Characteristic Accountability

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GLOBAL PRODUCT DATA INTEROPERABILITY SUMMIT 2024

Belcan Digital Engineering Solutions

Global Product Data Interoperability Summit | **2024**

Belcan
a cognizant company

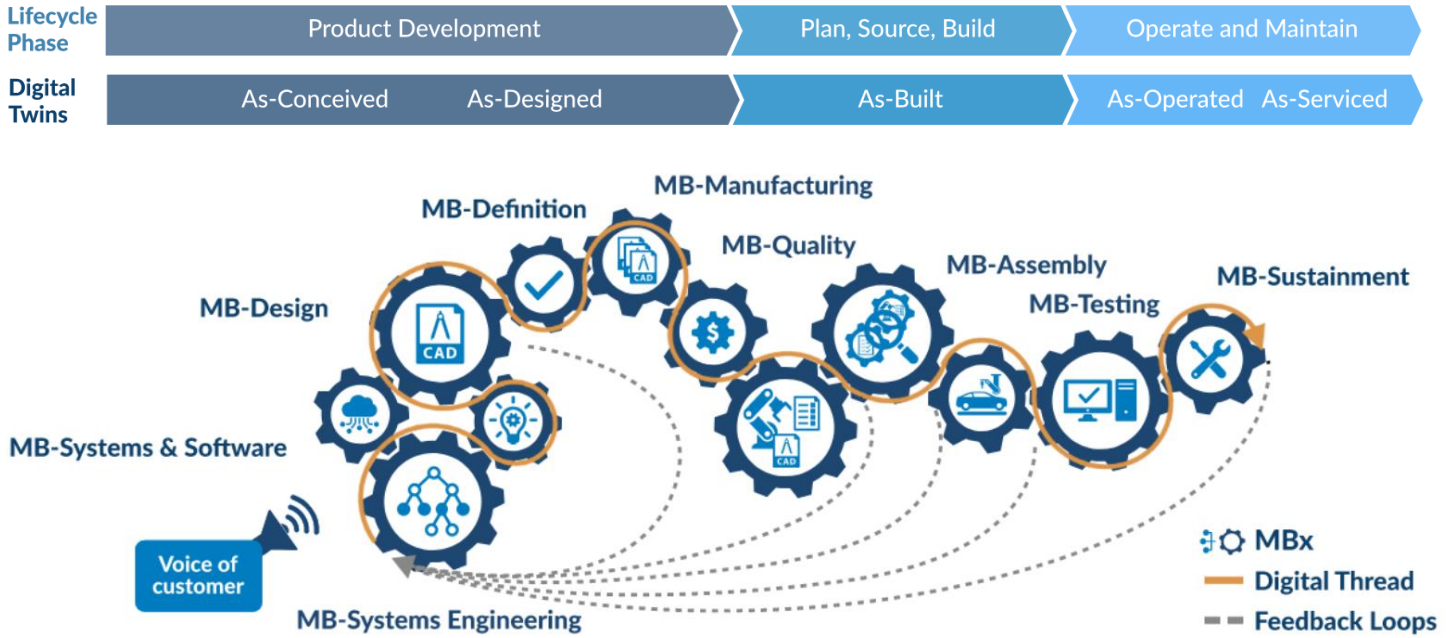
Belcan Overview

- 65 years of Engineering Better Outcomes
- Global Delivery Network
- 10,000 Professionals
- Annual Revenue of ~$1B

Aerospace
Defense
Space
Marine
Automotive
Government
Off-Highway
Industrial

Belcan Digital Engineering Solutions

Model-Based Engineering



GLOBAL PRODUCT DATA INTEROPERABILITY SUMMIT 2024

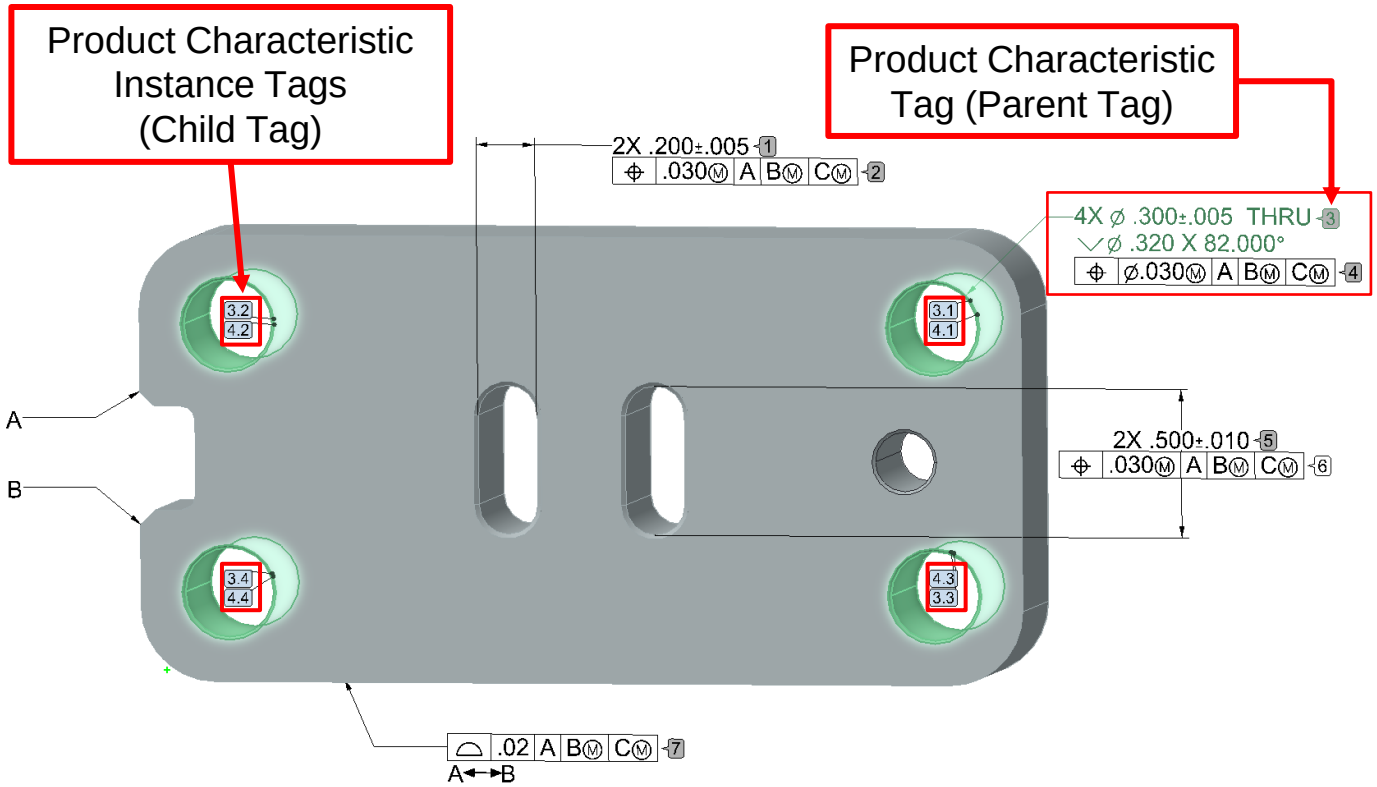
Terminology

Product Characteristic:

A trait, quality, or attribute of a feature or product that requires verification to ensure product acceptance.

