DMSC: One Consortium; Trinity of Standards

Impacting the Digital Thread with Quality

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President, DMSC

* The Department of Energy's Kansas City National Security Campus is managed and operated by Honeywell Federal Manufacturing & Technologies, LLC under contract number DE-NA0002839

Abstract

- The DMSC is a non-for-profit, cooperative sponsorship, consortium organization. It was conceived & sponsored in 1983 and became a separate legal entity in 2005. Its mission is dedicated to identifying, promoting, fostering, and encouraging the development and interoperability of standards that benefit the digital metrology community. Its membership participants consist of a professional group of manufacturing metrologists, software developers, and innovators worldwide. As an ANSI accredited standards making organization the DMSC is the maintainers of Dimensional Measuring Interface Standard (DMIS) standard, developers & maintainers of the Quality Information Framework (QIF) standard, and the most recent soon, very soon developers of the Model-Based Characteristics (MBC) standard.
- The speaker will provide a brief on the DMSC and provide updates on its current triad of standards and how they work together to contribute to connecting the digital thread

What is the DMSC?

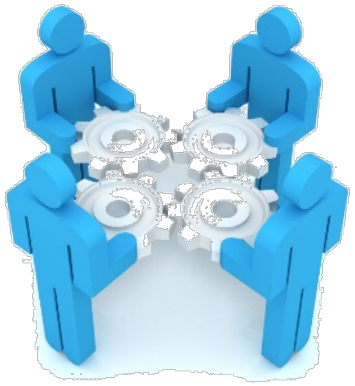
Digital Metrology Standards Consortium (DMSC)

Mission: *We provide a standardized, interoperable, data framework for manufacturing.*

Vision: *Quality Standards that impact the digital thread through digital metrology and interoperability.*

Tagline: Impacting the Digital Thread with Quality

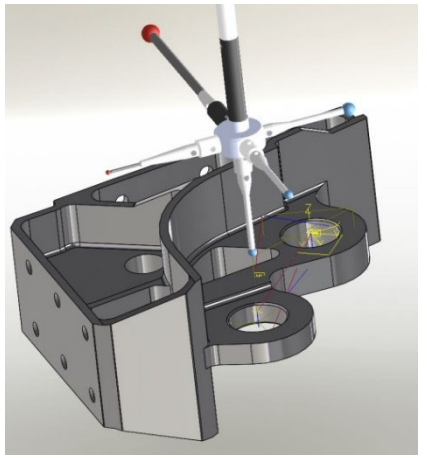
Goal: Publish and maintain industry standards that enable and enhance digital metrology workflows in a model-based extended enterprise.



Who is the DMSC?

Digital Metrology Standards Consortium (DMSC)

- A **non-for-profit**, cooperative sponsorship, **consortium** organization. Conceived & sponsored in 1983; Separate legal entity 2005.
- Dedicated to identifying, promoting, fostering, and encouraging the **development** and **interoperability** of standards that benefit the digital metrology community.
- Preparing standards that **impact** the digital **model-based quality** enterprise.
- A professional **group** of manufacturing metrologists, software developers, and innovators worldwide.
- **ANSI accredited** standards making organization
- Maintainers of **Dimensional Measuring Interface Standard** (**DMIS**) standard.
- Developers & maintainers of **Quality Information Framework** (**QIF**) standard.
- Developers of **Model-Based Characteristics** (**MBC**) proposed standard.
- **A-Liaison** member of **ISO / TC184 / SC 4** (The makers of STEP)



DMSC Objectives . . .

- To **reduce** the **cost of quality**
- To **develop** and maintain **trusted digital** interoperability standards
- To **interconnect Quality** within the **digital tread.**
- To **enable** digital **metrology** within manufacturing, specifically within Model-Based Enterprise
- To **enable** organizations the **freedom** to choose solutions
  - **Best** in **class**
  - **Best** in **value**
  - **Best** in **connection**

Bailey H. Squier DMSC Metrology Memorial Scholarship

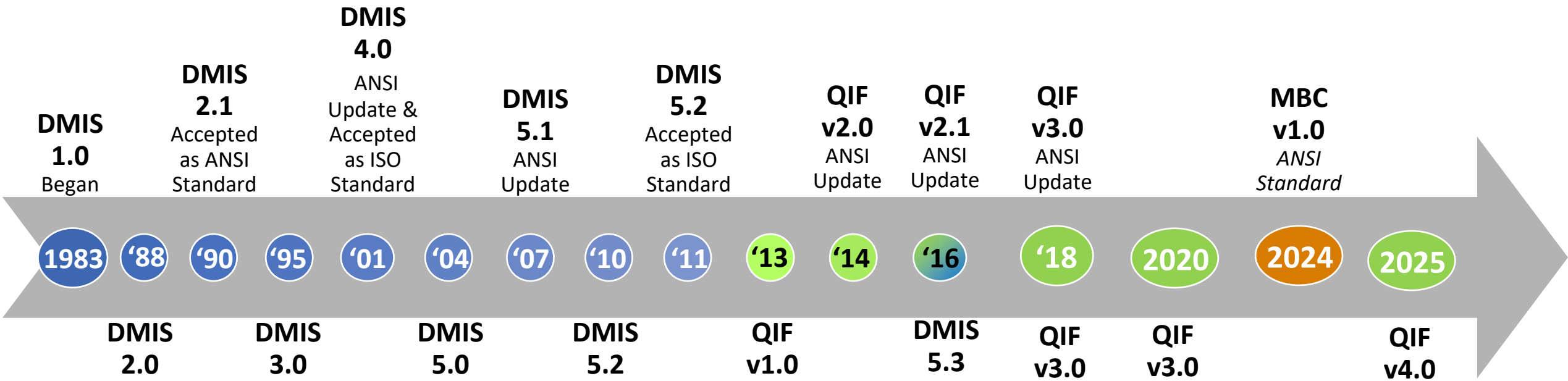
With the passing of Bailey Squier on July 26th 2023, the inspiration for the Digital Metrology Standards Consortium (DMSC), its Board of Directors established the Bailey H. Squier DMSC Metrology Memorial Scholarship as a symbol of gratitude and admiration for the life, contribution, and legacy of Mr. Squier.

Curtis Brown, DMSC President, and Bailey H. Squier, DMSC Executive Director Emeritus at a recent DMSC MBC meeting, July, 2023, Arlington, TX.

With great appreciation to Ray & Tanya Admire for their support and friendship to Bailey during his later years!

