Preview... Import Info... Mass Properties... Copy Paste Delete Undo Redo Options... Reset Import... Export... Language...

Properties

Model Tree Properties

Property Value

General

ID 172

Label 172

Type DI...

Parent DI...

UUID b...

Diameter Nominal

Parameters

Nominal Value 10...

Upper Tolerance 0.01

Bottom Tolerance -0...

Table

Grade

Statistical Tola... No

Free State No

Dynamic Profile No

Dimension Type PL...

Revision

Criticality Cr...

Criticality Area Fit

Measurement D... G...

Accepted Qualit... In...

Units

Text Around

Text Above

Text Below

Prefix 3X

Suffix

ISO-Defined Parame... Common Zone No

2D Drawing

Attach Capture Tabular Data Auto Capture Capture Zone Detect Exterior DPI 300 2 of 2 Export PDF... Grid Views Update By Revision Approve All

Entity Navigator...

172

Direct Refs

Back Refs

Diameter Definition 171

Diameter Item 213

Diameter Item 214

Diameter Item 543

Back Refs

172

Diameter Actual 544

Direct Refs

Diameter Item 543

Diameter Item 542

Diameter Item 547

Diameter Item 552

Diameter Item 554

Diameter Item 556

Diameter Item 558

Diameter Item 561

Diameter Item 563

Diameter Item 565

Diameter Item 567

General Diameter Nominal </> XML

<?xml version="1.0" encoding="UTF-8"?>

<root>

<DiameterCharacteristicNominal id="172">

+ <Attributes n="16">

<CharacteristicDefinitionId>171</CharacteristicDefinitionId>

<Name>172</Name>

<CharacteristicDesignator>

<Designator>22</Designator>

<UUID>b16c4df9-3584-4090-9577-b3706e9b904e</UUID>

<Criticality>

<LevelEnum>CRITICAL</LevelEnum>

<AreaEnum>FIT</AreaEnum>

</Criticality>

</CharacteristicDesignator>

<TargetValue decimalPlaces="2" linearUnit="inch">10</TargetValue>

</DiameterCharacteristicNominal>

</root>

Bill of Materials Demo

Bill of Characteristics [d4edc24-196c-4805-97cc-e29e596fcb28]

Information Bill of Characteristics [d4edc24-196c-4805-97cc-e29e596fcb28]

Report Type Report Camera Reset Decolorize Hide Re-Balloon Export Import Bind HTML Report 3D HTML Report PDF Report Net-Inspect Measurement Visualization Charts

Tag	Saved View	Dwg. Zone	Annotation Name	/	(-)	(+)	GD&T	DRF	Criticality	Measurement Device	SN #1	SN #2	SN #3	SN #4	SN #5
21.1	View PLAN	S2-H8	176	-	-	.002	0.002 A/B/C	A/B/C	Critical	Gage Block	.0010	.0010	.0010	.0010	.0010
21.2	View PLAN	S2-H8	176	-	-	.002	0.002 A/B/C	A/B/C	Critical	Gage Block	.0010	.0010	.0010	.0010	.0010
21.3	View PLAN	S2-H8	176	-	-	.002	0.002 A/B/C	A/B/C	Critical	Gage Block	.0010	.0010	.0010	.0010	.0010
22.1	View PLAN	S2-H8	172	10.00	-.01	.01	ø10.00 ± .01	-	Critical	Gage Block	10.000	10.010	10.000	10.000	10.010
22.2	View PLAN	S2-H8	172	10.00	-.01	.01	ø10.00 ± .01	-	Critical	Gage Block	10.000	10.000	10.000	10.000	10.000
22.3	View PLAN	S2-H8	172	10.00	-.01	.01	ø10.00 ± .01	-	Critical	Gage Block	10.000	10.000	10.000	10.000	10.000
25	View TOP	S2-F1	155	42.000	-.010	.010	42.000 ± .010	-	-	-	42.0000	42.0000	42.0000	42.0000	42.0000
26	View TOP	S2-F2	180	63.000	-.010	.010	63.000 ± .010	-	-	-	63.0000	63.0000	63.0000	63.0000	63.0000