Product Characteristic Tag:

A human and/or machine-readable tag applied to a characteristic



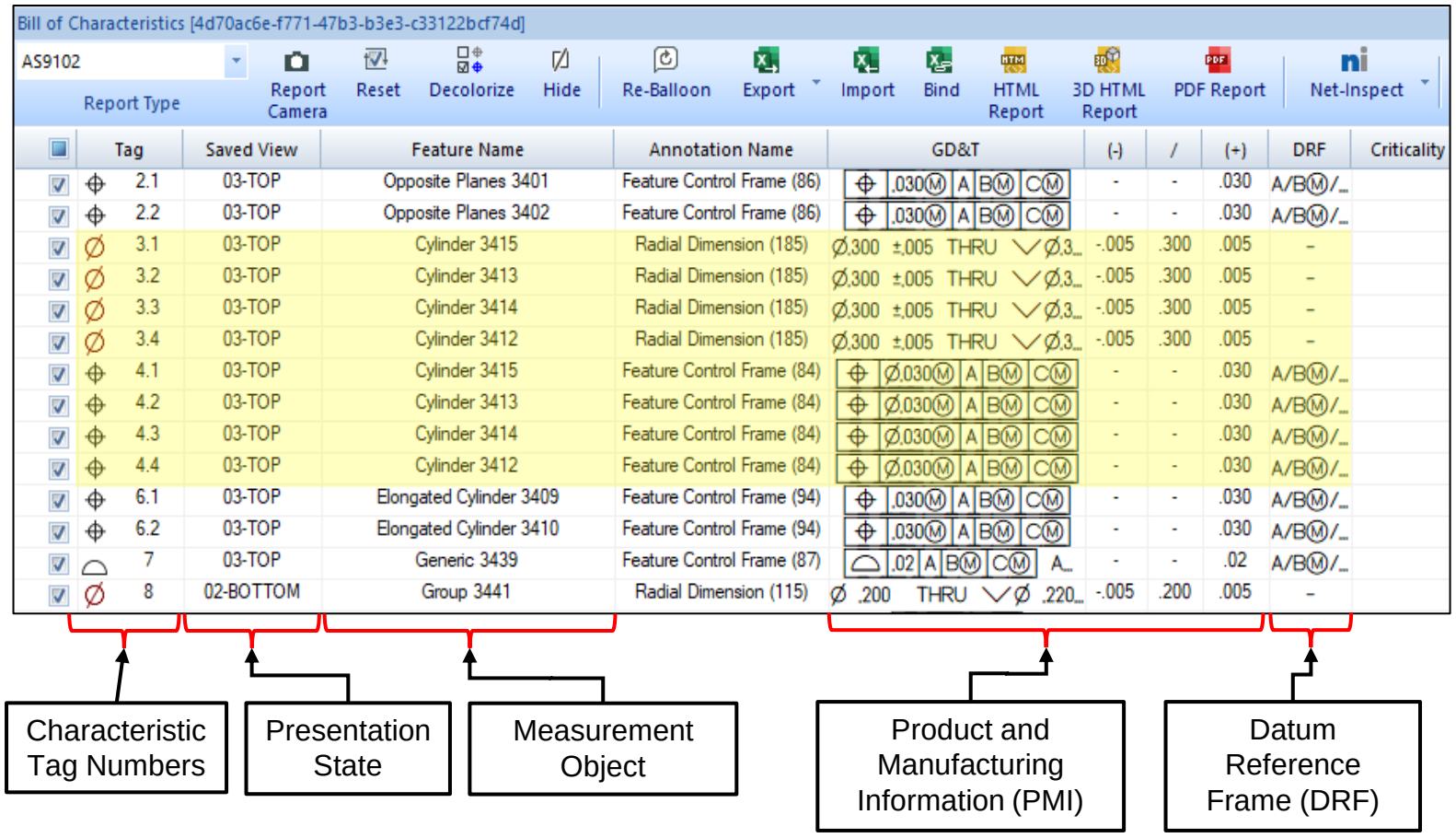
Terminology

Bill of Characteristics (BoC):

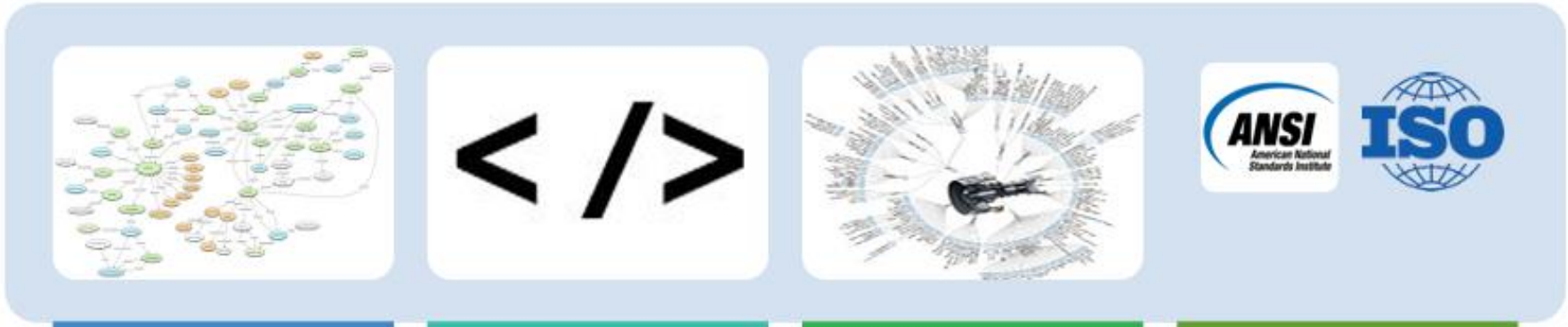
A list of all the characteristics applied to a product

Characteristic Accountability:

Ensuring all characteristic requirements have been met with traceability through inspection results



QIF Overview



Feature-Based Characteristic Centered Ontology of Manufacturing Quality Metadata

XML Technology: Simple Implementation with Built-In Code Validation

Information Semantically Linked to MBD for Full Data Traceability via Persistent IDs (QPId/UUID)

QIF 3.0 Approved as an Digital Interoperability Standard ANSI/DMSC 3.0; ISO 23952:2020

Developed and Maintained by the Digital Metrology Standards Consortium (DMSC)

Digital Metrology Standards Consortium DMSC

Learn more!

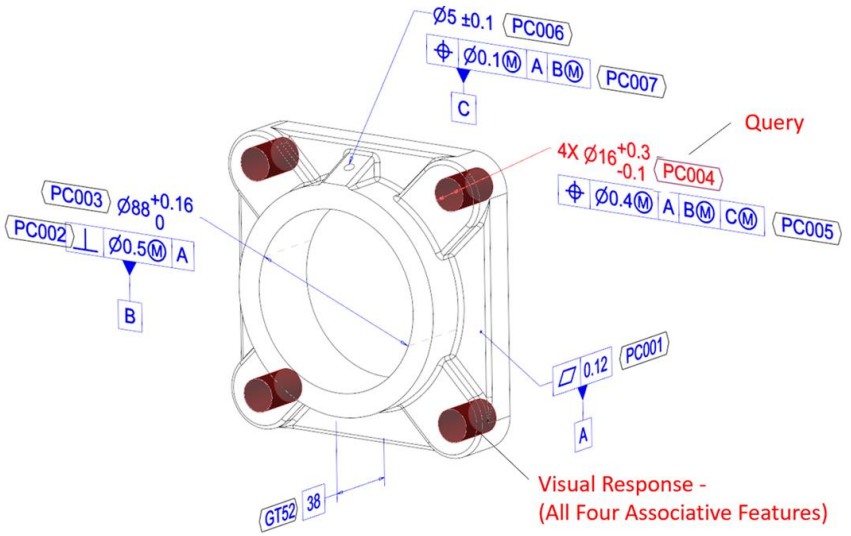
https://qifstandards.org/

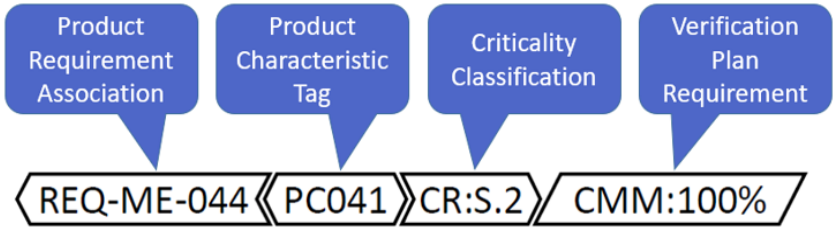
Belcan Blog:

How QIF Can Improve Data Interoperability

3D MBD – Characteristic Tag

- DMSC's " Model-Based Characteristics" document
- Same organization that manages QIF std
- ~180 page document
- Identifies specific types and categories of product characteristics and optional augmentations
- Nomenclature, definitions, symbols, practice, and data structure for the representation and communication of Model-Based characteristics
- June 2023 – voted to submit document for ANSI std consideration





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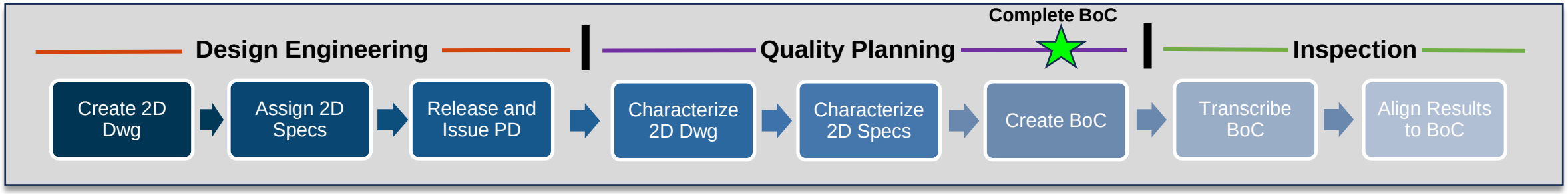
Drawing-Based Characteristics



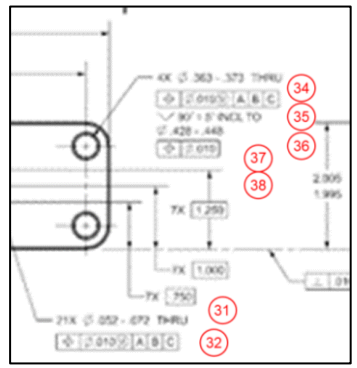
★Suppliers author complete BoC

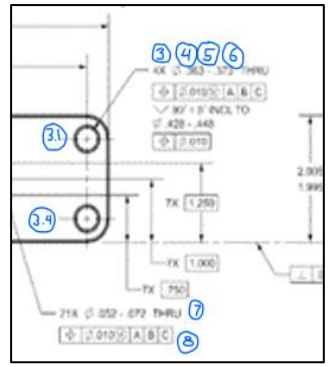
Gaps to a Digital Thread

- **Single Source of Truth:** Characterization is unique to each supplier
- **Speed:** Time consuming with little automation
- **Quality:** Manual data transcription is error prone
- **Traceability:** Manual effort to align inspection results and req's
- **Interoperability:** BoC does not support machine workflows
- **Consistency:** Characterization is not done to any industry stds