DMSC's Quality Standards Pedigree

Digital Metrology Standards Consortium | **2024**



Dimensional Measuring Interface Standard (DMIS)

Quality Information Framework (QIF)

Model-Based Characteristics (MBC)

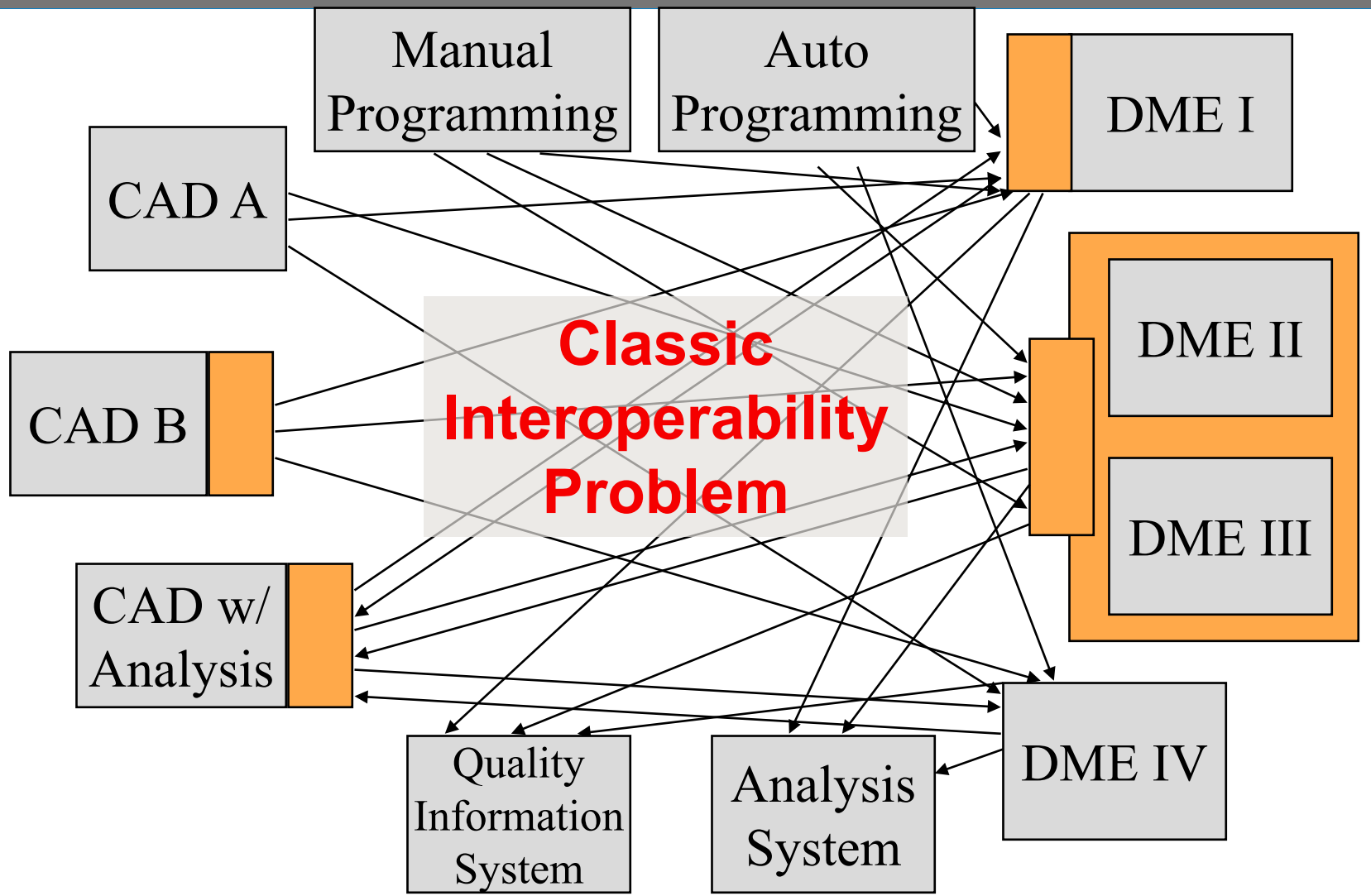
ISO 22093:2011 – Industrial automation systems and integration – Physical device control – Dimensional Measuring Interface Standard (DMIS)

ISO 23952:2020 – Automation systems and integration — Quality information framework (QIF) — An integrated model for manufacturing quality information

What is DMIS?

- **Dimensional Measuring Interface Standard (DMIS)** is an internationally recognized standard carrying ISO 22093:2011 status and is one of the most widely used standards related to dimensional metrology in the world. This standard has contributed to significant improvement of interoperability between CMMs, and traceability of measurement processes.
  - Bi-direction communication of information between computer systems and inspection equipment (e.g., CMM)
  - Establish neutral format for inspection programs and inspection results data.
  - Enables machine-readable between computer equipment
  - Allows human-readable and human-writable
    - Inspection Program
    - Inspection Results
  - Contains high-level language extensions
  - Functions as a Dimensional Measuring Equipment (DME) language.
  - Provides Standard vocabulary of terms that support
    - Exchange of Inspection Program to DME Execution systems
    - Exchange of measurement and process data back to an analysis, record, and/or archiving systems.

