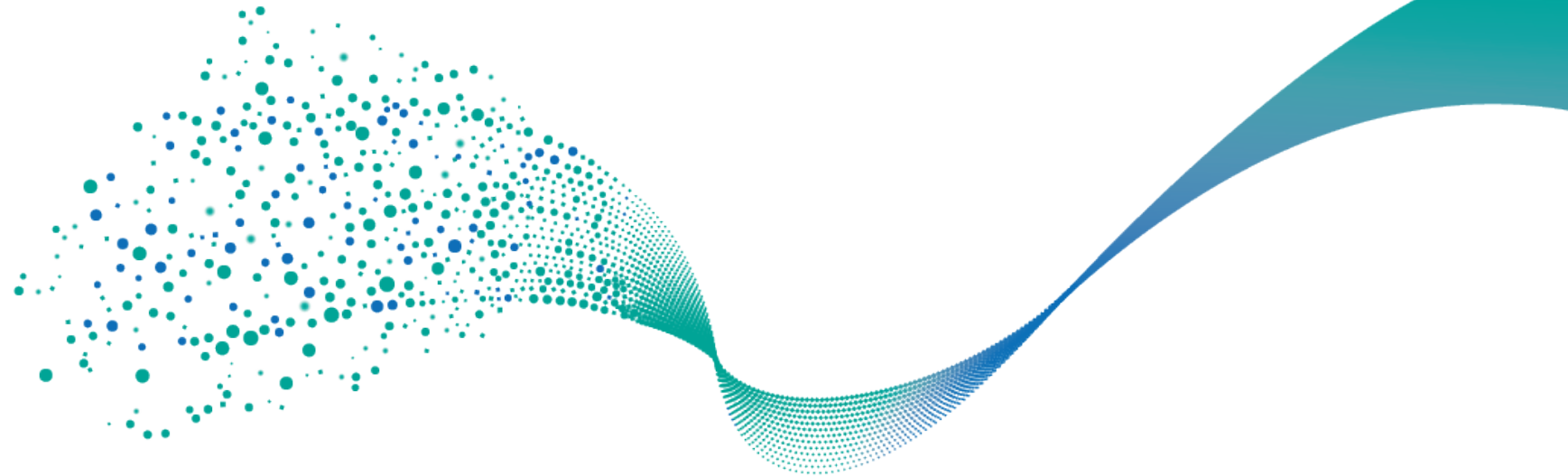


Closing the Gaps: Unifying Standards for Enterprise-Ready MBD

QIF & MBE Summit 2026



About The Speaker:



Evan Kessick

Director of Model-Based Initiatives

Contact Info:

Phone: 269-400-4128

Email: evan.kessick@elysiuminc.com

- 18+ years working in engineering and design, 8+ GD&T Training/Mentoring
- Led and advised on MBD and MBE Implementations for 7 years
- Industry Standards Involvement:
 - ASME MBE Committee Chair
 - ASME MBE & Y14 Harmonization Committee Co-Chair
 - ASME Y14.41 Member
 - ASME Y14.47 Support Group Member
 - ASME Y14.5-2009 GDTP Senior Certified
 - DMSC Board of Directors

Contact Info:

Phone: 269-400-4128

Email: evan.kessick@elysiuminc.com

About The Speaker:



Atsuto Soma

President, COO-CTO

Contact Info:

Email: soma@elysium.co.jp

- President and CEO of Elision Co., Ltd.
- After joining the company in 1995, I engaged in software development related to 3D CAD, including geometry processing and data conversion.
- In recent years, I have also participated in international standards development as Chairman of the Japanese National Committee for ISO/TC 184/SC 4.

Contact Info:

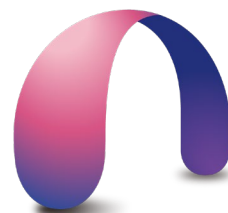
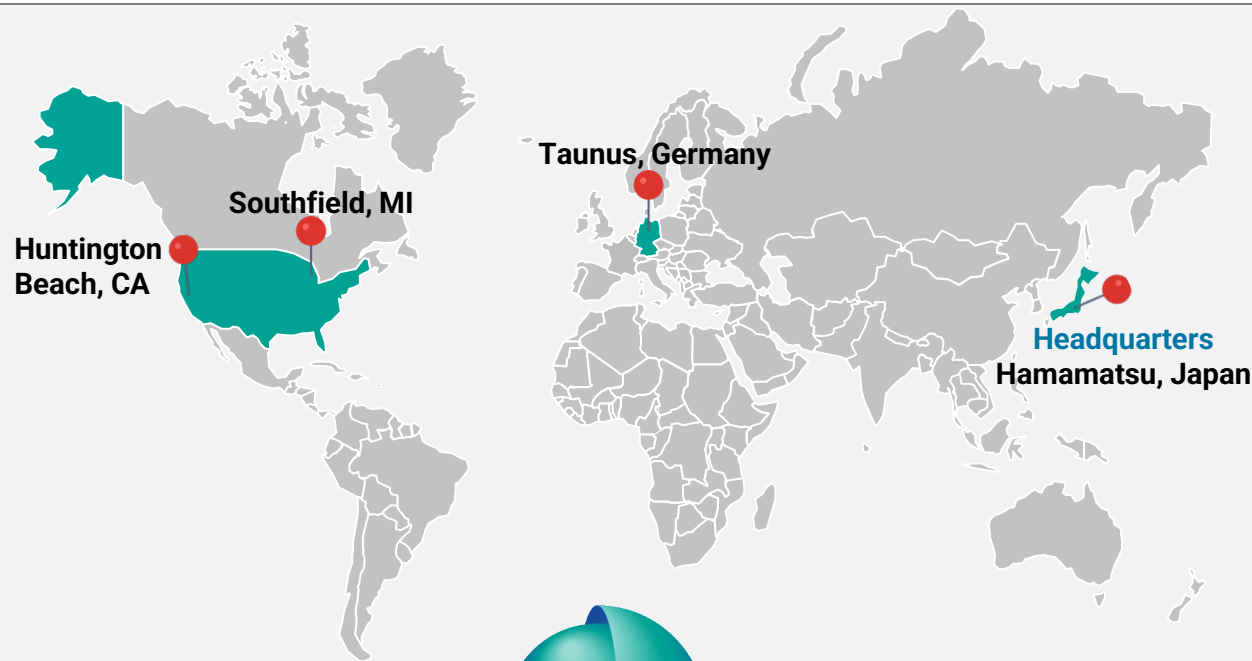
Email: soma@elysium.co.jp

About Elysium:

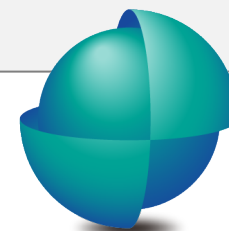
- Global Software Company
- Over 40 Years of CAD Data Interoperability Expertise
- Strong Partnerships with CAD & PLM Vendors
- Specialize in Model-Based Digital Capabilities
 - CAD Migration
 - Model-Based Workflow
 - Point Cloud Handling



CAD & PLM Vendors Partnership:



Elysium
CADfeature™



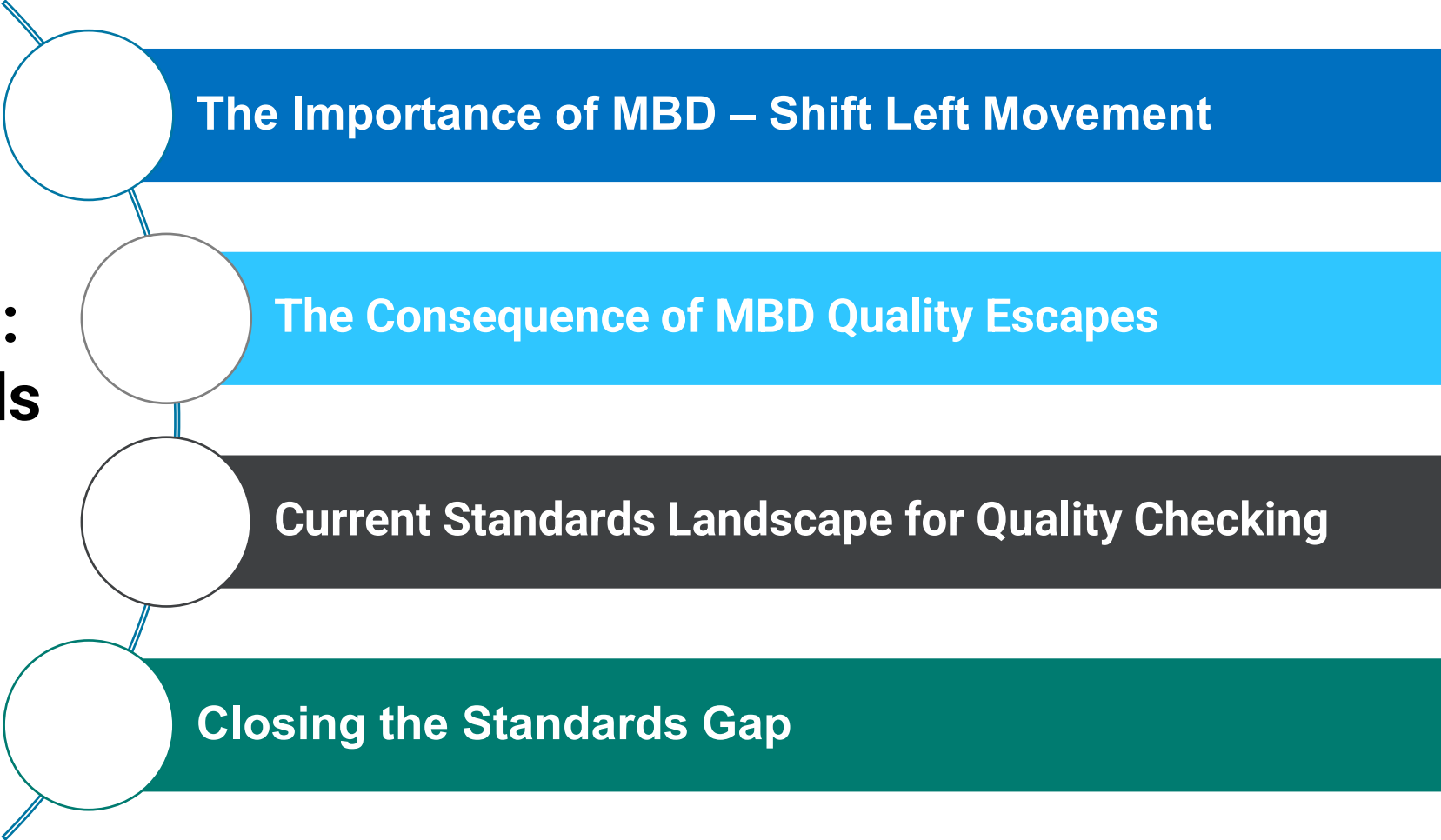
Elysium
3D-SUITE™



Elysium
InfiPoints®

Agenda

Closing the Gaps: Unifying Standards for Enterprise- Ready MBD



The Importance of MBD – Shift Left Movement

The Consequence of MBD Quality Escapes

Current Standards Landscape for Quality Checking

Closing the Standards Gap

Agenda

Closing the Gaps: Unifying Standards for Enterprise- Ready MBD



The Importance of MBD – Shift Left Movement

The Consequence of MBD Quality Escapes

Current Standards Landscape for Quality Checking

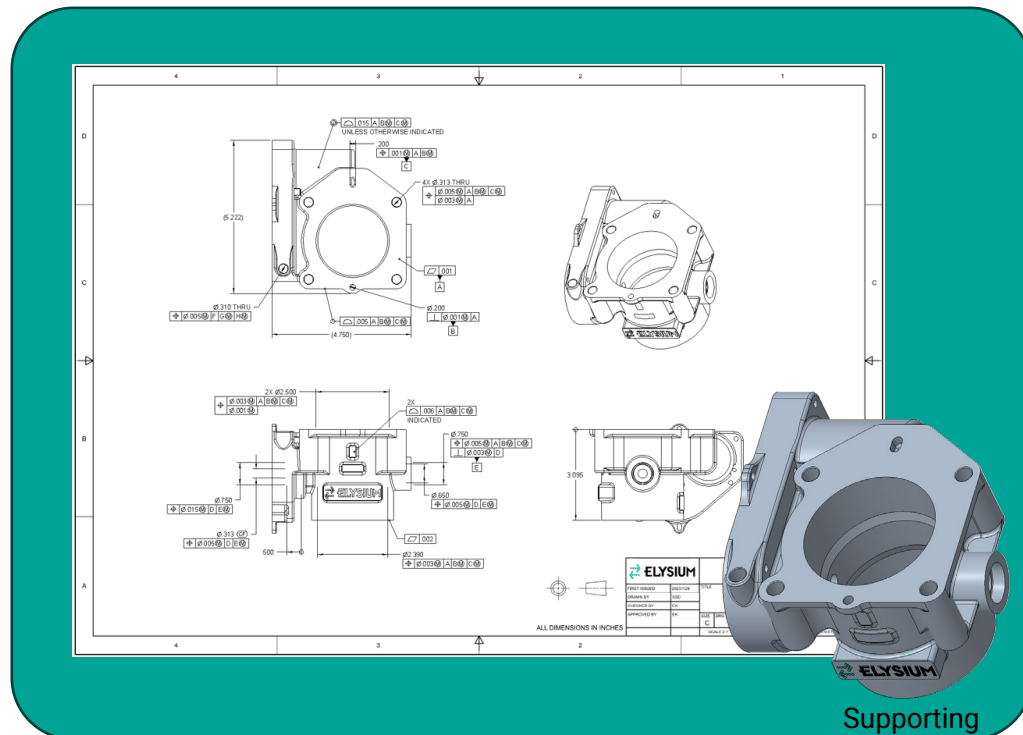
Closing the Standards Gap

What is MBD?

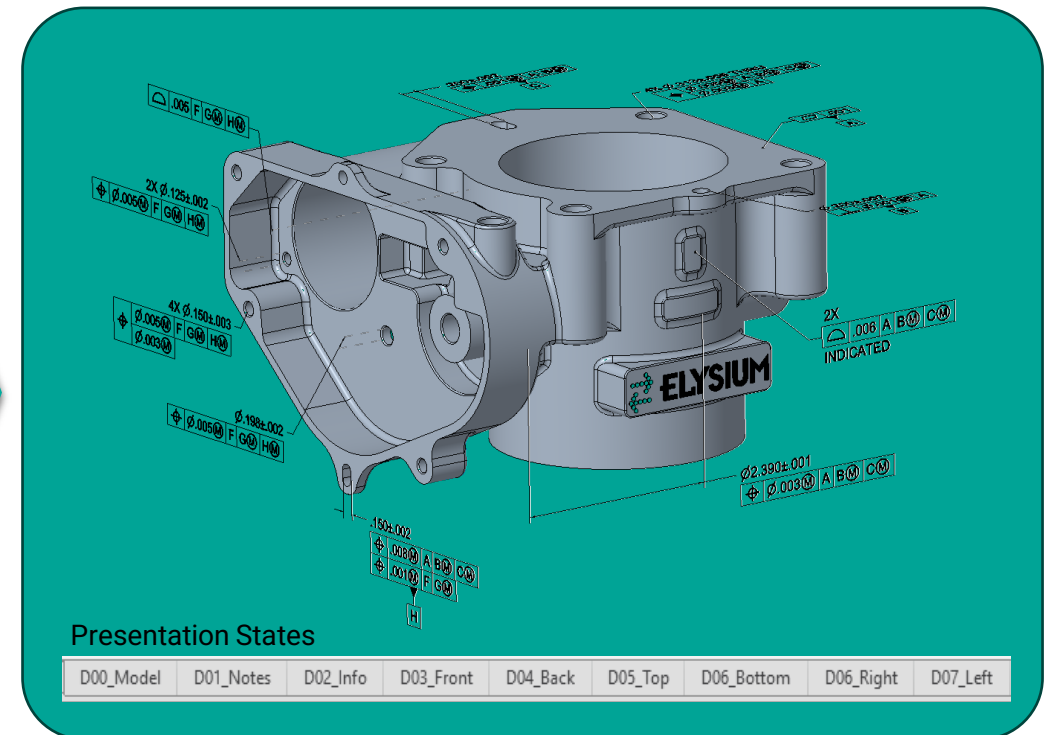
■ Model-Based Definition (MBD): Per ASME Y14.47-2023

- an annotated model and its associated data that defines the product in a manner that can be used effectively without a drawing graphic sheet.

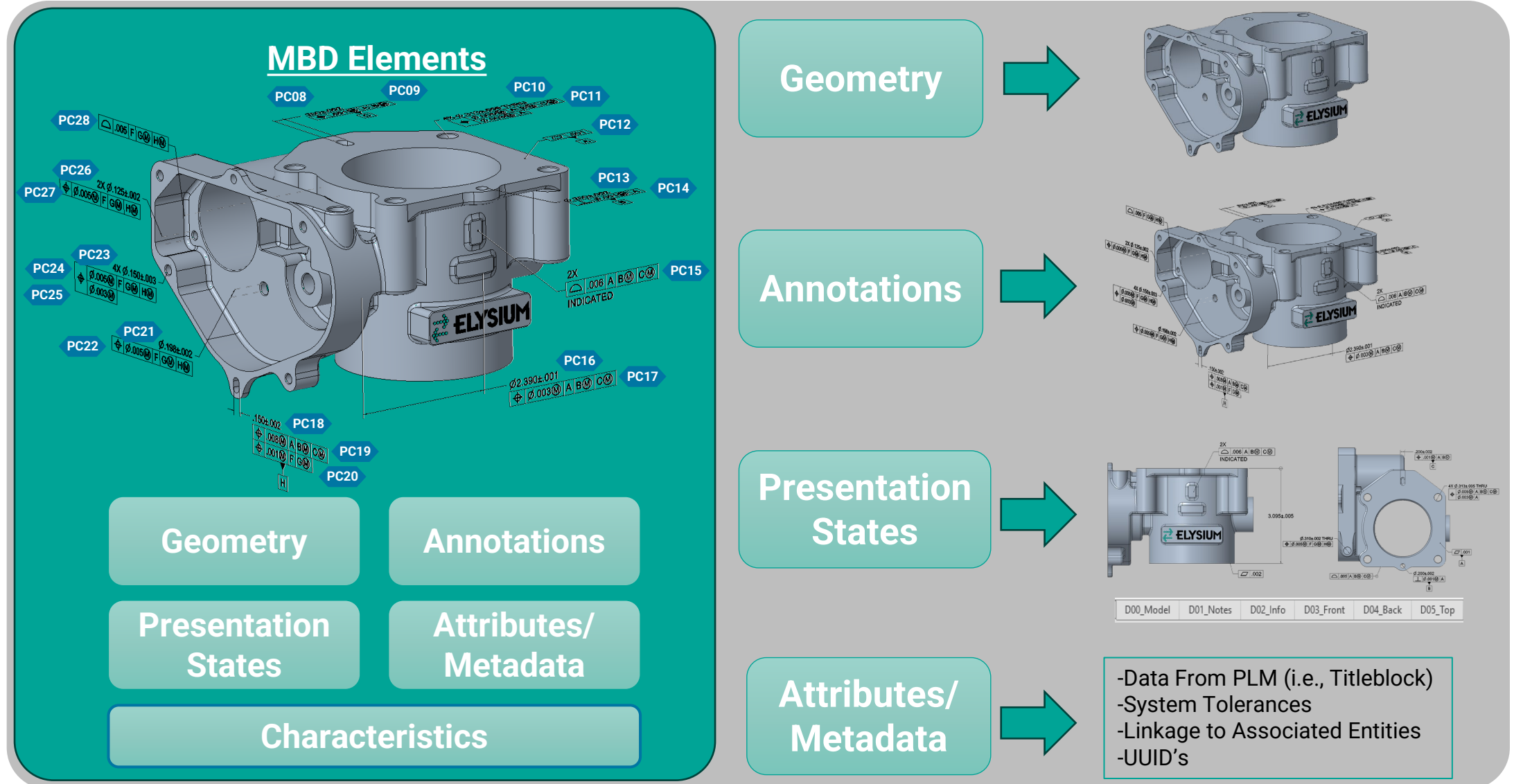
2D Drawing:



3D Model-Based Definition:



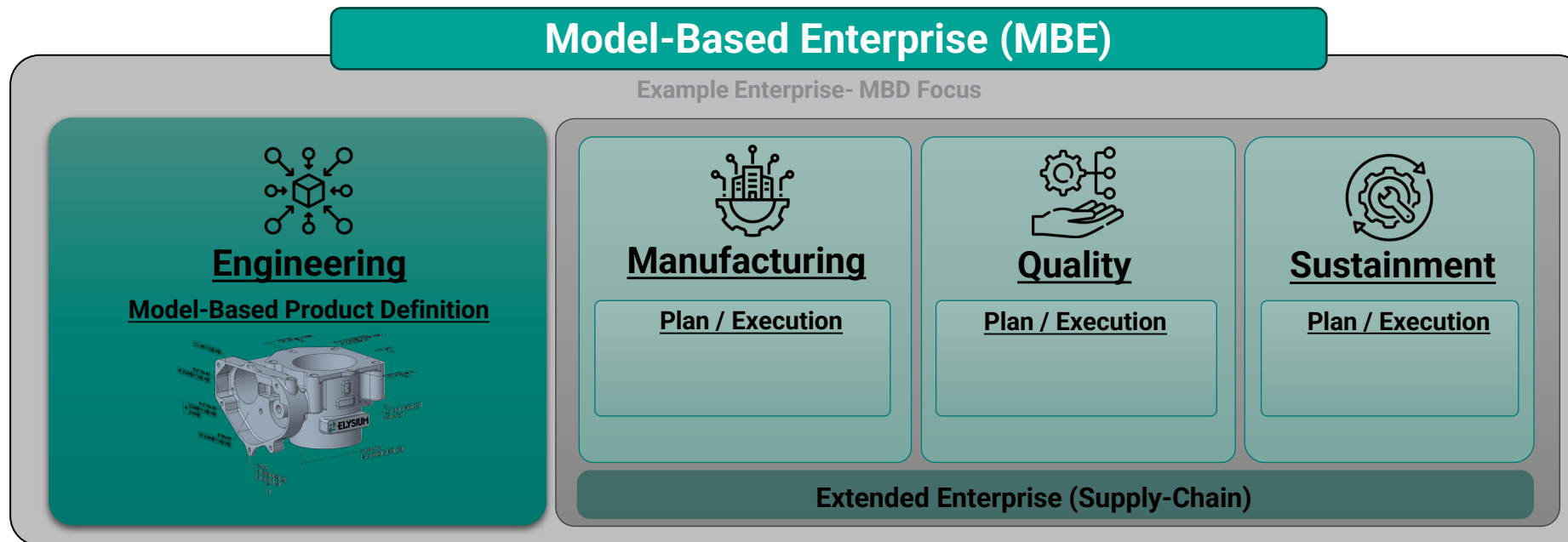
MBD Elements



What is a Model-Based Enterprise?

■ Model-Based Enterprise (MBE): Per ASME Y14.47-2023

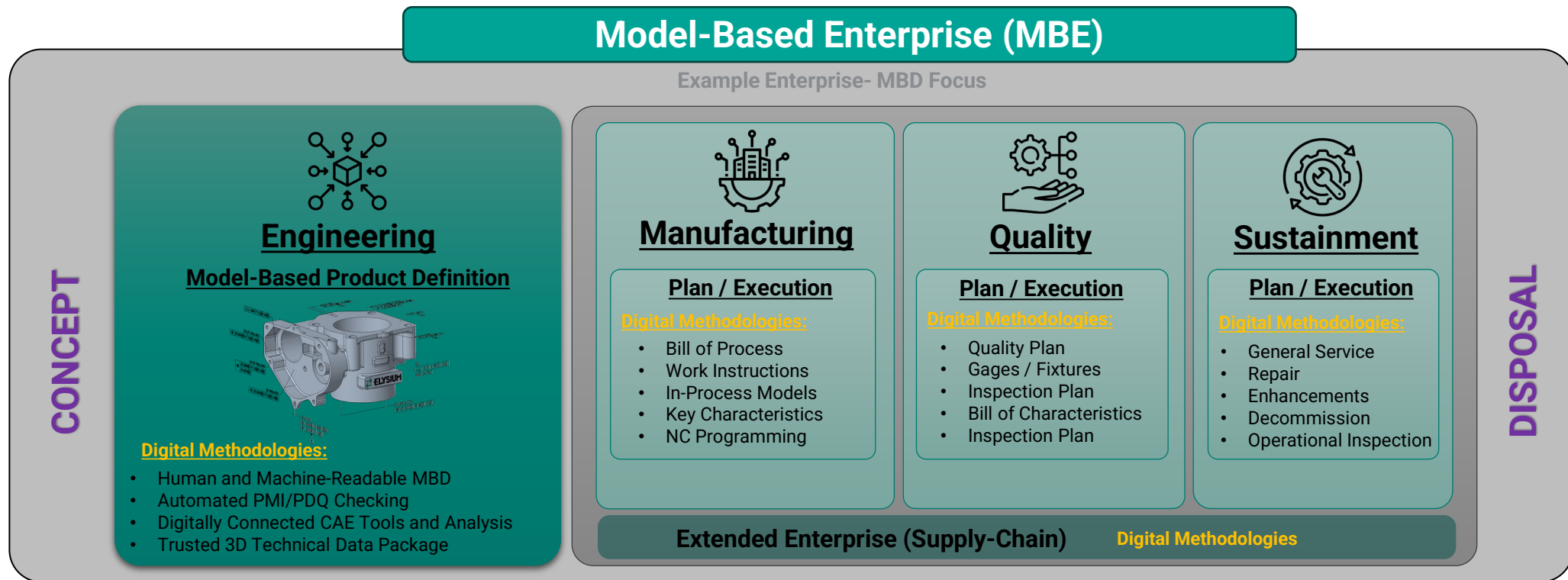
- An organization that uses digital methodologies as the foundation to enable deployment of products from concept to disposal.



What is a Model-Based Enterprise?

■ Model-Based Enterprise (MBE): Per ASME Y14.47-2023

- An organization that uses **digital methodologies** as the foundation to enable deployment of products from **concept to disposal**.

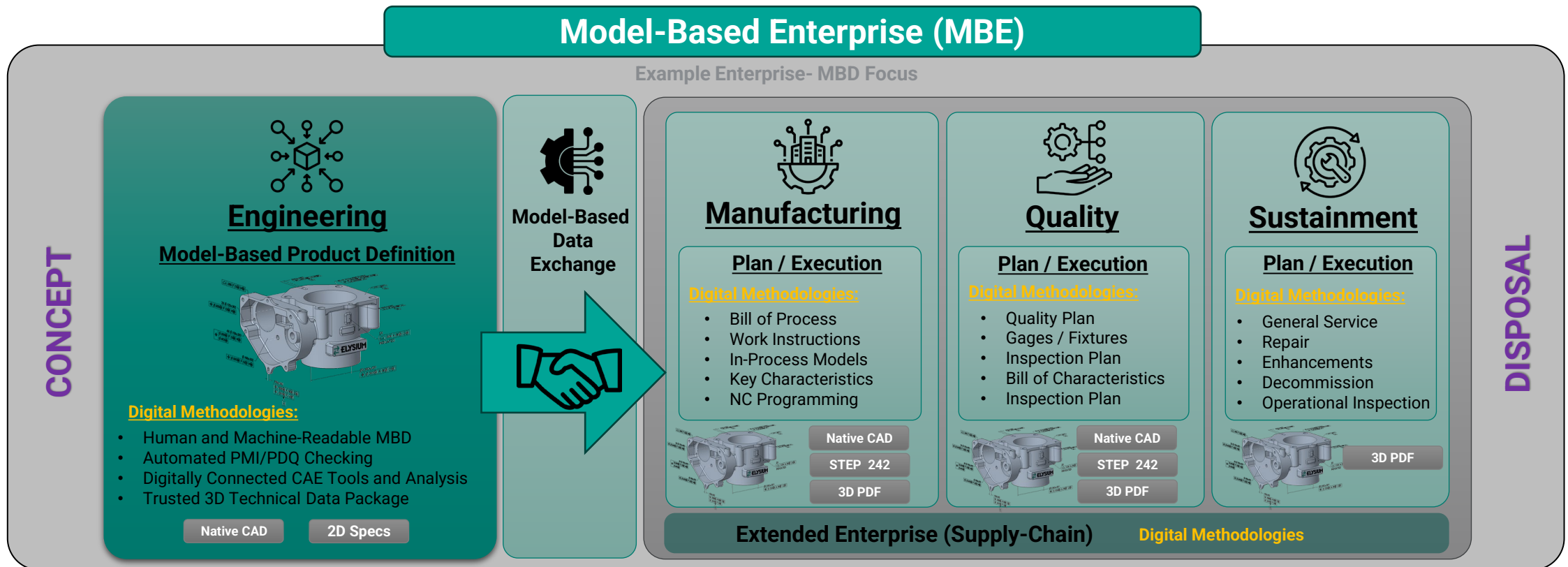


*A Model-Based Enterprise (MBE) is no more than a defined set of **model-based digital capabilities** that supports the deployment of products from concept to disposal

What is a Model-Based Enterprise?

■ Model-Based Enterprise (MBE): Per ASME Y14.47-2023

- An organization that uses **digital methodologies** as the foundation to **enable deployment of products** from **concept to disposal**.