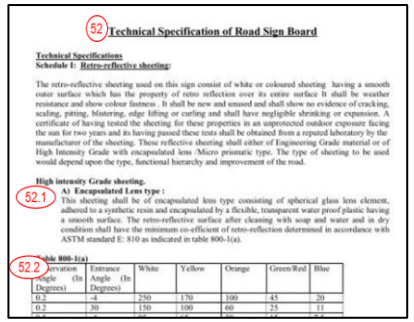
Supplier A | Supplier B

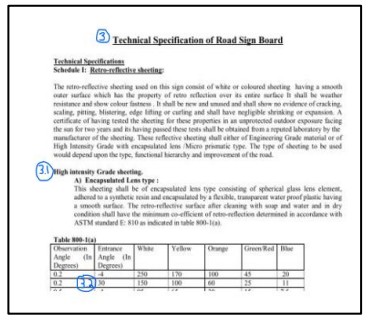
2D Dwgs



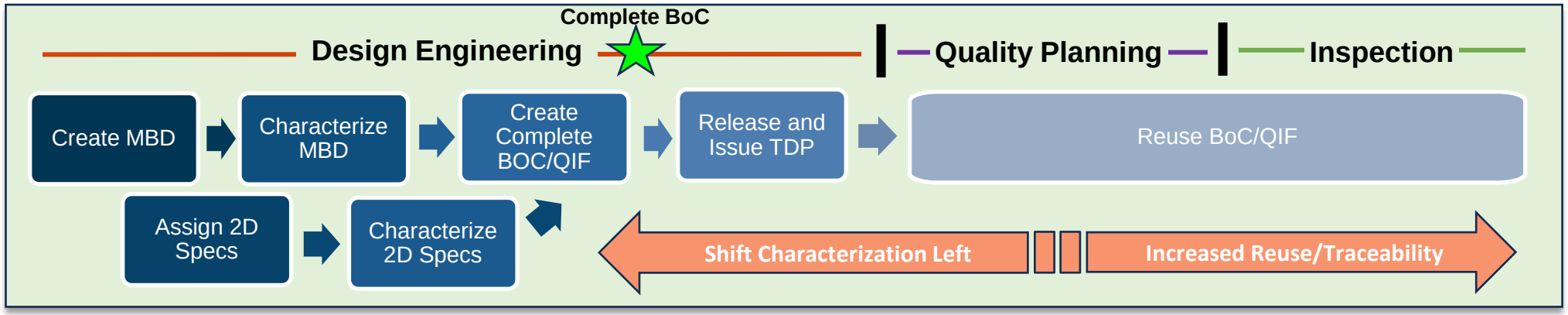


2D Specs

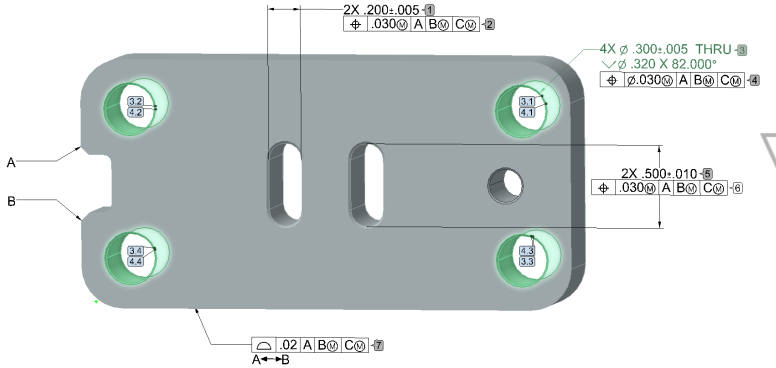




Model-Based Characteristics

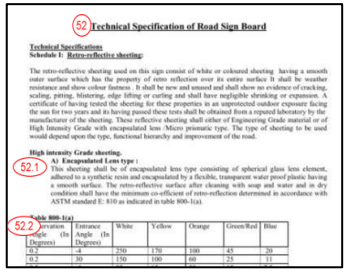


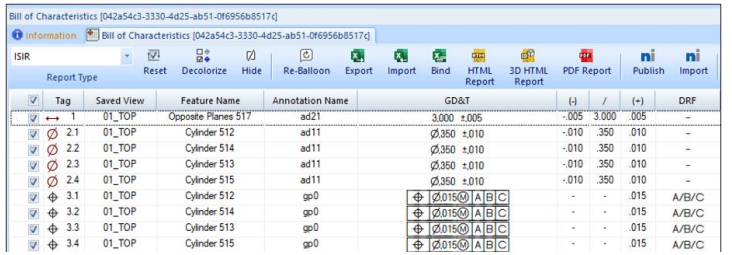
★Engineering authors complete BoC



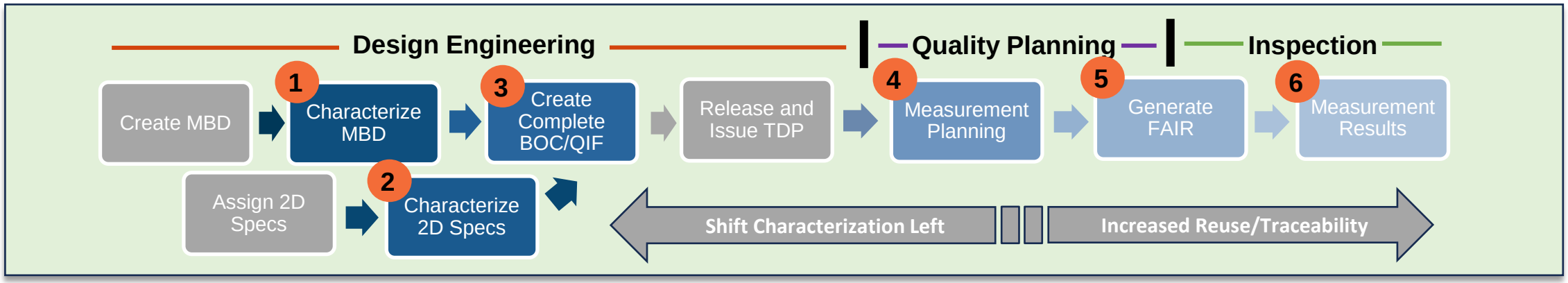
Enabling a Digital Thread

- **Single Source of Truth:** Characterization is authored once in Eng definition
- **Speed:** Automation enabled by machine readable formats
- **Quality:** Software integration replaces manual transcription
- **Traceability:** Unique characteristic IDs persist in digital thread
- **Interoperability:** Characteristics are embedded in interop file format
- **Consistency:** Characteristic authored to industry std format





Model-Based Characteristic Workflows



1 3D MBD
- 3D req's characterized, associated to features
- QIF MBD published for quality workflows

3 Complete BOC
- Unified 3D and 2D req's
- 3D interactive viewer of measurement req's

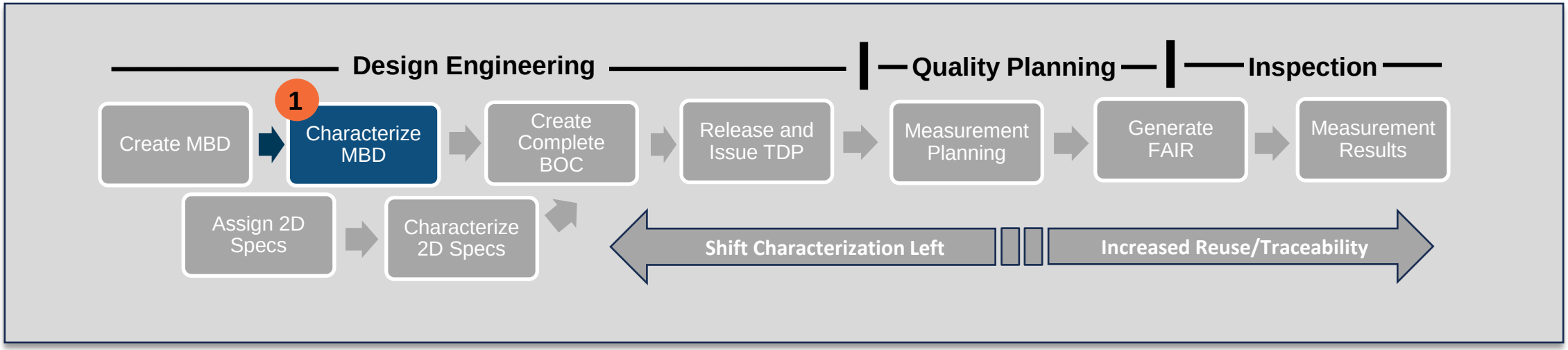
5 Generate FAIR
- Complete set of requirements published to quality database

2 2D Req's
- OCR Characterizes 2D req's

4 Measurement Planning
- QIF automates coordinate metrology

6 Measurement Results
- Inspection results captured and linked to req's in QIF
- SPC and statistical analysis

Model-Based Characteristic Workflows



1 3D MBD

- 3D req's characterized, associated to features
- QIF MBD published for quality workflows

Option 1:
Characteristic Authoring in Native CAD

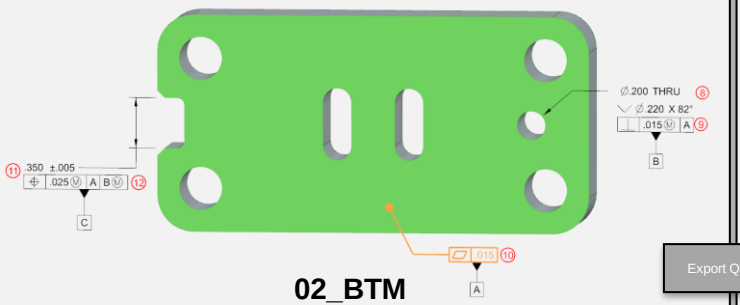
Option 2:
Characteristic Authoring in QIF Workflow

QIF Export – Option 1

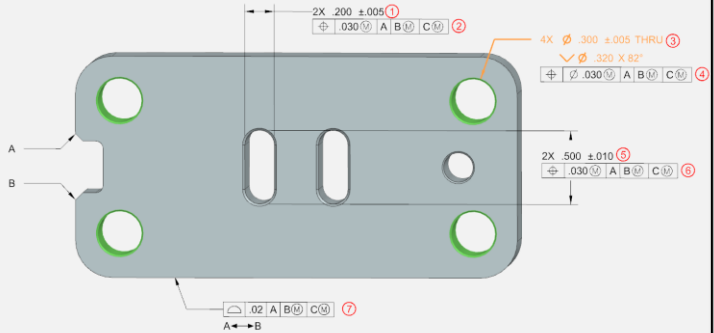
Native CAD System

SIEMENS NX · creo · SOLIDWORKS

- Source 3D MBD CAD
- Machine/Software-Readable



02_BTM



03_TOP

Export QIF

QIF Export

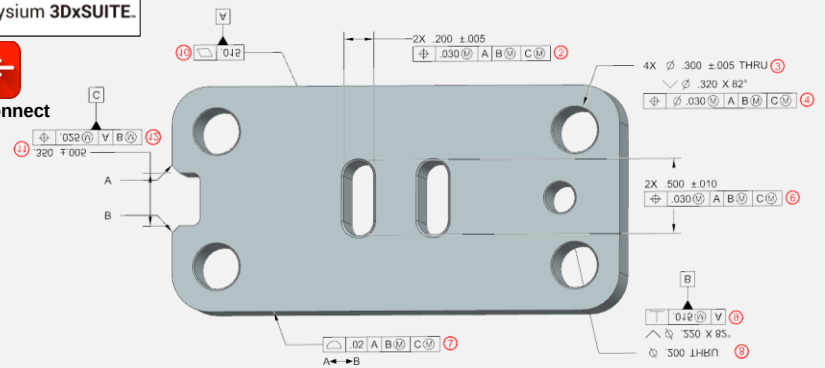
QIF by DMSC

Harvesting Source CAD MBD Elements:

- Geometry
- Annotation
- Characteristics
- Presentation States
- Attributes

Elysium 3DxSUITE

MBDConnect



Bill Of Characteristics (BoC)

MBDVidia

Bill of Characteristics [e16c412c-db40-4483-aa03-0b8e19ff8a04]

AS9102 (Report Type) · Report Camera · Reset · Decolorize · Hide · Re-Balloon · Export · Import · Bind · HTML Report · 3D HTML Report · PDF Report · Publish