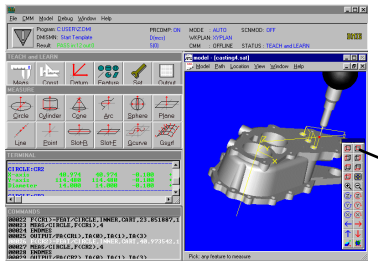
Pre-DMIS Environment



DMIS Environment

Manual Programming

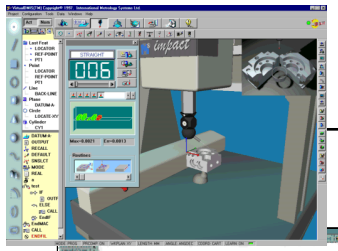
DMIS Auto Programming

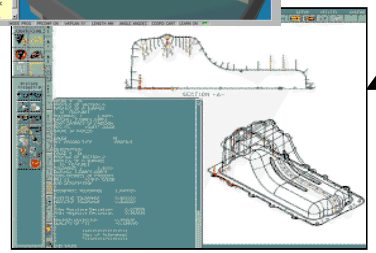


DMIS by DMSC

DME II

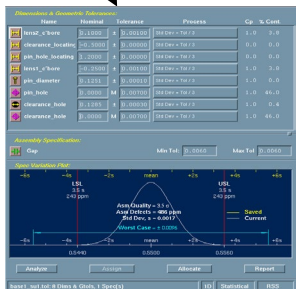
DME III



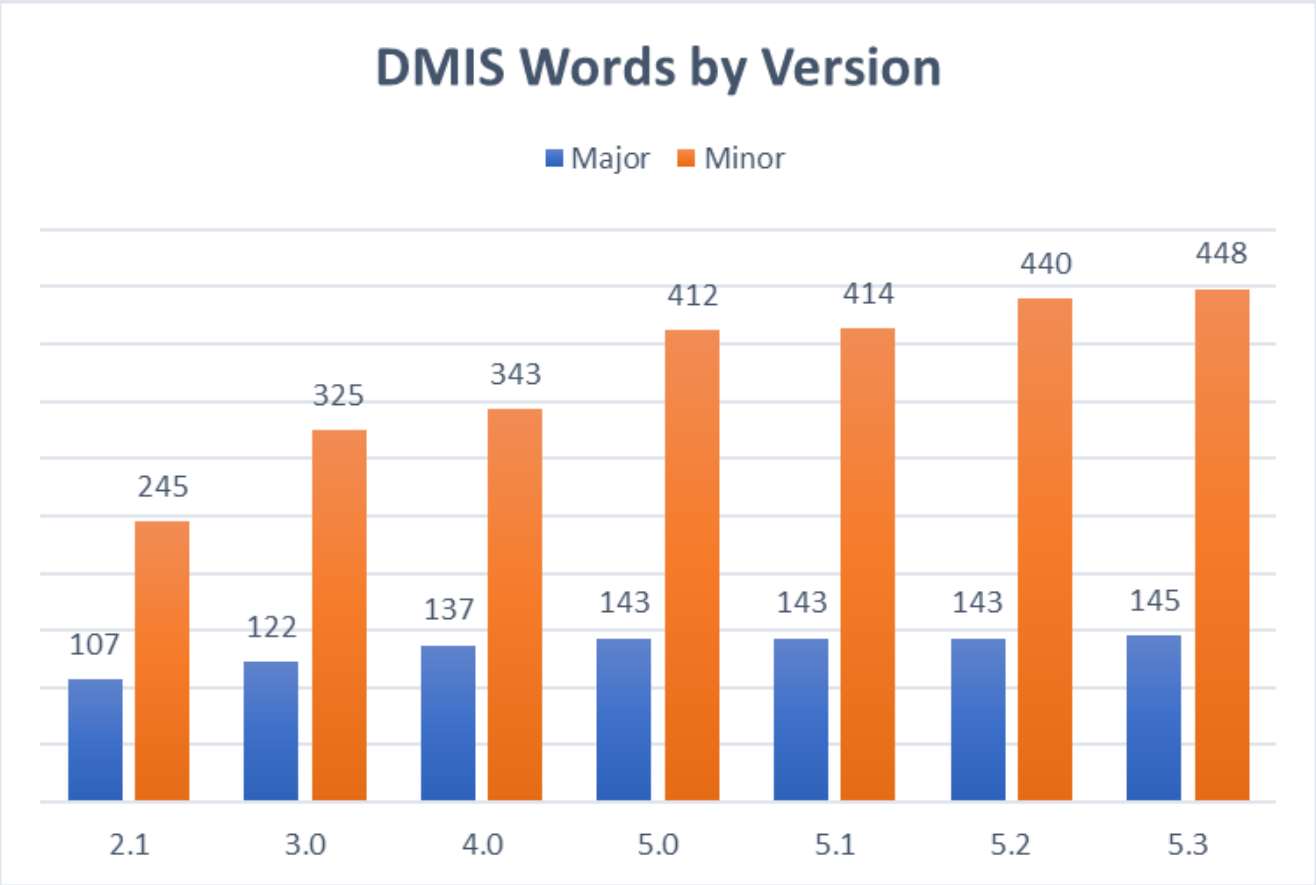


Standards-Based Interoperability

Quality Information System



DMIS Word Count by Version



DMIS Standard Version

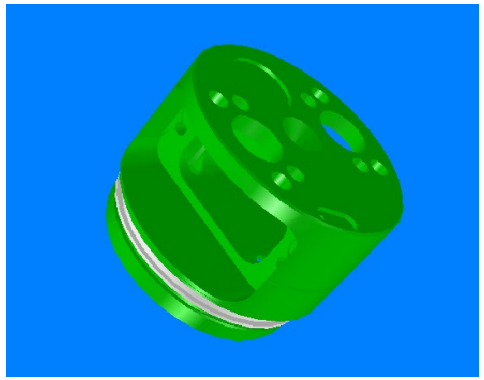
What is DMIS?

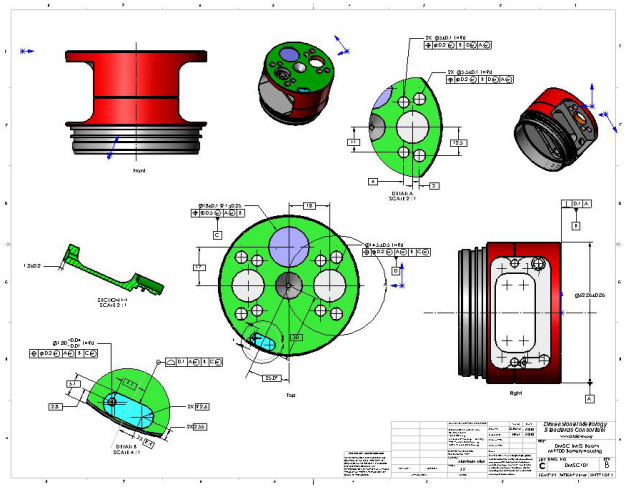
- Fulfillment of a Technology Void
- Standard for Bi-directional Communication for Dimensional Measurement Data
- Specifies a Vocabulary of Terms
  - Metrology Measurement (e.g., CMM) Programs
  - Dimensional Measurement Results Data
- Neutral Information Exchange Format
- Human Readable and Writeable
- Functions as a CMM Inspection Program Language
- American & ISO Standard