4 Datums Non-Measurable Main

# QIF for 2D Example: Capvidia

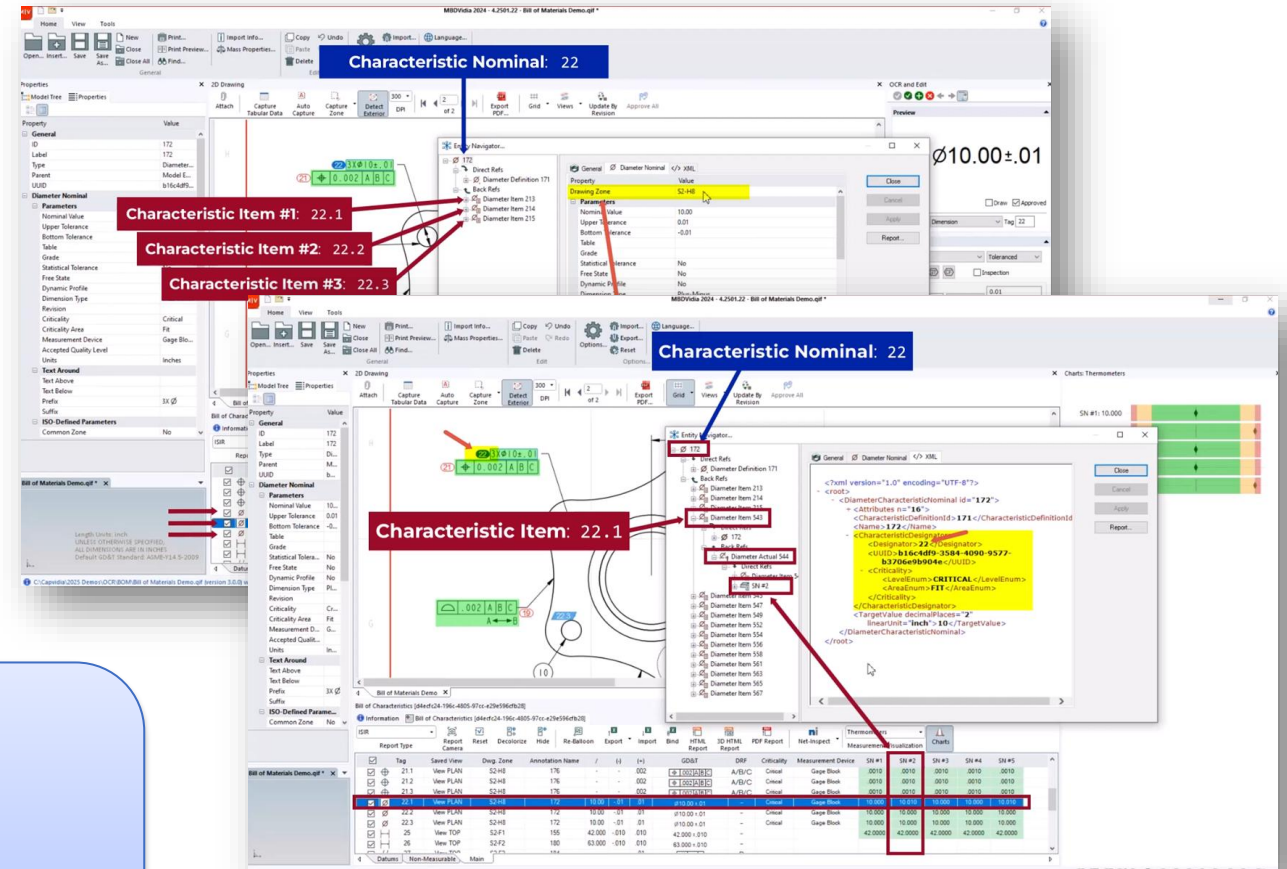


Characteristic  
Nominal

Characteristic  
Item

Characteristic  
Measurement

Actual  
Component



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.

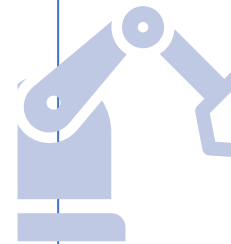


# Low Hanging Fruit with 2D QIF



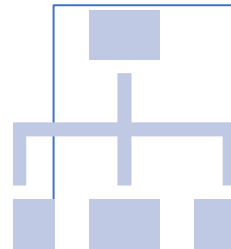
## Digital Characteristic Management

- 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

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