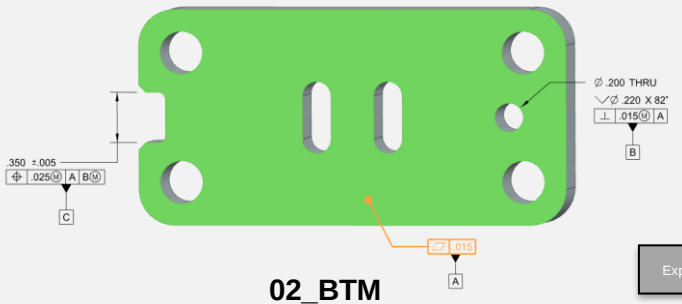
Tag	Saved View	Feature Name	Annotation Name	GD&T	(-)	/	(+)	DRF
1.1	03-TOP	Opposite Planes 1830	Linear Dimension (85)	.200 ±.005	-.005	.200	.005	–
1.2	03-TOP	Opposite Planes 1831	Linear Dimension (85)	.200 ±.005	-.005	.200	.005	–
2.1	03-TOP	Opposite Planes 1830	Feature Control Frame (86)	.030 Ⓜ A B Ⓜ C Ⓜ	-	-	.030	A/B Ⓜ/_
2.2	03-TOP	Opposite Planes 1831	Feature Control Frame (86)	.030 Ⓜ A B Ⓜ C Ⓜ	-	-	.030	A/B Ⓜ/_
3.1	03-TOP	Group 1857	Radial Dimension (120)	Ø .300 ±.005 THRU	-.005	.300	.005	–
3.2	03-TOP	Group 1853	Radial Dimension (120)	Ø .300 ±.005 THRU	-.005	.300	.005	–
3.3	03-TOP	Group 1855	Radial Dimension (120)	Ø .300 ±.005 THRU	-.005	.300	.005	–
3.4	03-TOP	Group 1851	Radial Dimension (120)	Ø .300 ±.005 THRU	-.005	.300	.005	–
4.1	03-TOP	Group 1857	Feature Control Frame (84)	Ø.030 Ⓜ A B Ⓜ C Ⓜ	-	-	.030	A/B Ⓜ/_
4.2	03-TOP	Group 1853	Feature Control Frame (84)	Ø.030 Ⓜ A B Ⓜ C Ⓜ	-	-	.030	A/B Ⓜ/_
4.3	03-TOP	Group 1855	Feature Control Frame (84)	Ø.030 Ⓜ A B Ⓜ C Ⓜ	-	-	.030	A/B Ⓜ/_
4.4	03-TOP	Group 1851	Feature Control Frame (84)	Ø.030 Ⓜ A B Ⓜ C Ⓜ	-	-	.030	A/B Ⓜ/_
5.1	03-TOP	Elongated Cylinder 1838	Linear Dimension (93)	.500 ±.010	-.010	.500	.010	–
5.2	03-TOP	Elongated Cylinder 1839	Linear Dimension (93)	.500 ±.010	-.010	.500	.010	–
6.1	03-TOP	Elongated Cylinder 1838	Feature Control Frame (94)	.030 Ⓜ A B Ⓜ C Ⓜ	-	-	.030	A/B Ⓜ/_
6.2	03-TOP	Elongated Cylinder 1839	Feature Control Frame (94)	.030 Ⓜ A B Ⓜ C Ⓜ	-	-	.030	A/B Ⓜ/_

QIF Export – Option 2

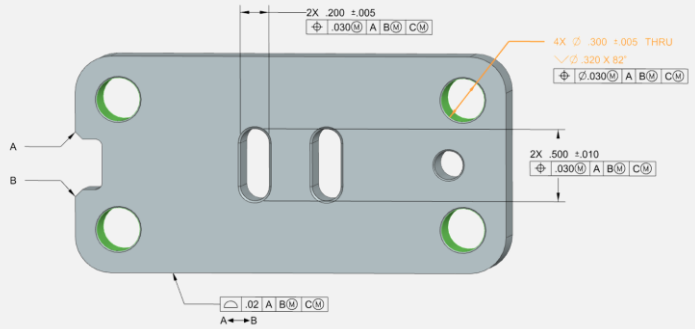
Native CAD System

SIEMENS NX · creo · SOLIDWORKS

- Source 3D MBD CAD
- Machine/Software-Readable



02_BTM



03_TOP

Export QIF

QIF Export

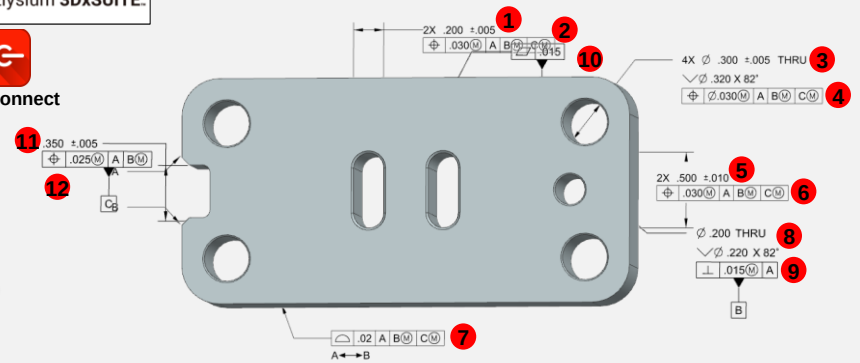
QIF by DMSC

Harvesting Source CAD MBD Elements:

- Geometry
- Annotation
- Characteristics
- Presentation States
- Attributes

Elysium 3DxSUITE

MBDConnect



Bill Of Characteristics (BoC)

MBDVidia

Bill of Characteristics [e16c412c-db40-4483-aa03-0b8e19ff8a04]

AS9102 · Report Type · Report Camera · Reset · Decolorize · Hide · Re-Balloon · Export · Import · Bind · HTML Report · 3D HTML Report · PDF Report · Publish

	Tag	Saved View	Feature Name	Annotation Name	GD&T	(-)	/	(+)	DRF	Critic
☑	1.1	03-TOP	Opposite Planes 1830	Linear Dimension (85)	.200 ±.005	-.005	.200	.005	–	
☑	1.2	03-TOP	Opposite Planes 1831	Linear Dimension (85)	.200 ±.005	-.005	.200	.005	–	
☑	2.1	03-TOP	Opposite Planes 1830	Feature Control Frame (86)	.030Ⓜ A BⓂ CⓂ	-	-	.030	A/BⓂ/_	
☑	2.2	03-TOP	Opposite Planes 1831	Feature Control Frame (86)	.030Ⓜ A BⓂ CⓂ	-	-	.030	A/BⓂ/_	
☑	3.1	03-TOP	Group 1857	Radial Dimension (120)	Ø .300 ±.005 THRU	-.005	.300	.005	–	
☑	3.2	03-TOP	Group 1853	Radial Dimension (120)	Ø .300 ±.005 THRU	-.005	.300	.005	–	
☑	3.3	03-TOP	Group 1855	Radial Dimension (120)	Ø .300 ±.005 THRU	-.005	.300	.005	–	
☑	3.4	03-TOP	Group 1851	Radial Dimension (120)	Ø .300 ±.005 THRU	-.005	.300	.005	–	
☑	4.1	03-TOP	Group 1857	Feature Control Frame (84)	Ø.030Ⓜ A BⓂ CⓂ	-	-	.030	A/BⓂ/_	
☑	4.2	03-TOP	Group 1853	Feature Control Frame (84)	Ø.030Ⓜ A BⓂ CⓂ	-	-	.030	A/BⓂ/_	
☑	4.3	03-TOP	Group 1855	Feature Control Frame (84)	Ø.030Ⓜ A BⓂ CⓂ	-	-	.030	A/BⓂ/_	
☑	4.4	03-TOP	Group 1851	Feature Control Frame (84)	Ø.030Ⓜ A BⓂ CⓂ	-	-	.030	A/BⓂ/_	
☑	5.1	03-TOP	Elongated Cylinder 1838	Linear Dimension (93)	.500 ±.010	-.010	.500	.010	–	
☑	5.2	03-TOP	Elongated Cylinder 1839	Linear Dimension (93)	.500 ±.010	-.010	.500	.010	–	
☑	6.1	03-TOP	Elongated Cylinder 1838	Feature Control Frame (94)	.030Ⓜ A BⓂ CⓂ	-	-	.030	A/BⓂ/_	
☑	6.2	03-TOP	Elongated Cylinder 1839	Feature Control Frame (94)	.030Ⓜ A BⓂ CⓂ	-	-	.030	A/BⓂ/_	