DMSC at the IMTS 2008

DMIS Interoperability Demonstration

- Oct. 2008





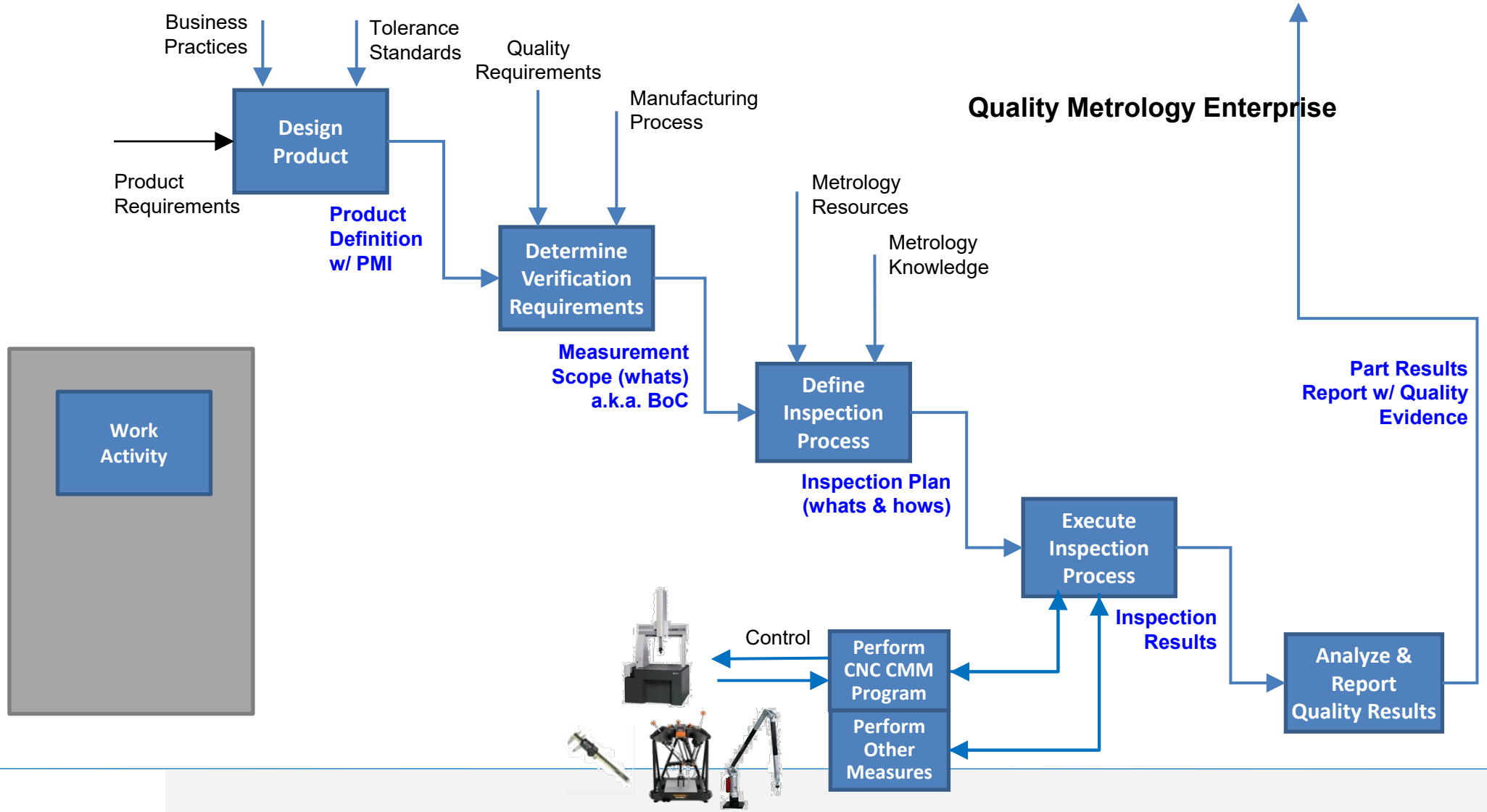
Ray Admire, Lockheed Martin Missiles & Fire Control; John Horst, NIST; Curtis Brown, Honeywell FM&T; Jerry Lewis, Siemens; Bill Rippey, NIST; Vince Clements, Wenzel Xspect Solutions; Not Pictured: Keith Morton, Metris .

ANSI/DMSC QIF 3.0 - 2018

- ANSI Approved: October 5th, 2018
- Information Model: Schema: XSD/XSLT
  - QIF Document: 1
  - QIF Applications: 6
  - QIF Libraries: 15
- Normative Document: PDF
  - Pages: 537
  - Definitions: 143
  - References: ASME, ISO Standards
  - Sections: 12
  - Figures: 239
  - Tables: 11
  - Annex: 4

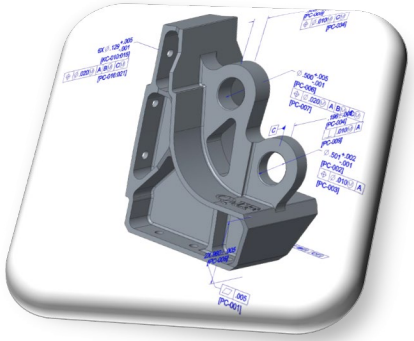
QIF by DMSC

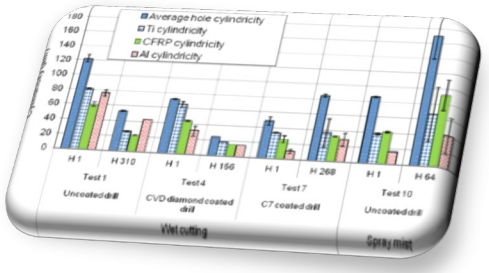
Product Inspection / Acceptance Activity Workflow