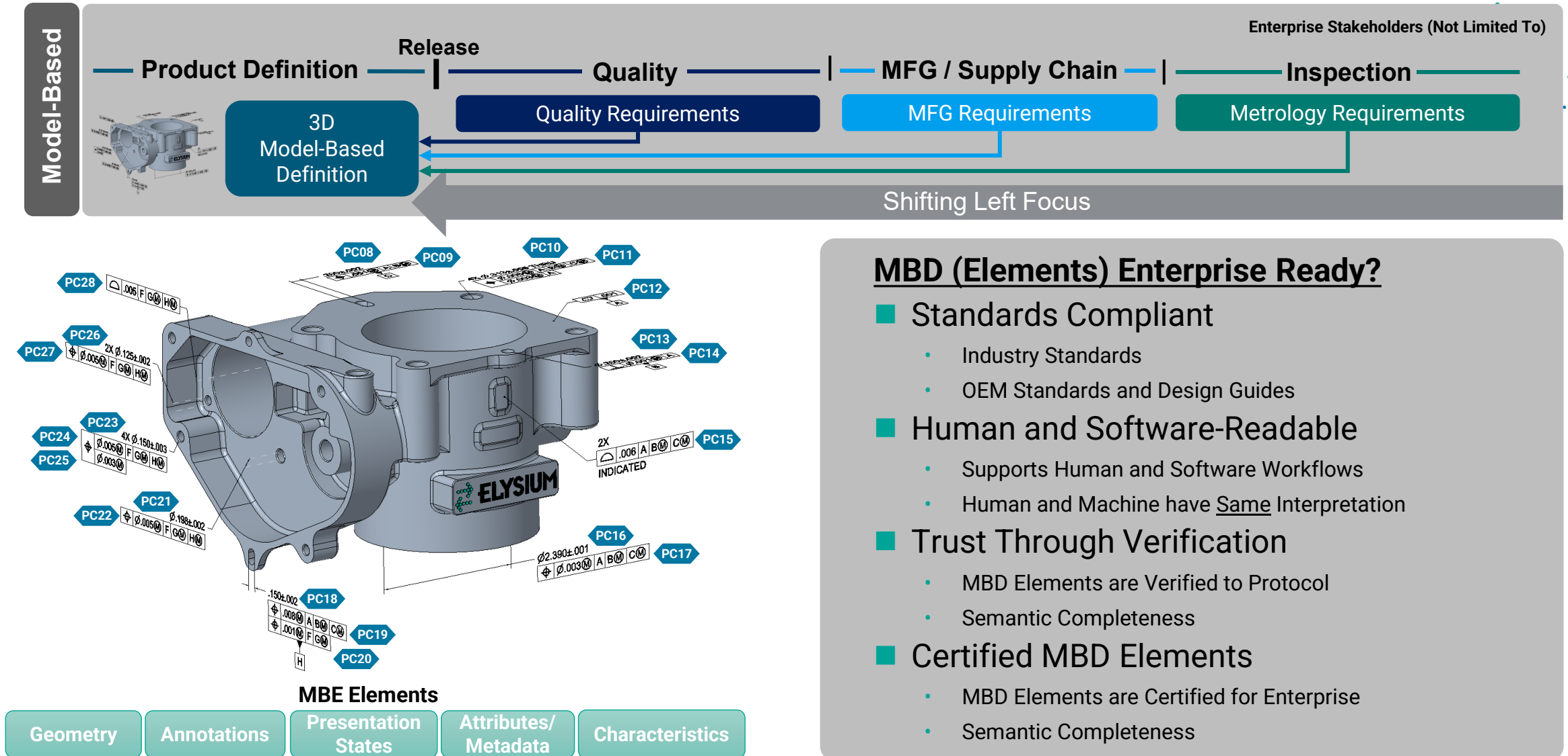


Agenda

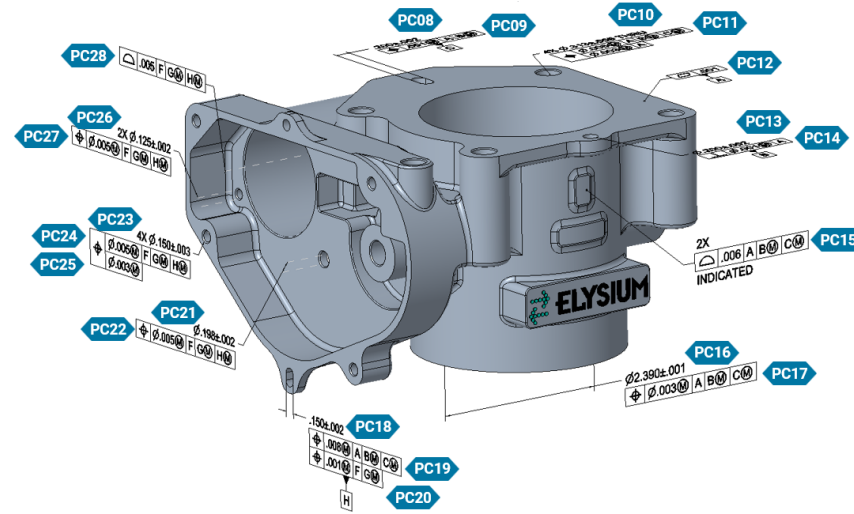
Closing the Gaps: Unifying Standards for Enterprise- Ready MBD



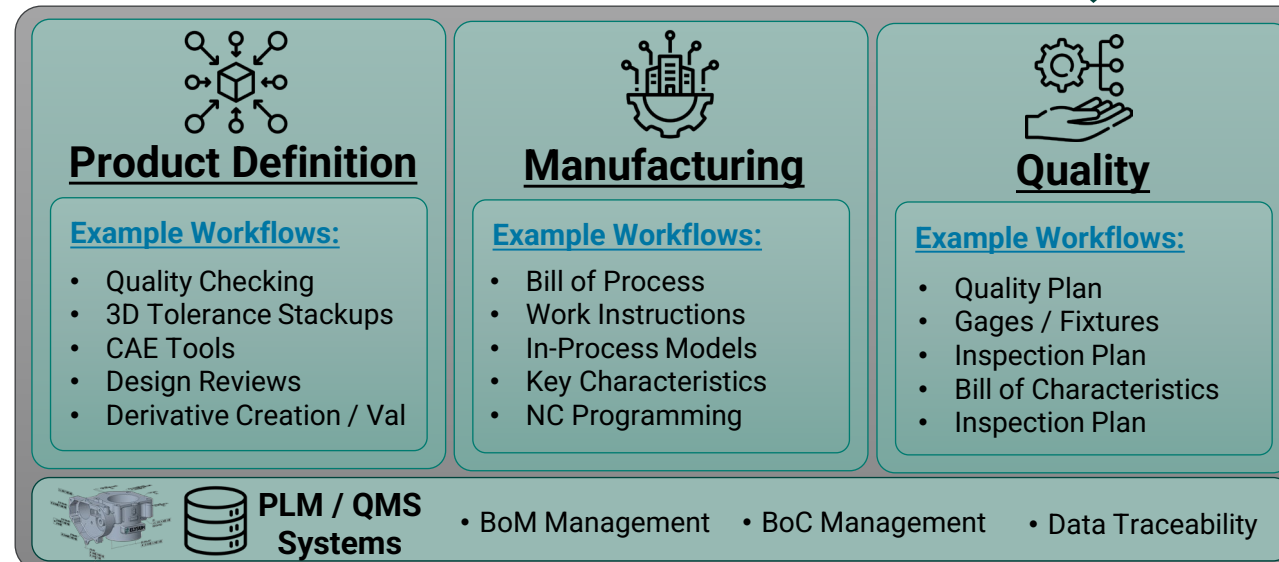
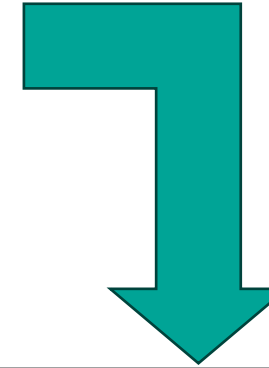
Why Are We Here - Upfront MBD Quality Checking



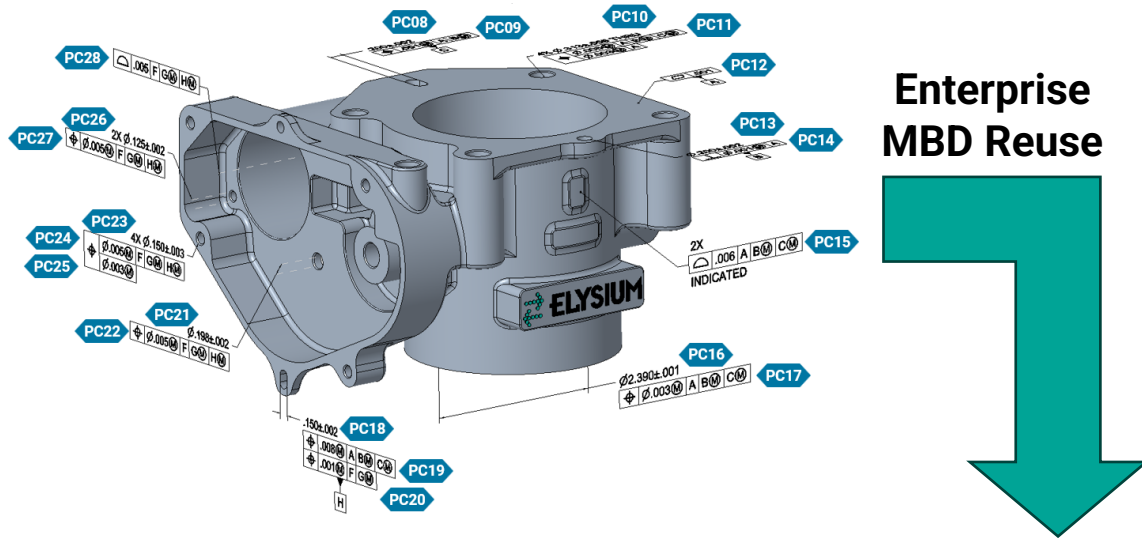
MBD Reuse and Consumption within the Enterprise:



Enterprise
MBD Reuse



The Consequence of “Poor” MBD Quality



Consequence of Poor MBD Quality:

- Enterprise Reuse and Propagation of Error Prone Data
- Lack of Automation
- Manual Rework Within Each Enterprise Domain
- Limited or Degraded Data Traceability
- Potential for Turnbacks, Rework, and High Scrap Rate
- Lack of Trust in MBD



Product Definition

Example Workflows:

- Quality Checking
- 3D Tolerance Stackups
- CAE Tools
- Design Reviews
- Derivative Creation / Val



Manufacturing

Example Workflows:

- Bill of Process
- Work Instructions
- In-Process Models
- Key Characteristics
- NC Programming



Quality

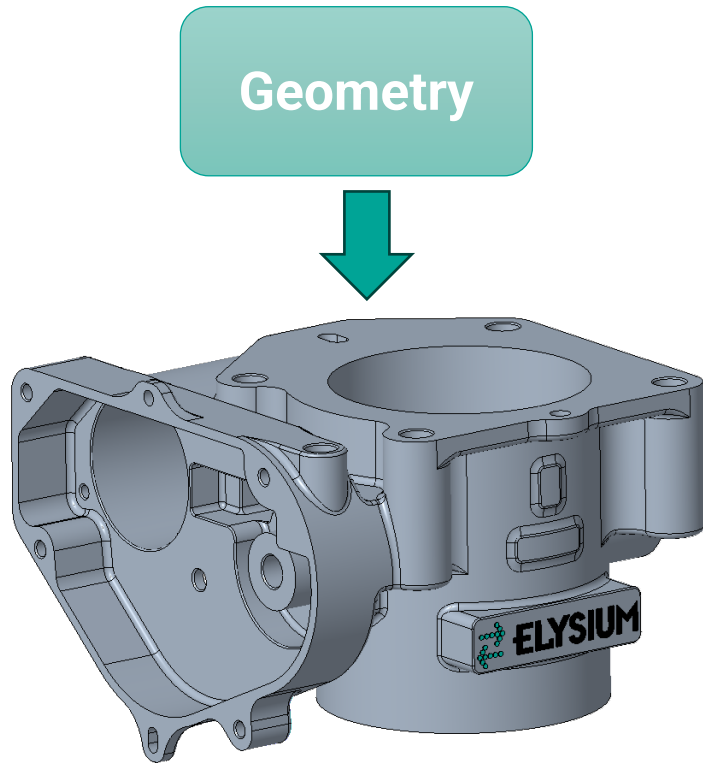
Example Workflows:

- Quality Plan
- Gages / Fixtures
- Inspection Plan
- Bill of Characteristics
- Inspection Plan



- BoM Management
- BoC Management
- Data Traceability

The Consequence of Poor “Geometry” Quality

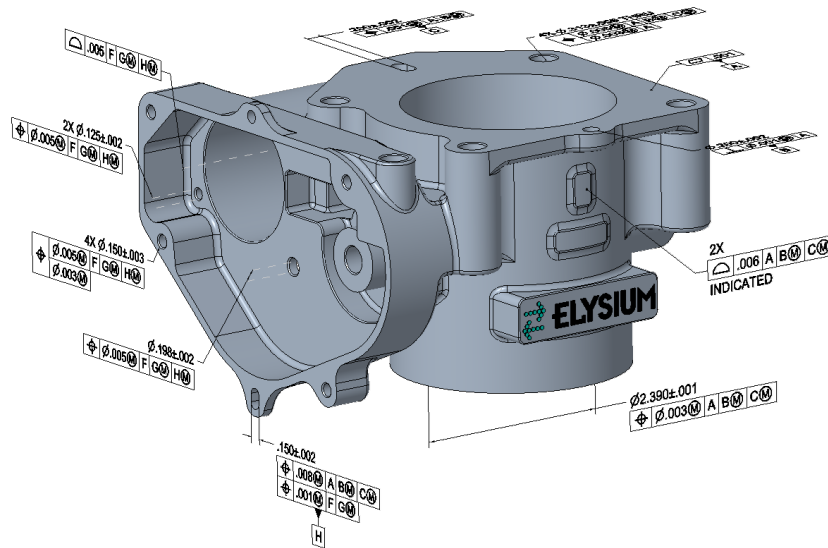


Geometry (3D Shape Geometry):

- Unstable fragile geometry can cause consumption issues
 - Tinny edges, Gaps and Cracks (Non-water-tight)
 - Low geometry precision for high precision parts
- Downstream MBD consumers “fix” geometry locally, breaking the digital thread and adding costly rework
- Geometry Interoperability Issues: (Unstable geometry)
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 - (Dia Symbol on NURB surface)
- Geometry conditions or design is not suitable for intended manufacturing or assembly process
- Scrap, rework, or late ECO changes

The Consequence of Poor “Annotation” Quality

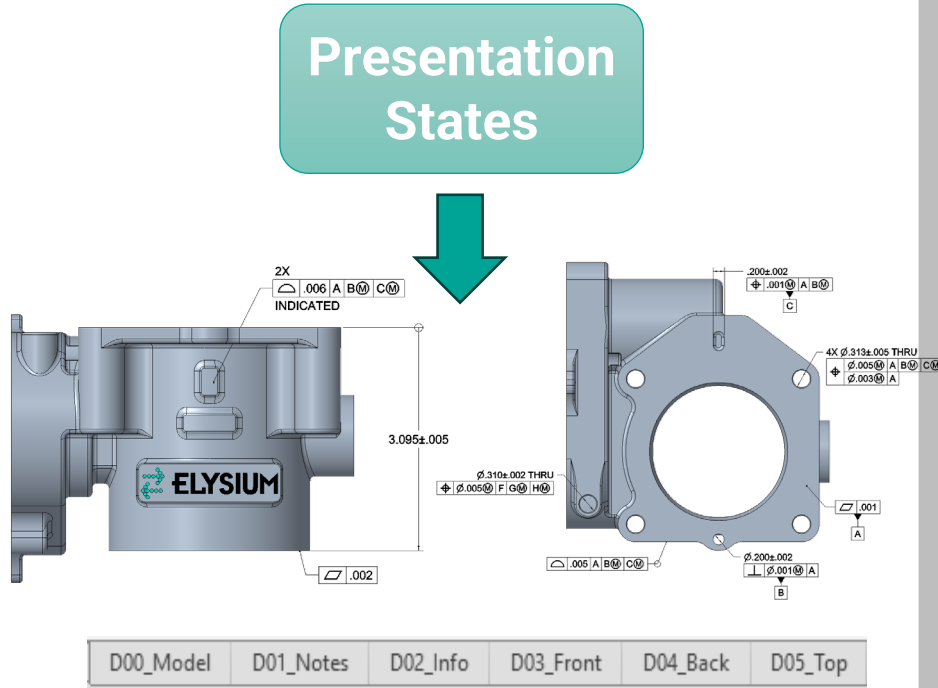
Annotations



Annotations (PMI: GD&T, dimensions, notes)

- Ambiguous or incorrect product definition
 - Misleading Human and machine- interpretation
 - Misleading manufacturing, quality, and inspection choices
- Automated workflows transform into manually transcribed workflows
 - 3D Tol Stacks, Should Cost, Quality Planning, BoC, Inspection
- Increased RFI from suppliers and internal teams
- Potential for false positives in inspection and bad parts are accepted
- Loss of human confidence and trust in semantic PMI, forcing drawing-like behavior

The Consequence of Poor “Presentation State” Quality



Presentation States (Views, Captures)

- Users misinterpret design intent or misses critical requirements across views
- Missing technical information due to view not marked as “published”
- View sorting issues without proper view naming conventions – outside of CAD system
- Incorrect layer state or visibility of MBD due to incorrect setup
 - Missing Supplemental Geometry (i.e., Datum Targets, Designated Areas)
 - Part or surface visibility, color, or texture...
- Dedicated manufacturing and/or quality views promote limited reviews of ALL other views

The Consequence of Poor “Attributes” Quality

Attributes/ Metadata

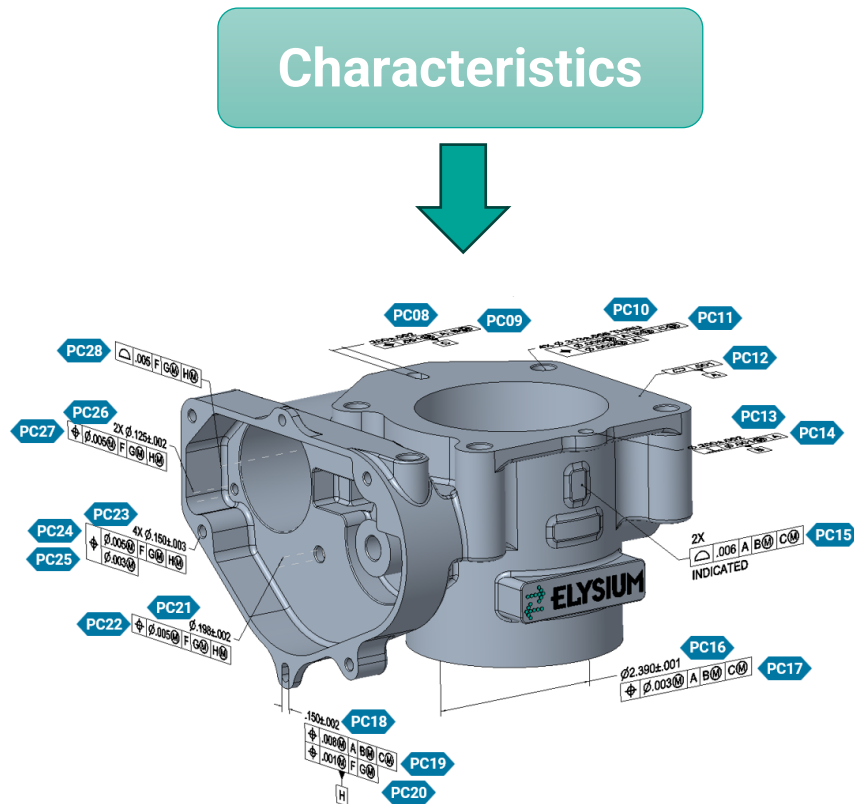


-Symbols
-Annotations
-Data From PLM (i.e., Titleblock)
-System Tolerances
-Linkage to Associated Entities
-UUID's

Attributes / Metadata (All MBD Elements)

- Attributes are the backbone of machine readability
- Without proper attribution, we would only have human interpretation...
- Incorrect or misleading data propagated into downstream systems and tools within the enterprise
- **THIS AFFECTS ALL MBD ELEMENTS!!**

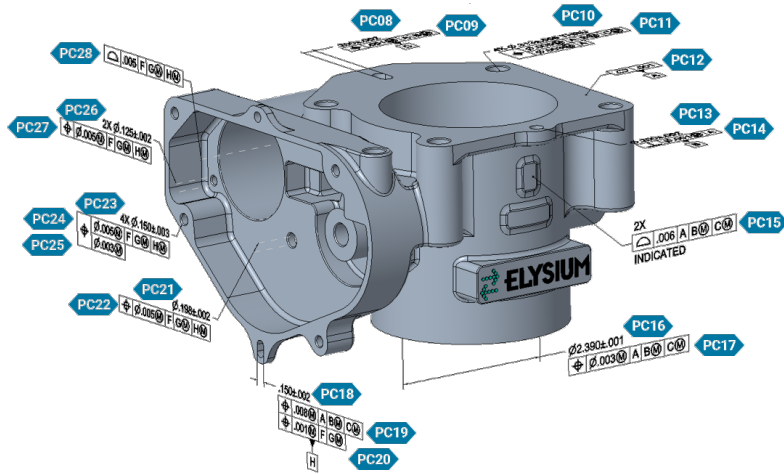
The Consequence of Poor “Characteristics” Quality



Model-Based Characteristics (Tags, Balloons, Bubbles)

- Low or inefficient data traceability at the annotation (requirement level)
- Duplicate characteristics and/or UUID's can cause traceability and data analytics issues
- Inspection results manually be linked to requirements
- Manual creation and assignment of characteristics
 - Non-persistent across revisions and lifecycle
 - Time –consuming manual process, error prone
- Quality report creation (FAI, PPAP, or AS9102) becomes manual and error-prone
- Loss of closed-loop quality and statistical analysis capability
- Digital thread between design, manufacturing, and quality collapses

Protocol for MBD Quality Checking?



MBD Elements

Geometry

Annotations

Presentation
States

Attributes/
Metadata

Characteristics



What are the correct protocols to ensure “GOOD” data quality for MBD?

- PDQ Protocols for all MBD Elements

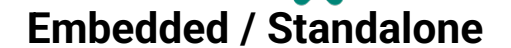
What industry standards support Product Data Quality of MBD?

- For both Native and Derivative MBD Formats?