QIF Export

Video

Native CAD

SIEMENS NX

creo®

SOLIDWORKS

QIF Derivative

CAPVIDIA

MBDVidia

Enabling a Digital Thread

Single Source of Truth, Speed, Quality, Traceability, Interoperability, Consistency

FREE QIF Viewer

Video

QIF Derivative

QIF MBD

Free QIF Viewer

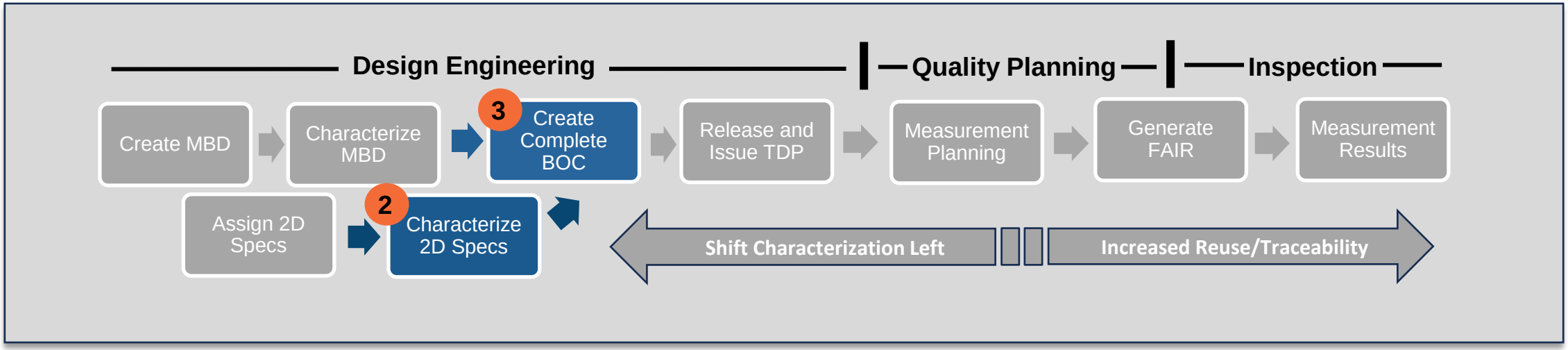
KOTEM

Evolve Viewer

Enabling a Digital Thread

Single Source of Truth, Speed, Quality, Traceability, Interoperability, Consistency

Model-Based Characteristic Workflows



2 2D Req's

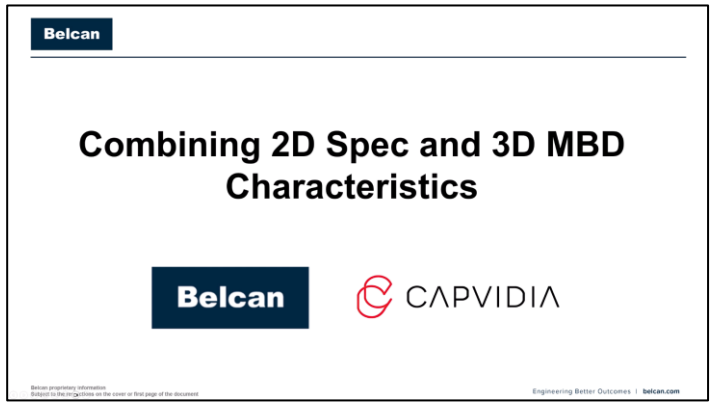
- OCR Characterizes 2D req's

3 Complete BOC

- Unified 3D and 2D req's
- 3D interactive viewer of measurement req's

2D PDF and Complete BoC

Video



QIF Derivative / 2D Specifications

QIF MBD

PDF

2D Specs

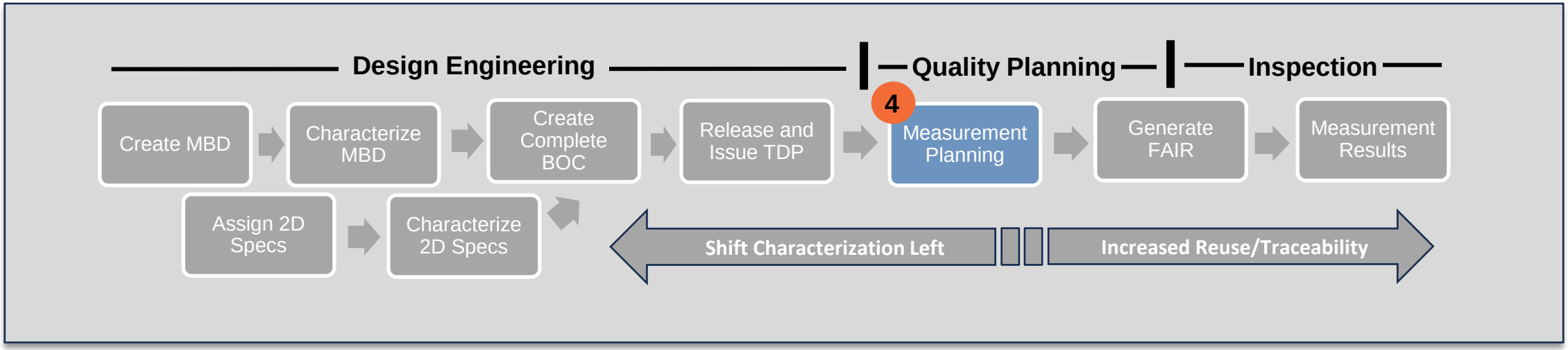
Complete 2D/3D BoC

MBDVidia

Enabling a Digital Thread

Single Source of Truth, Speed, Quality, Traceability, Interoperability, Consistency

Model-Based Characteristic Workflows

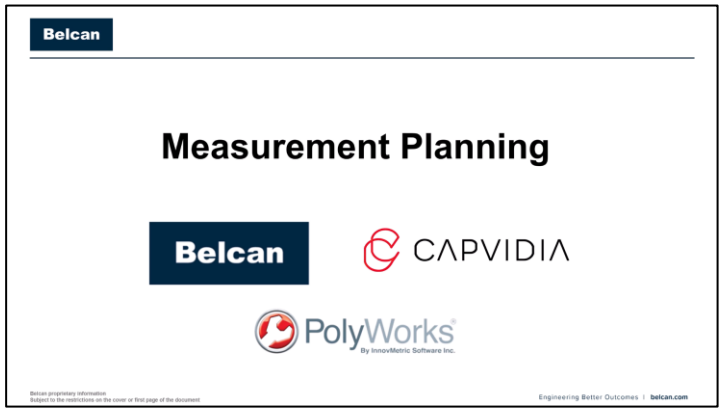


4 Measurement Planning

- QIF automates coordinate metrology

QIF – Measurement Planning

Video



QIF Derivative

CAPVIDIA

QIF by DMSC

MBDVidia

Inspection Plan

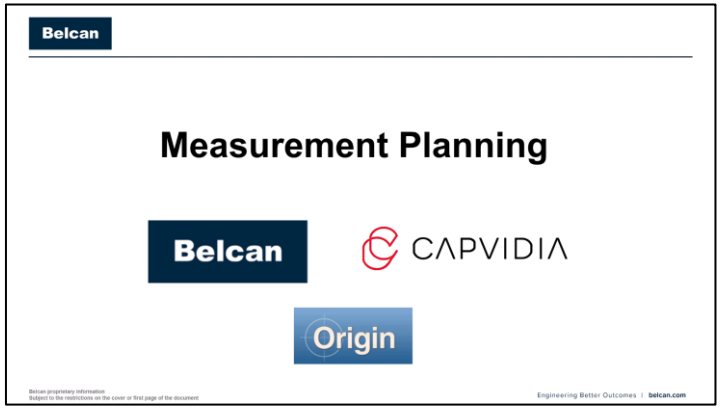
PolyWorks® By InnovMetric Software Inc.