The QIF Standard

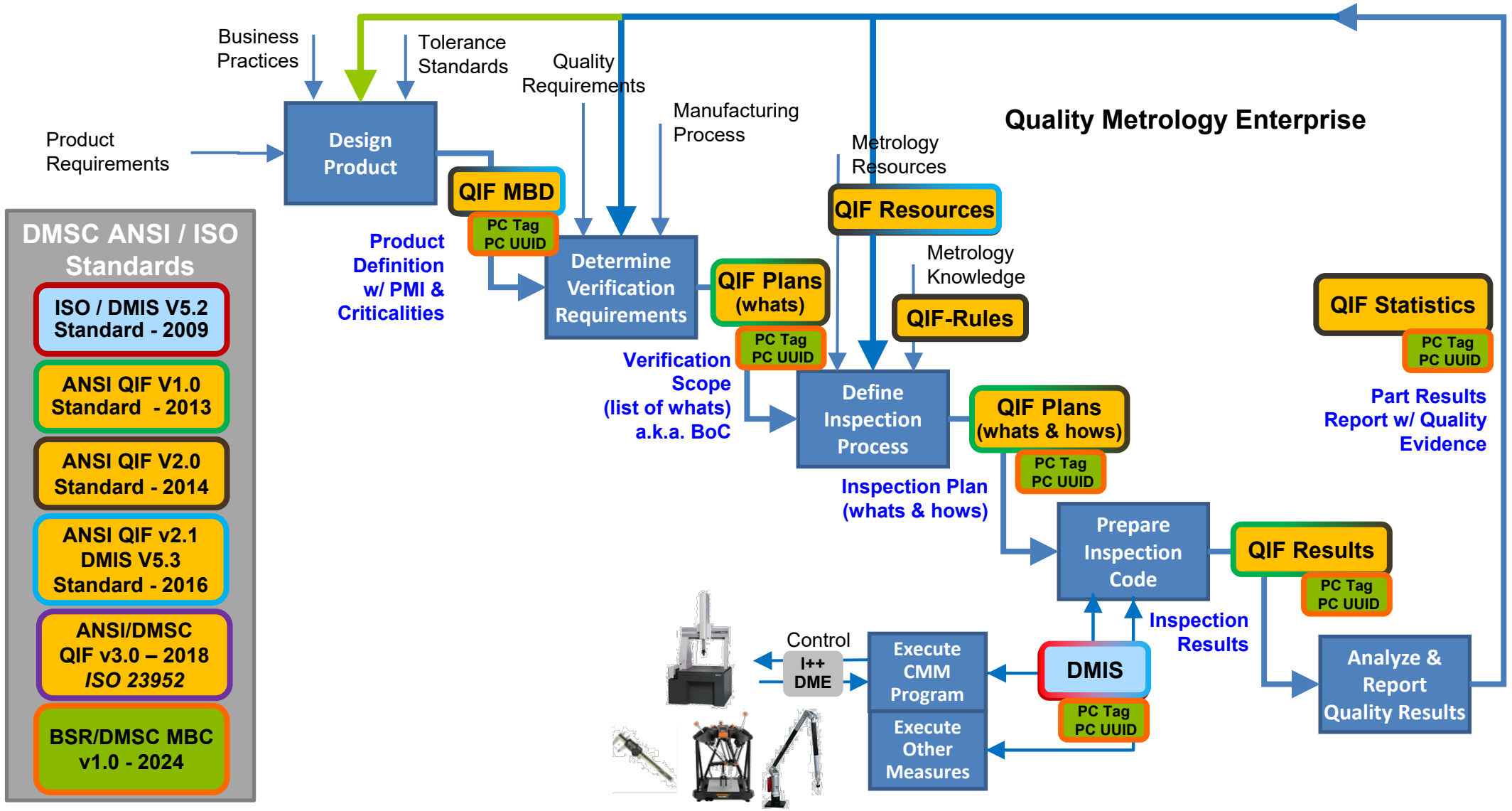
- *Quality Information Framework (QIF) – ANSI/DMSC QIF v3.0 - 2018*
- *An Integrated Model for Manufacturing Quality Information*
- Defines, Constrains, and Exchanges:
  - *Model-Based Definition*
    - *Feature-Based (Metrology/Measurement)*
    - *Semantic PMI (Characteristics)*
  - *Quality Planning*
    - *Whats: Bill of Characteristics (BoC)*
    - *Hows: Inspection Plan (Methods)*
  - *Measurement Execution*
    - *DMIS 5.3 w/QPIds*
  - *Measurement Results*
    - *Part*
    - *Statistical*
  - *Enterprise Connectivity for Quality Feedback*
    - *Quality Persistent ID (QPId) (i.e., Universal Unique ID (UUID))*
    - 651aded1-ff04-498a-968e-044147a2506d



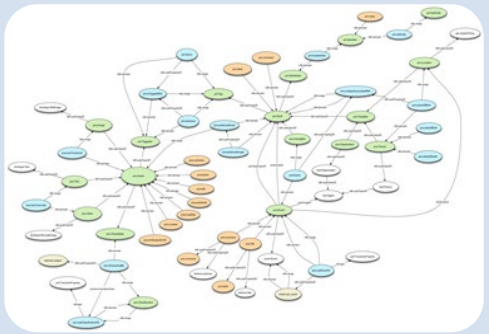


DMSC QIF Activity Workflow

Digital Metrology Standards Consortium | **2024**



What is the QIF?



Characteristic-Centric, Feature-Based Ontology of Manufacturing Quality Metadata

(Structured Data)

XML Technology: Simple, Modern Implementation with Built-In Code Validation

(Modern Approach)

Information Semantically Linked to the Model-Based Definition for Full Information Traceability

(Connected Data)

Approved ANSI Interoperability Standard

Harvested by ISO/TC 184/SC 4 as ISO/QIF 23952

(Standard Artifacts)

QPIds – Persistent UUID within the QIF

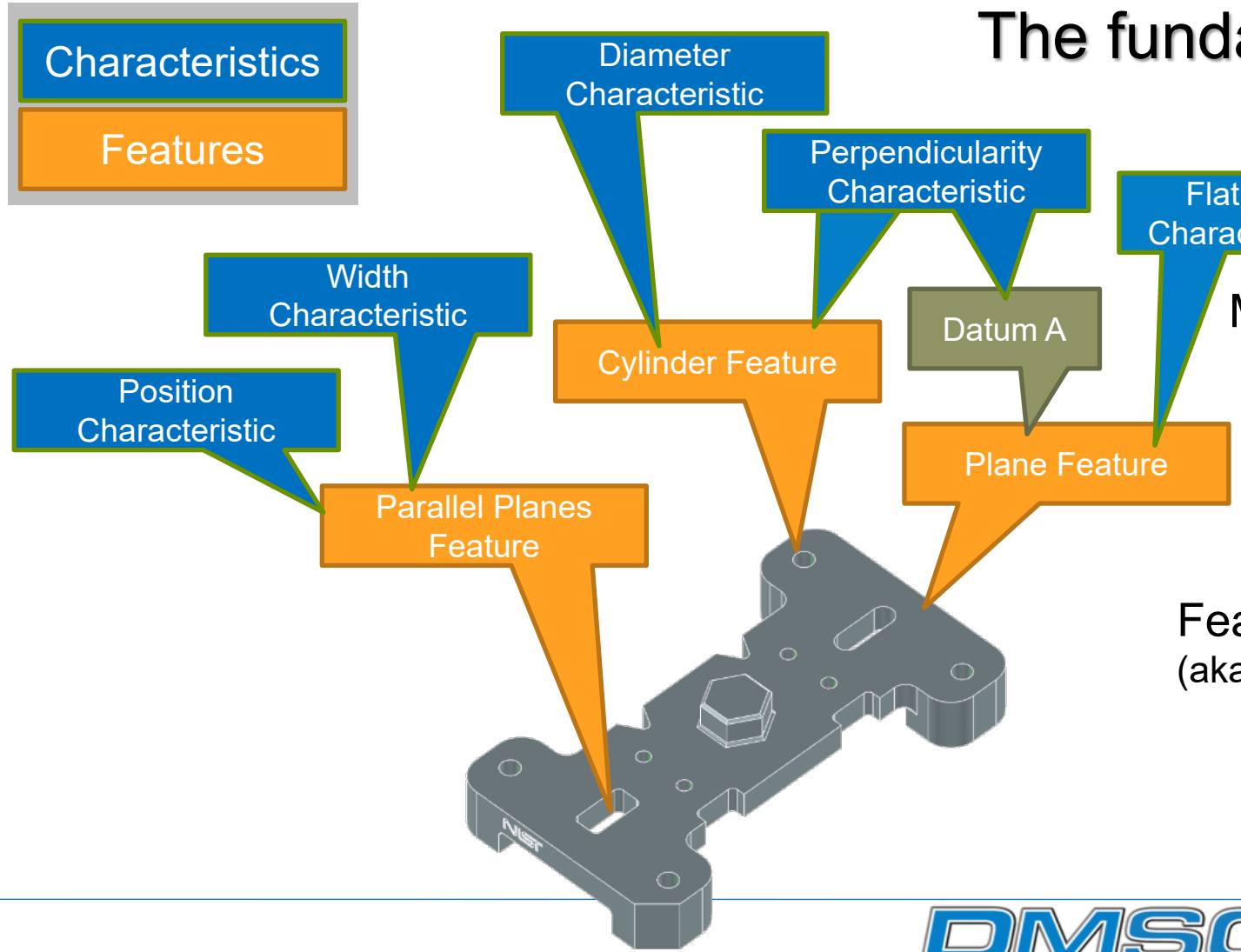
QIF Persistent Identifier (QPId) *noun* Cu·pid \ˈkyü-pəd\