What's Missing: A unified framework that addresses the quality of all MBD elements that can ensure model-based data is enterprise ready.

**Industry
Standards
Gap**

MBD Product Data Quality



Agenda

Closing the Gaps: Unifying Standards for Enterprise- Ready MBD



Current Standards Landscape for PDQ

■ NSE MBE Maturity Index

- Defines the need for Product Data Quality
- Does not define a protocol for PDQ MBD

■ ISO/TS 10303

- Defining the protocol for STEP, but not for native CAD and all MBD elements

■ 1520:2018 Product Data Quality Definition

■ 1851:2024 Product and Manufacturing Information Data Quality

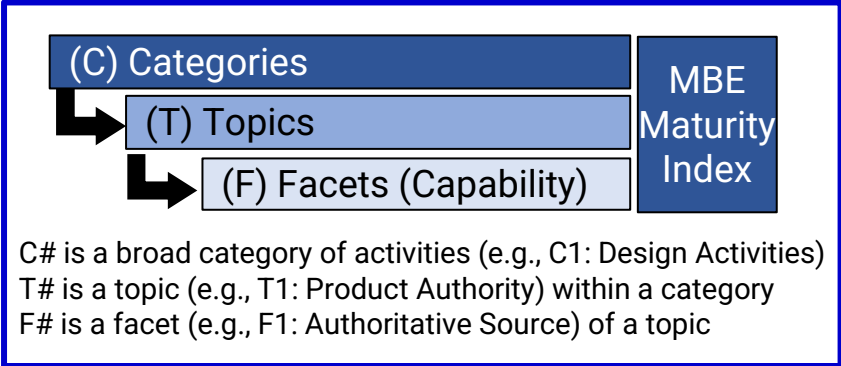
■ 1523:2019 Shape Data Quality Criteria

■ 1821:2014 Externally Conditioned Data Quality Criteria

NSE MBE Maturity Index (ASME MBE2)

#NAME?										AS-IS Level				TO-BE Level
Name	Maturity Level		Drawing-Centric	Drawing Model-Centric	Validated Model-Centric	Formalized Model-Based Definition	Trusted Model-Based Definition	Integrated Model-Based Enterprise	Extended Model-Based Enterprise	Capability: Tools are Available?	Readiness: Processes are Ready?	Adoption: People are Using?	Target Adoption	
	Level	Transition: As maturity increases, the organization's ...	L0	L1	L2	L3	L4	L5	L6	N/A	N/A	N/A	N/A	
# Categories (e.g., C1)		Description: How the organization ...												
C1: Design Activities			2D Drawings used for all activities	2D Drawings derived from models	2D Drawings and other derivatives from validated 3D model	Semantic PMI included within 3D model	Certified, Authorized MBD	MBD dataset made useable for all lifecycle activities within enterprise	Product definition system model made useable for all lifecycle activities	N/A	N/A	N/A	N/A	
T1: Product Authority														
F1: Authorized Definition		Identifies the authorized product definition (i.e. legal definition).	Paper 2D drawing with support documents	Electronic 2D drawing with support documents	2D drawing from 3D model with support documents and support model	3D drawing (e.g. 3D Interactive Viewable) from MBD model with support documents and support model	MBD model with support drawing and support documents	MBD dataset containing all authorized product definition artifacts	Product definition system model communicating all authorized product definition artifacts along with their relationships	N/A	N/A	N/A	N/A	
T2: Product Requirements Association														
F1: Form		States the representation of the product requirements as data.	Non-electronic document	Electronic document	Same	Uniquely identifiable digital objects/records	Same	Same	Same	N/A	N/A	N/A	N/A	
F2: Associativity		States how well product requirements are linked to product definition.	Disconnected	Manually linked to characteristic on 2D drawing	Replicated to part object in PDM system	Linked to part object in PDM system	Linked to product characteristics in 3D model	Bi-directional link	Automated bi-directional link	N/A	N/A	N/A	N/A	
T3: Product Definition Description														
F1: Shape Definition		States how to define the base shape definition.	2D drawing	3D model as solid geometry	Same via feature-based design and parametric capabilities	Same with mixed modes of modeling (e.g., parametric, direct) techniques	Same with multiple feature-based disciplines (e.g., design, manufacturing, metrology, deburring)	Same with precise &	Same with generative	N/A	N/A	N/A	N/A	
F2: Non-Shape Information		States how to define visible non-shape product and manufacturing information (PMI) (e.g., annotations and notes)	Textual annotations and notes on 2D drawing	Same with textual notes driven from 3D model	Annotations and notes in 3D model	Semantic annotations and notes in MBD model	Same with common notes across inter-organization							
F3: Metadata		States where to record a product's metadata.	As text on drawing	Parameters within 3D Model	Same	3D Model and PDM	Automatic syncing between Model and PDM							
F4: Presentation Views		Identifies the types of	2D drawing views,	Standard 2D drawing	Same	3D model presented in	3D model presented in							

Lifecycle Activities



Maturity Levels L0-L6

Level	Level Name	Level Themes
L0	Drawing-Centric	2D Drawings Only; Disconnected
L1	Drawing Model-Centric	2D Drawings & STEP Derived from 3D Models; Drawings Managed, Disconnected from Models
L2	Validated Model-Centric	2D Drawings & Equivalent Derivatives from Validated 3D Models; Drawings Managed, Disconnected from Models
L3	Formalized Model-Based Definition	3D Models with Semantic PMI Added; Producing 3D Interactive Viewables, Managed as Part-Centric
L4	Trusted Model-Based Definition	Digital Model-Based Definition (MBD) , Certified & Authorized; Managed & Sourced as Part-Centric
L5	Integrated Model-Based Enterprise	Enterprise Integrated from Trusted Digital Product Definition Dataset; Process Data Managed with Part-Centric
L6	Extended Model-Based Enterprise	Enterprise Extended with Optimized Capabilities and Extended Partners

NSE MBE Maturity Index References:

- White Paper: [HERE](#)
- MBE Maturity Index: [HERE](#)

C1T4- Facets Overview

Categories (e.g., C1) └ Topics (e.g., T3) └ Facets (e.g., F2)	Description: How the organization . . .	Transition: As maturity increases, the organization's . . .		Drawing-Centric	Drawing Model-Centric	Validated Model-Centric	Formalized Model-Based Definition	Trusted Model-Based Definition	Integrated Model-Based Enterprise	Extended Model-Based Enterprise
				L0	L1	L2	L3	L4	L5	L6
C1: Product Design Activities	Activities involved in designing the product and preparing product definition.	Complete product definition becomes a product definition dataset with a trusted model-based definition model.		2D Drawings used for all activities	2D Drawings derived from models	2D Drawings and other derivatives from validated 3D model	Semantic PMI included within 3D model	Certified, Authorized MBD	MBD product definition dataset (PDD) made useable for all lifecycle activities throughout Enterprise	Product definition system model made useable for all lifecycle activities
T4: Model Quality & Certification										
F1: Verification	States the subject of checks (e.g., business/design, geometry, & PMI).	Checks become more inclusive.		Business/Design practices	Same and geometry	Same	Same and semantic PMI	Same	Same and checks related to production processes	Same and advanced precision geometry checks
F2: Automation	States degree of automation for verification of model quality.	Model verification becomes more automated and bound to promotion states.		Manual checks	Same	Ad hoc interactive check	On demand checking	Same	Same and automatic checks through workflow or promotion state change	Same
F3: Certification	States the methods for certifying verification of the model.	Certification becomes more digital and integrated with procedural workflows.		Signature on drawing	Signature on electronic drawing	Separate electronic certificate with traceability to model	Electronic certificate associated with part object	Same	Digital certificate embedded in model file	Same

C1T5 – Facets

Categories (e.g., C1) └ Topics (e.g., T3) └ Facets (e.g., F2)	Description: How the organization . . .	Transition: As maturity increases, the organization's . . .	Drawing-Centric	Drawing Model-Centric	Validated Model-Centric	Formalized Model-Based Definition	Trusted Model-Based Definition	Integrated Model-Based Enterprise	Extended Model-Based Enterprise
			L0	L1	L2	L3	L4	L5	L6
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T5: Model Derivatives									
F1: Content	States the information contained in a derivative model.	Derivative becomes richer and more precise.	N/A	Basic delineation (e.g., shape for MCAD)	Same w/ metadata	Same w/ textual PMI	Same w/ semantic PMI	Same w/ precision for target production processes	Same w/ precision for multiple target production processes
F2: Authoring Automation	States the degree of automation for generation of derivatives.	Derivative generation becomes more automated.	N/A	Manual from the Client Desktop	On demand from the PDM interface	Same	Automatic via PDM promotion states and/or workflows	Same and rules determining the type of derivative	Same
F3: Validation to & Certificates	States the degree of automation for validation of derivatives to a source, as well as the form of validation certificates.	Validation becomes more automated, and certificates become more closely linked to the derivative content.	N/A	Manual sign-offs without certificate	Manual sign-offs with separate electronic certificate	Interactively with certificate linked to PDM object	Same with embedded digital certificate	Same and automatic via a promotion state change	Same
F4: Traceability	States the depth of traceability information available for derivatives.	Traceability information increases back to origin.	N/A	None	Reference to source model	Same	Same and reference to basis model	Complete traceability to original source model	Same
F5: Managed	States how derivatives are stored and associated with the part definition.	Derivatives are stored in connected systems and associated more closely to the part definition.	N/A	Electronic file directories and disconnected	Document-centric PDM systems, but disconnected	Part-centric PDM systems, and associated	Part-centric, connected PLM system with common schema between Peer-Organization	Single, part-centric, PLM system with common schema throughout the Enterprise.	Same with Extended Enterprise
F6: Viewables	States the human-readable mechanism for communicating product definition.	Viewables become 3D, annotated, interactive, interrogatable, and holographic.	Paper 2D Drawing	Electronic 2D static drawing	Proprietary 3D viewer, geometric interaction	Geometric and annotation interaction in a standard format	Same with spatial interrogation	Same with managed mark-ups	Same with holographic

“Quality” standard in ISO 10303

■ From the scope clause of ISO 10303-59

- *“This document specifies the integrated generic resource constructs for quality of product shape data. These constructs enable the representation of product data quality with a specific focus on three-dimensional product shape data and shape-related data. The representations cover **quality criteria, quality measurement requirements, quality assessment specifications** and **quality inspection results** for product data.”*

■ Quality criteria

- “Black list” of erroneous or inapt data instances.