Enabling a Digital Thread

Single Source of Truth, Speed, Quality, Traceability, Interoperability, Consistency

QIF – Measurement Planning

Video



QIF Derivative

CAPVIDIA

MBDVidia

QIF by DMSC

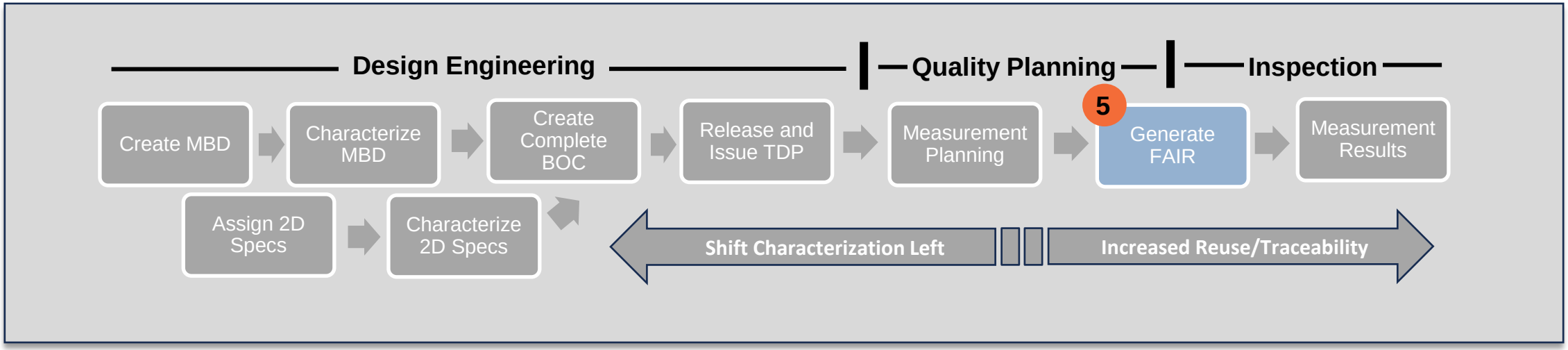
Inspection Plan

Origin

Enabling a Digital Thread

Single Source of Truth, Speed, Quality, Traceability, Interoperability, Consistency

Model-Based Characteristic Workflows



5 Generate FAIR

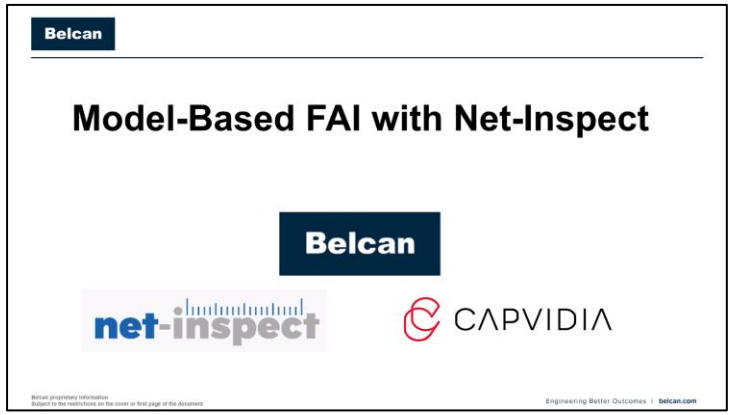
- Complete set of requirements published to quality database

Option 1:
FAIR Using Net-Inspect

Option 2:
FAIR Using Excel

QIF - FAIR – Net-Inspect

Video



QIF Derivative

CAPVIDIA

MBDVidia

QIF by DMSC

FAIR Characteristic List

net-inspect

Enabling a Digital Thread

Single Source of Truth, Speed, Quality, Traceability, Interoperability, Consistency

QIF – FAIR – Excel

Video

QIF Derivative

CAPVIDIA

MBDVidia

FAIR Characteristic List

Excel

Enabling a Digital Thread

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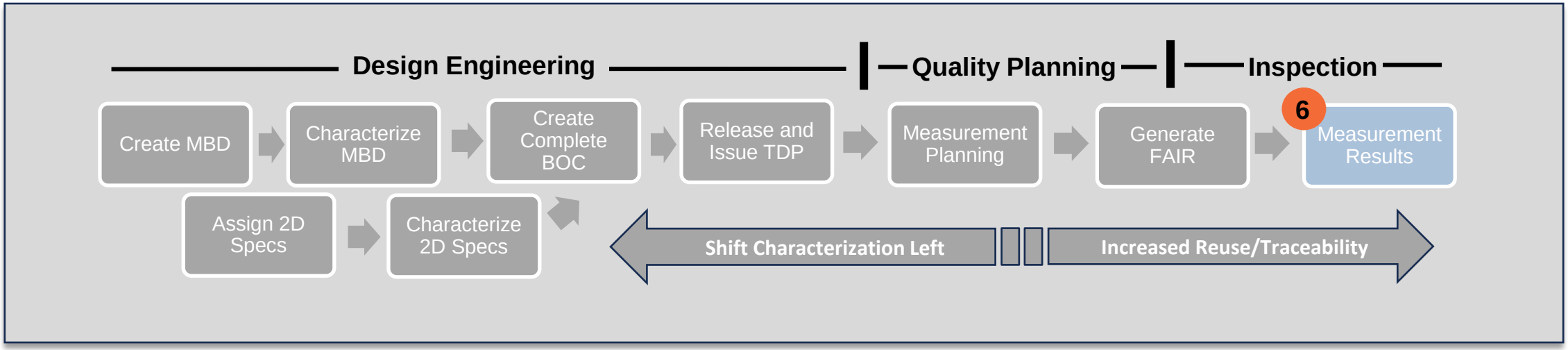
Model-Based Characteristic Workflows



6 Measurement Results

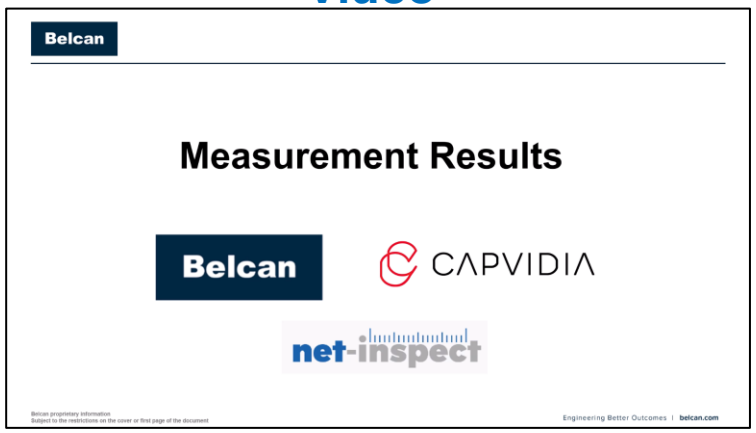
- Inspection results captured and linked to req's in QIF
- SPC and statistical analysis

Option 1:
Measurement Results from Net-Inspect

Option 2:
Measurement Results from Excel

QIF – Measurement Results (Net-Inspect)

Video



QIF Results

net-inspect

QIF by DMSC

Measurement Analysis

CAPVIDIA

MIV

MBDVidia

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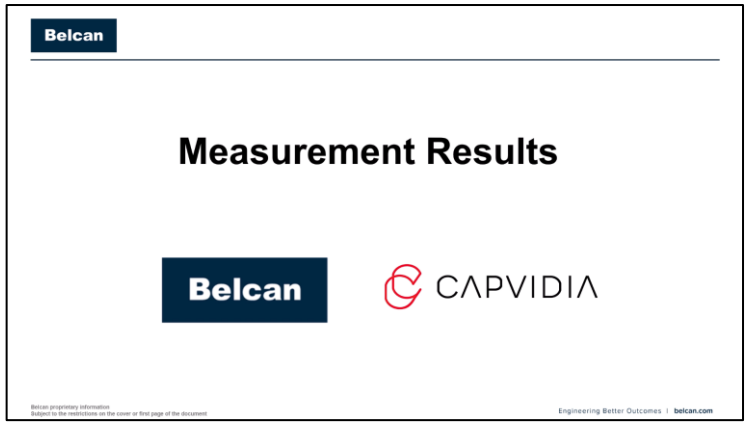
QIF – Measurement Results (Excel)

Video



QIF Results

PolyWorks® By InnovMetric Software Inc.