- Universally Unique Identifier (UUID) (adopted by Microsoft as GUID)
  - ISO/IEC 9834-8
  - 550e8400-e29b-41d4-a716-446655440000
- Chances of generating two that are the same within the universe are practically nil.
  - 340000000000000000000000000000000000 ($3.4x10^{38}$) possible UUIDs
- **Allows information to be combined later without resolving identifier conflicts**
- Many software development libraries generate UUIDs
- QPIds uniquely identify
  - QIF Document
  - QIF Plan
  - QIF Result
  - QIF Rule Set
  - Feature Item
  - Characteristic Item
  - Product Item
  - Resource Item

An Important Mechanism that facilitates Lifecycle Connectivity w/ Traceability

Curtis W. Brown, 2016

QIF: Features & Characteristics



The fundamental constructs behind QIF:

- Metrology Features &
- Characteristics

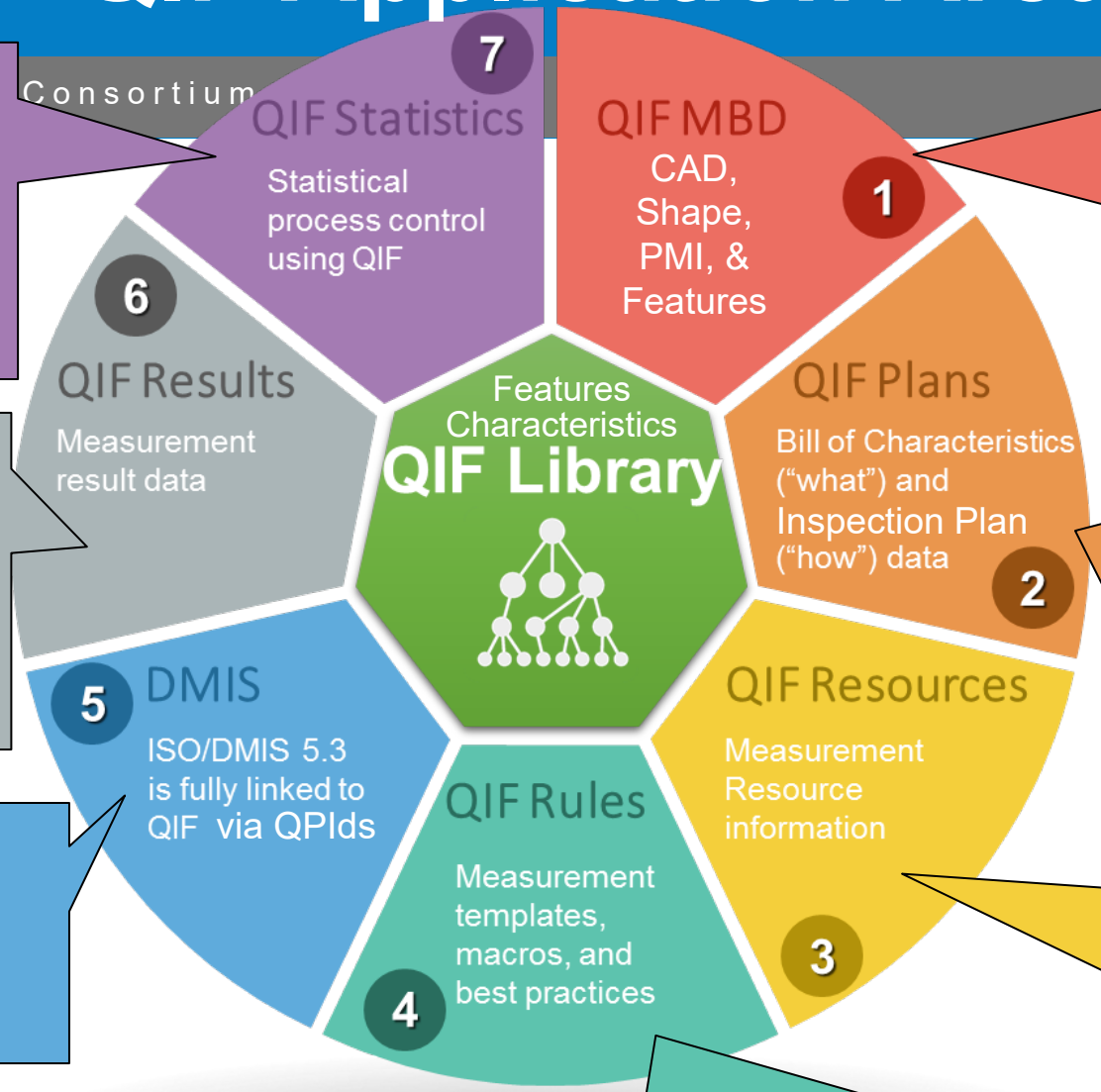
Model geometry is wrapped by ***Features***

- Different concept than CAD features!
- Sometimes referred to as:
  - Tolerance Features
  - Metrology Features
  - Measurement Features

Features are referenced by ***Characteristics***
(aka, Product Characteristics, Verification Requirements)

- Geometric Tolerances
- Dimensional Tolerances
- Specifications
- Notes

QIF Application Areas



Reference a bundle of QIF Results sets and specify a statistical analysis method to be carried out. Can optionally include the results of the statistical analysis as well

QIF MBD (Model-Based Definition) is the basis for providing traceability to authority CAD data. It is not required for basic QIF use cases. Considered to be the strongest semantic CAD+PMI standard available.

Measurement results data, associated with the MBD! This can be just tolerance evaluation results and can even include all the point cloud data from the features.

Wide range of optional levels of detail for measurement plans:

- What to Measure: Bill of Characteristics
- How to Measure: Inspection Plan
- Assign measurement resources
- Specify sampling point locations

DMIS is <u>not</u> part of QIF, ISO 22093, however the latest ANSI DMIS 5.3 has been updated to harmonize with the data traceability mechanisms in QIF.