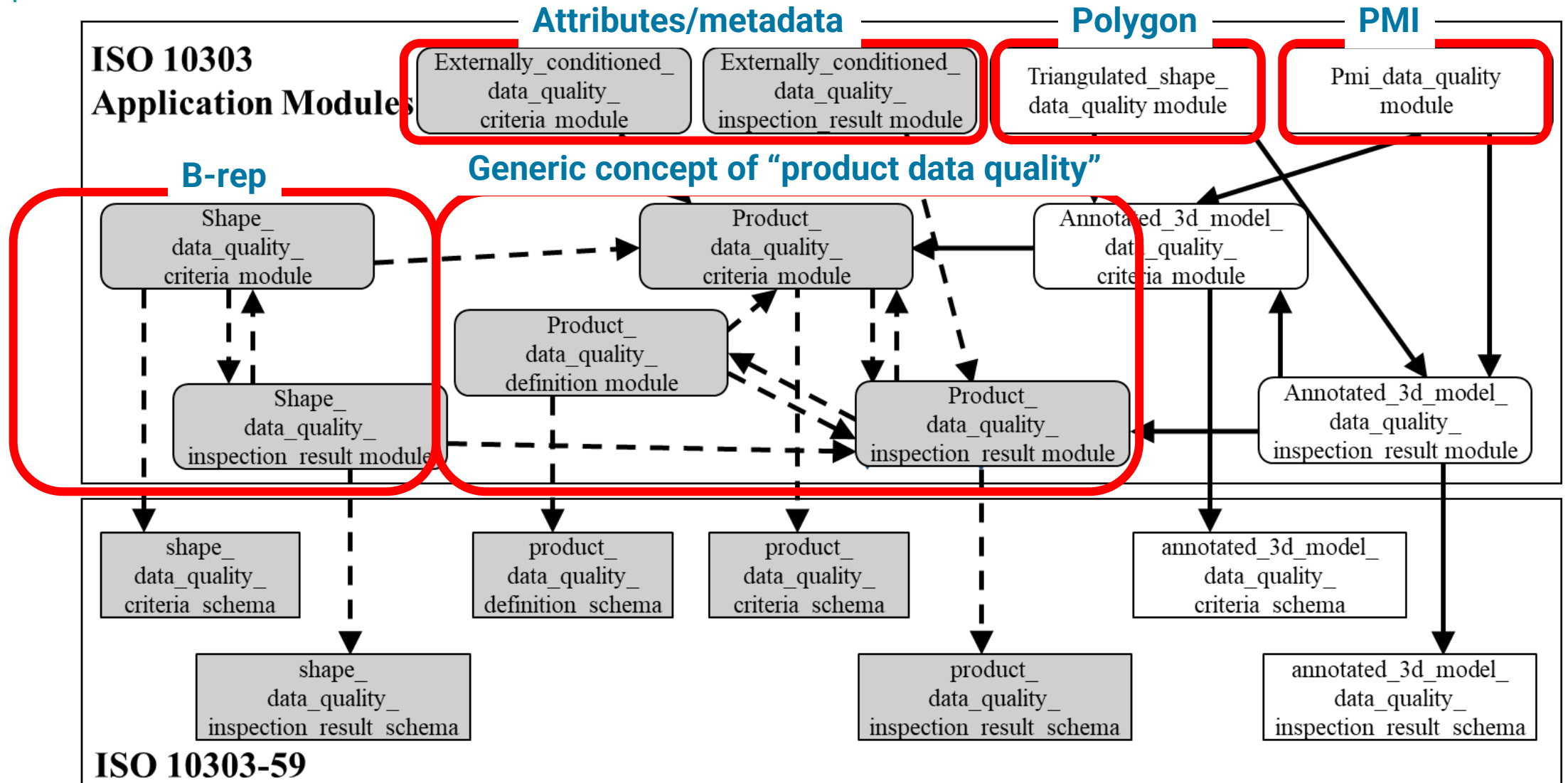
■ Quality measurement requirements and assessment specifications

- Precise description of how to inspect the given dataset and how to assess the measurement results using STEP terminology.
 - Native CAD data is not excluded because every CAD system can interpret their own CAD entities to STEP entities.

■ Quality inspection results

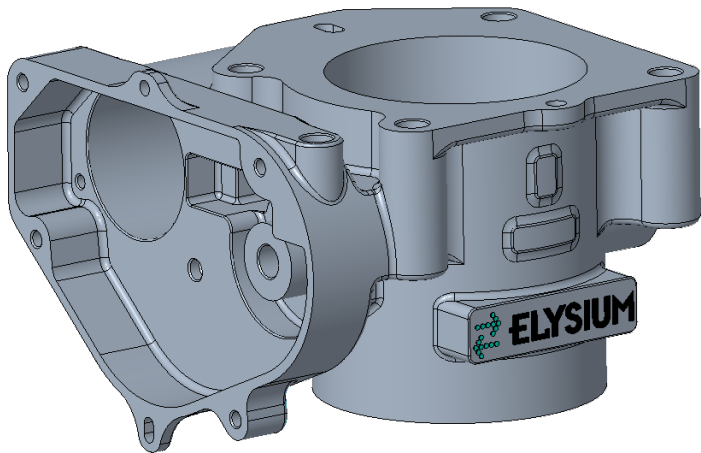
- Summarized or detailed inspection results so that it can be used for quality assurance (quality stamp) or problem solving purposes.

Structure of PDQ standards in STEP AP 242



The Consequence of Poor “Geometry” Quality

Geometry



Used to be a major problem in industries in late 90's – early 2000's

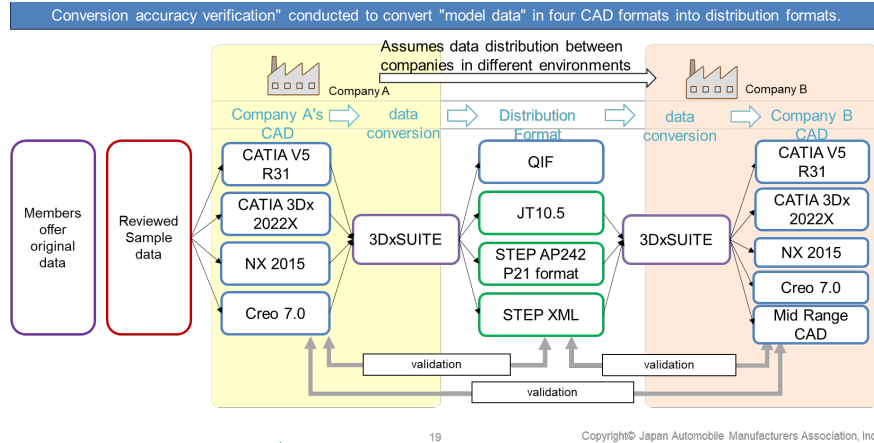
- Dramatically improved by public activities of PDQ

Geometry (3D Shape Geometry):

- Unstable fragile geometry can cause consumption issues
 - Tinny edges, Gaps and Cracks (Non-water-tight)
 - Low geometry precision for high precision parts
- Downstream MBD consumers “fix” geometry locally, breaking the digital thread and adding costly rework
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Planned enhancement of PMI criteria for AP 242 ed5

Large scale PMI conversion tests using practical data



Root – cause analysis

Candidates of new PMI quality criteria

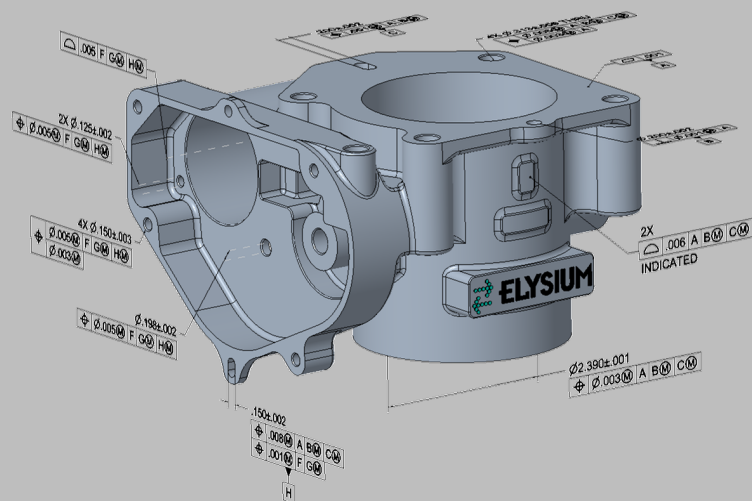
- Overlapping_pmi_in_saved_view
- PMI_semantics_represented_by_text
- Geometric_tolerance_incorrectly_related_to_dimension
- Surface_texture_related_to_edge
- Datum_target_series_associated_with_same_features
- Ambiguous_dimension
- Pmi_associated_with_tiny_feature
- ----- etc.

	Class	Causes	Future actions by JAMA	#
1	Design	Design and modeling methods	Create and publish a "copybook" for designers to improve design quality.	24
2	CAD	Specifications and limitations of CADs	Include in the "CAD Functional Requirements Guidelines" to encourage vendors to develop functionality	54
3	Conversion	Specifications and limitations of converters	Improvement requests to vendors and benchmark activities	85
4	Standard	Specifications and limitations of standards	Revision requests to the international organization	17

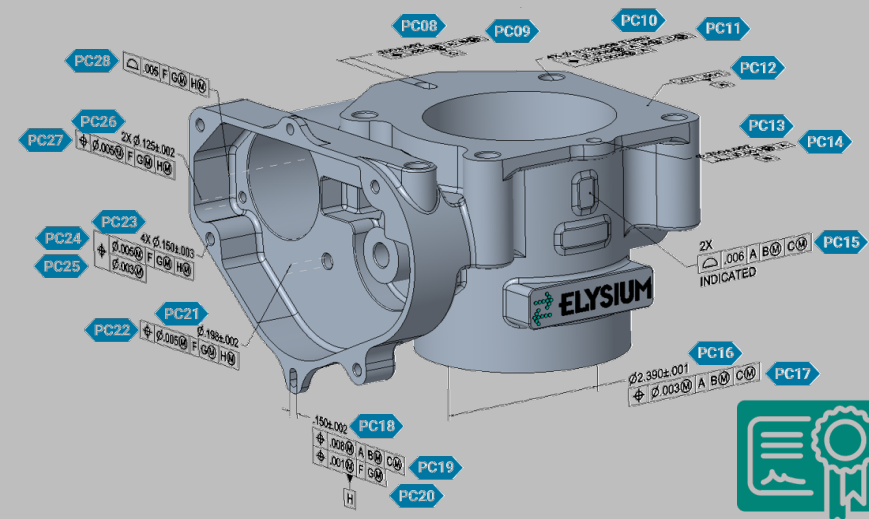
The Standards Gap...