QIF by DMSC

Measurement Analysis

CAPVIDIA

MIV

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Drawing VS Model-Based Characteristics

Drawing-Based Characteristics:

Design Engineering | **Quality Activities** *OEM MFG / Supply-Chain* | **Inspection**

Create 2D Dwg → Assign 2D Specs → Release and Issue PD → Manually Characterize 2D Dwg → Manually Characterize 2D Specs → Manually Create BoC → Manually Transcribe BoC → Manually Align Results to BoC

Complete BoC ★

Digital Transformation

Model-Based Characteristics:

Design Engineering | **Quality Activities** *OEM MFG / Supply-Chain* | **Inspection**

Complete BoC ★

Create MBD → Characterize Native MBD → Create 3D/2D BoC/QIF → Release and Issue TDP → Reuse BoC/QIF → Streamlined Results using BoC

Shortened Timeline

Assign 2D Specs → Characterize 2D Specs

Shift Characterization Left ⟷ **Increased Reuse/Traceability**

How QIF Can Improve Data Interoperability

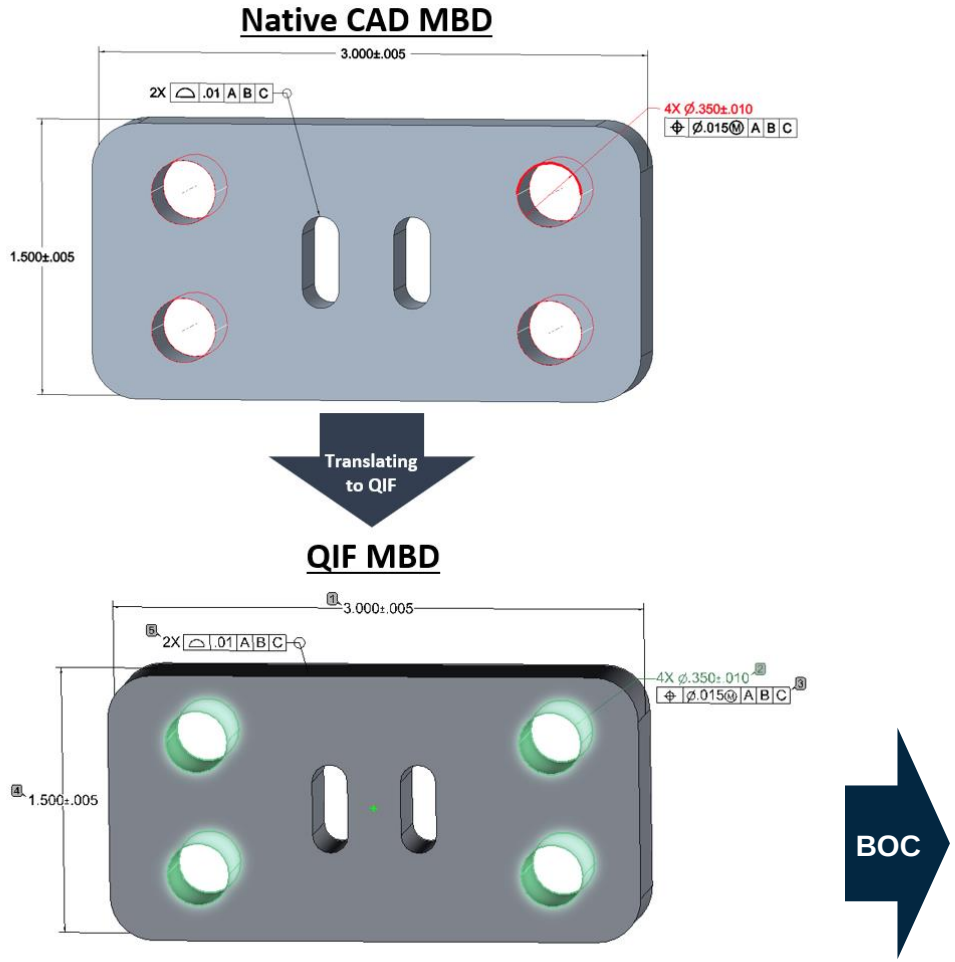


Figure 1: Native MBD Translated to QIF, Harvesting All the Native MBD Elements

Belcan Blog: [How QIF Can Improve Data Interoperability]

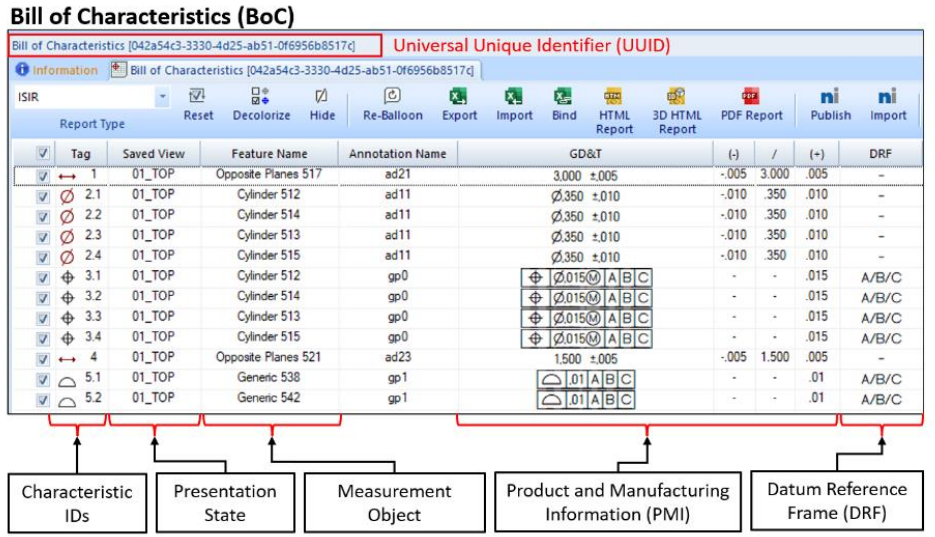
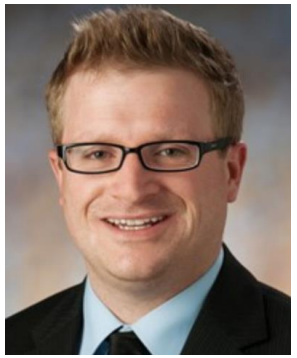


Figure 4: Characterized Bill of Characteristics (BoC)

Starting your Transformational Journey

What Foundational Elements are Needed to Support a Digital Thread?

- Shift Characterization Left
- Author a Complete BoC
- Leverage Industry Standards
- Work with trusted SMEs



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Thank You for Participating!

Terminology

Product Characteristic:

A trait, quality, or attribute on an element of a feature such as its size, location, form, or property, which may be a specification limit, a dimension with tolerance etc.

Product Characteristic Tag:

A human and/or machine-readable tag applied to a characteristic