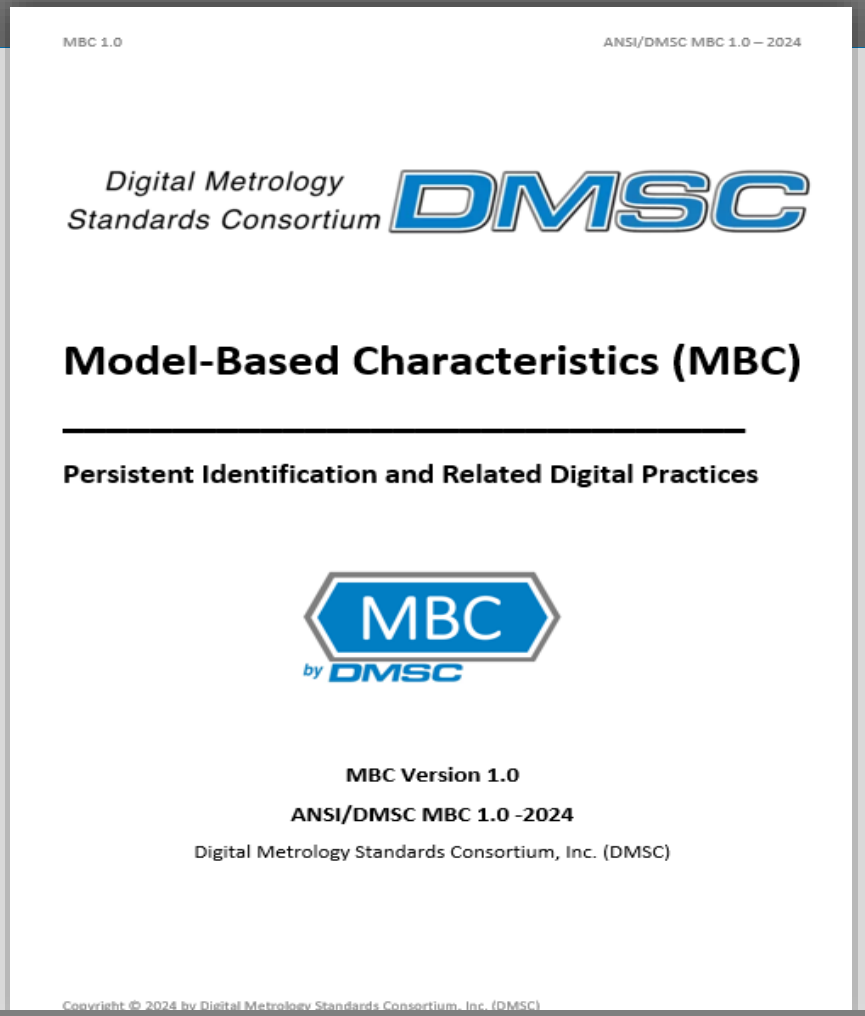
Specify basic or highly detailed information about available measurement equipment (e.g., CMMs, probes, calipers, gages). As always, this data is contextual and semantic.

Rule templates for creating measurement rule instances. (e.g., *If a Surface Profile tolerance value is less than **x**, then use a CMM method with at least **y** number of point/sq.in.)*

BSR/DMSC Model-Based Characteristics v1.0

New ANSI. Standard:

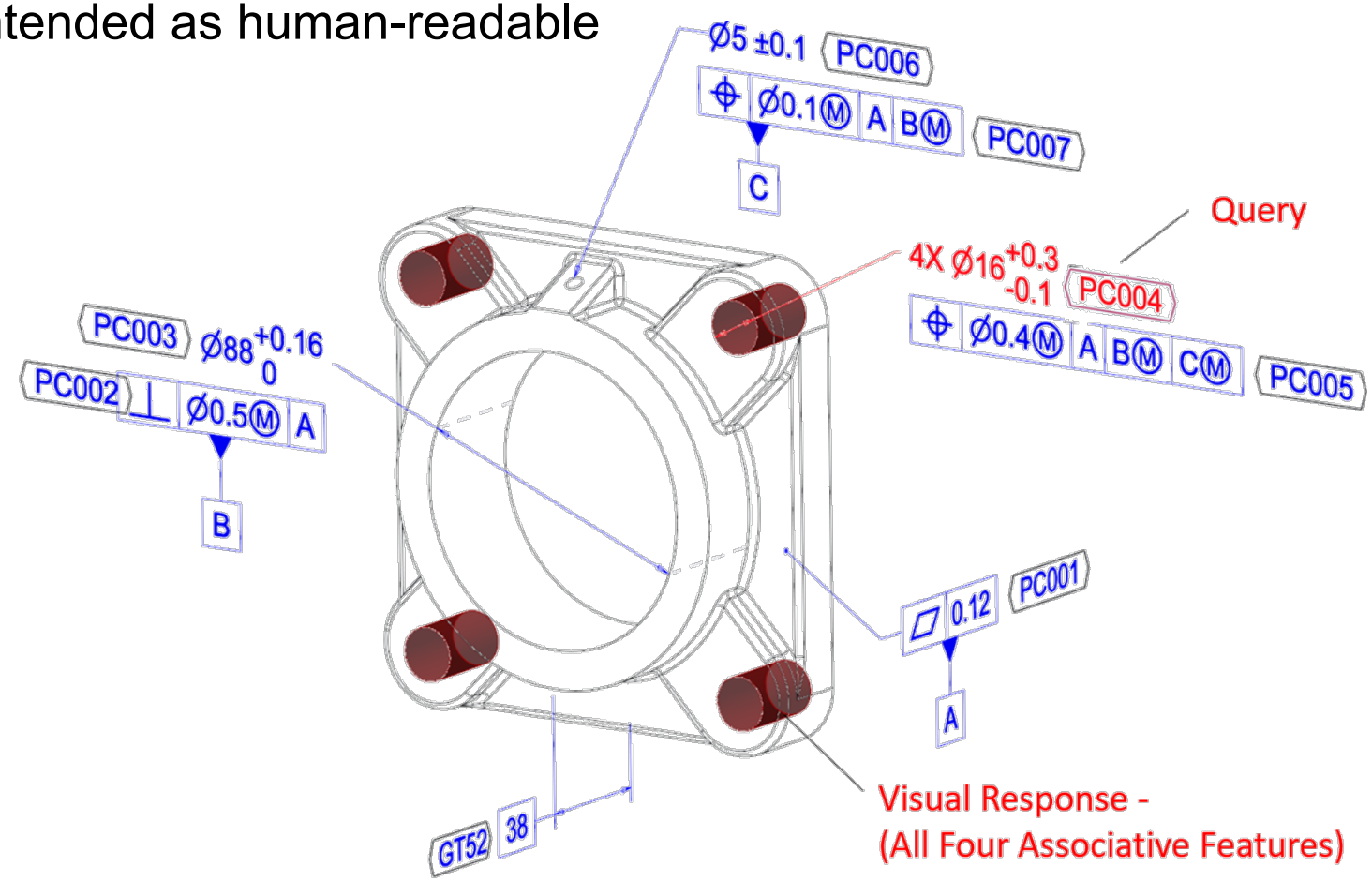
- **defines** common nomenclature, definitions, symbols, data structures
- **practices** for identifying, communicating, and exchanging model-based characteristics with various optional augmentations
- **behaviors** within a model-based system
- **through** both a logical data model and supporting documentation.