- We have a requirement for PDQ and model certification (MBE Maturity Index), but we lack a “complete” standard for execution
- Bridging the standards GAP → Unified Framework for PDQ and Model Certification...
- PDQ shall support both native CAD checking and derivative validation...

Industry Standards Gap



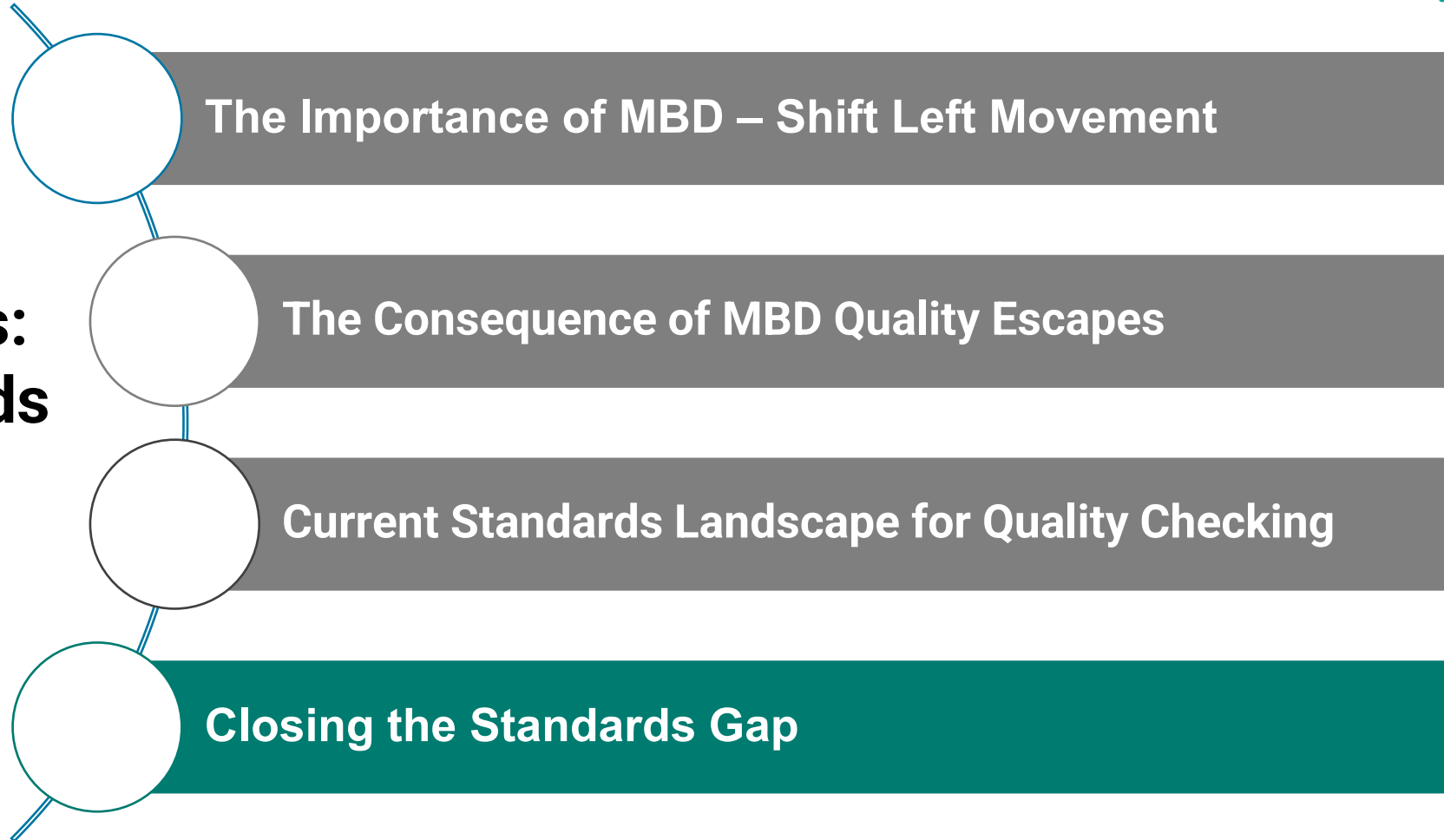
- Checking to Non-standard Protocol
- Geometry and Annotations Primary Focus
- Some MBD Elements Unchecked
- No Model Certification



- Checking to a Standard Protocol
- ALL MBD Elements Checked
- Embedded Model Certification
 - Human and Machine-Readable

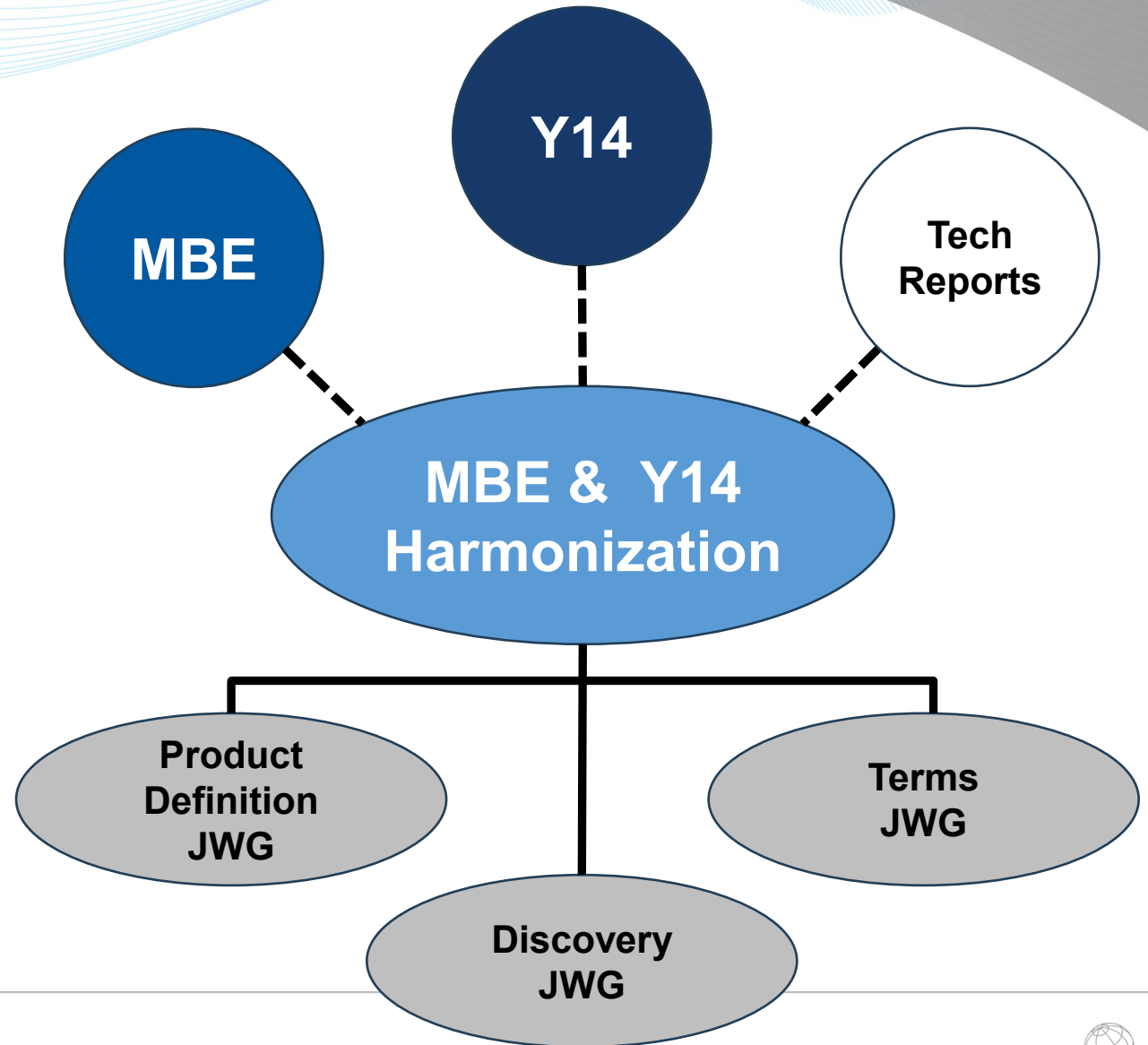
Agenda

Closing the Gaps: Unifying Standards for Enterprise- Ready MBD



Call to Action: MBE & Y14 Harmonization

- **Develop guidance in using Y14 standards in a Model-Based Enterprise**
 - Proposals for Y14 standards revisions
 - Identify new MBE standards
 - Proposals for MBE standards revision
 - Industry Technical Reports
- **Joint Working Group Activities**
 - Gap descriptions and user stories developed in **Discovery**
 - Gap proposals and technical reports developed in **Production Definition** and **Terms Harmonization**



Call to Action: Current Pattern Gaps in Progress

- **Discovery Harmonization JWG:**
 - MBD Product Data Quality [HG011]
 - MBD Model Certification [HG012]

Call to Action: HG011 Gap

GAP: Product Data Quality (PDQ) Standards for MBD (All MBD Elements).

User Story:

- As an **MBD Author** and **MBD Consumer**:
- **I want** a unified set of standards that clearly defines product data quality requirements and protocols for Model-Based Definition (MBD) and MBD derivatives (e.g., STEP, JT, QIF)
- **So that** product definition data is complete, accurate, interoperable, traceable, trusted, and enterprise-ready at release.

Acceptance Criteria:

- Define unambiguous requirements and protocols for MBD product data quality
 - Protocols for MBD Elements (Geometry, Annotations, Attributes and Parameters, Presentation States, Characteristics)
- Protocols framework should account for industry standards and custom OEM standards or requirements
- Harmonize with MBE2 MBE Maturity Index, HG012 Model Certification Gap, ISO 10303

Call to Action: HG012 Gap

GAP: Model Certification Standards for MBD – Embedded and Standalone.

User Story:

- As an **MBD Author** and **MBD Consumer**:
- **I want** a unified set of requirements that clearly defines model certification for Model-Based Definition (MBD) and MBD derivatives (e.g., STEP, JT, QIF) that is human and machine-readable as a standalone certification or embedded in the model
- **So that** MBD product definition data is marked as certified to an established protocol instilling trusted of enterprise-ready MBD data.

Acceptance Criteria:

- Define unambiguous requirements for model certification
- Certification requirements should be established for embedded and standalone certifications
- Certifications shall be human and machine-readable
- Model certifications should be linked to an industry protocol framework
- Harmonize with MBE2 MBE Maturity Index, and HG011 Gap, SASIG PDQ Guideline



Questions?



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