Enables connection points that establishes a **digital thread** at the PC definition level

Product Characteristic (PC) Tag w/Annotation

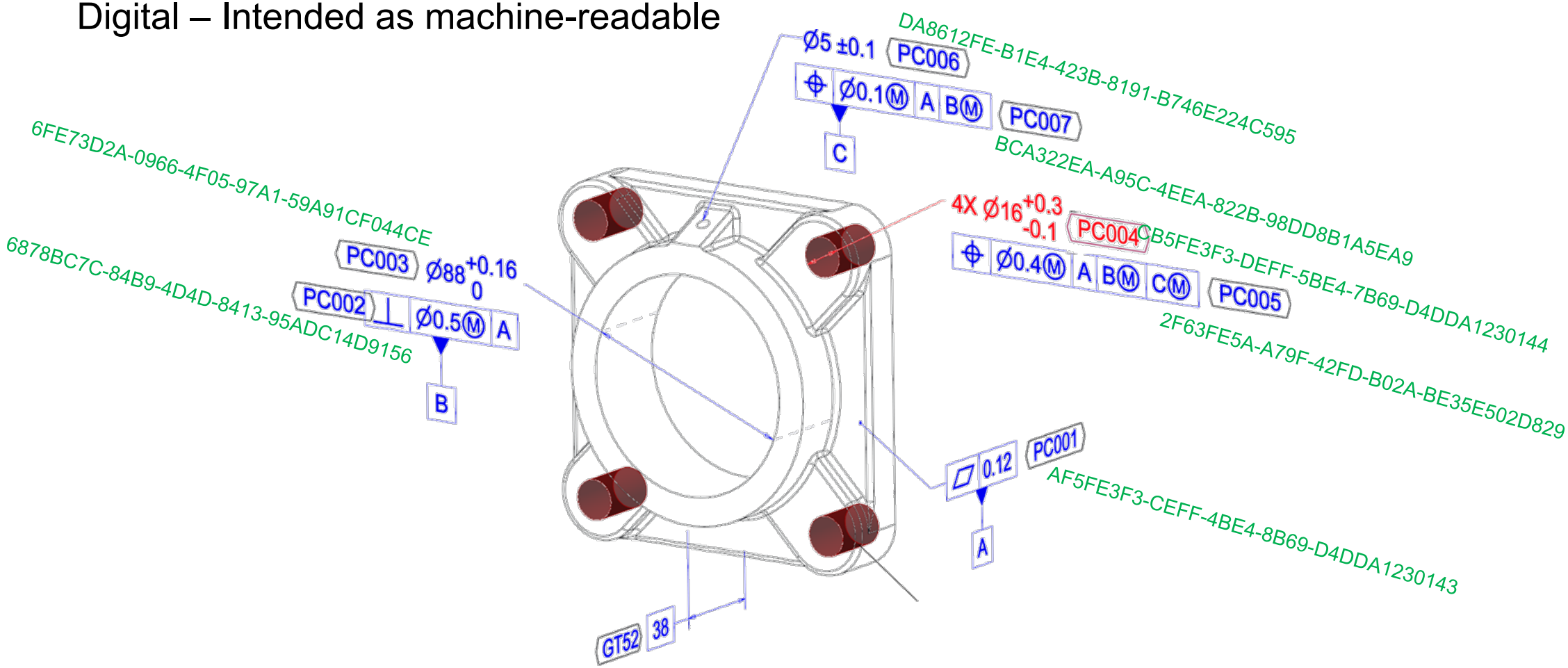
Electronic – Intended as human-readable



Visualization of a Product Characteristic Reference Tags on at Model-Based Definition

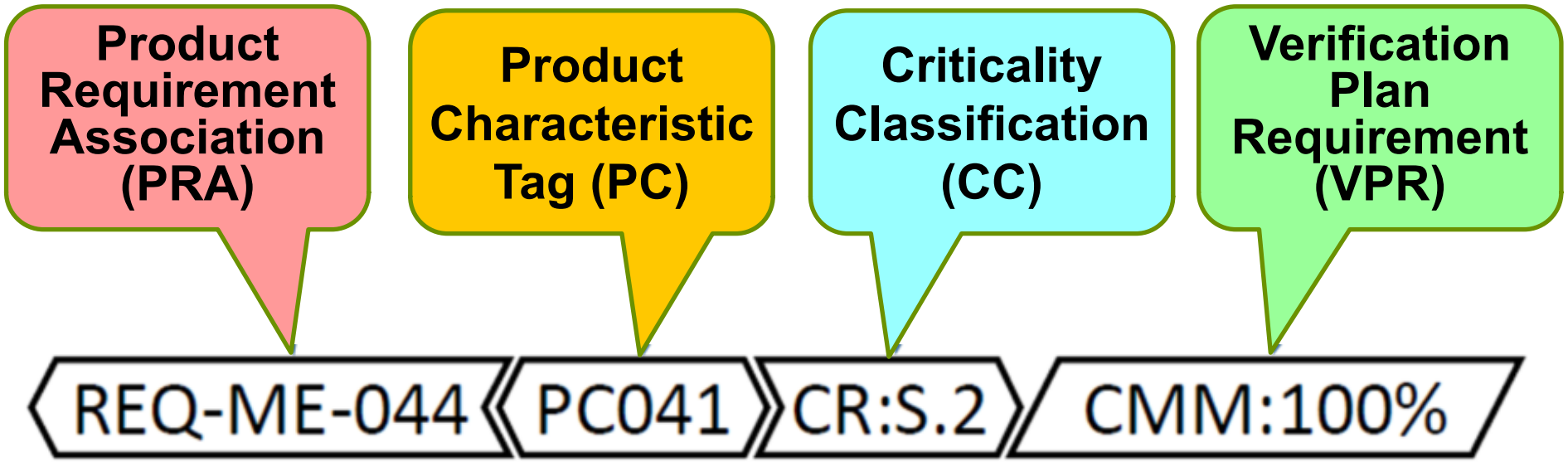
Product Characteristic (PC) UUID Attributes

Digital – Intended as machine-readable



Representation of Product Characteristic Reference Tags & UUIDs within a Model-Based Definition

Product Characteristics Designations with all optional Augmentations Example



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Primer Presented at PTC 2024 Global Summit, Jan. 2024
Presenting Primer at QIF Summit, Apr. 2024 @ MxD

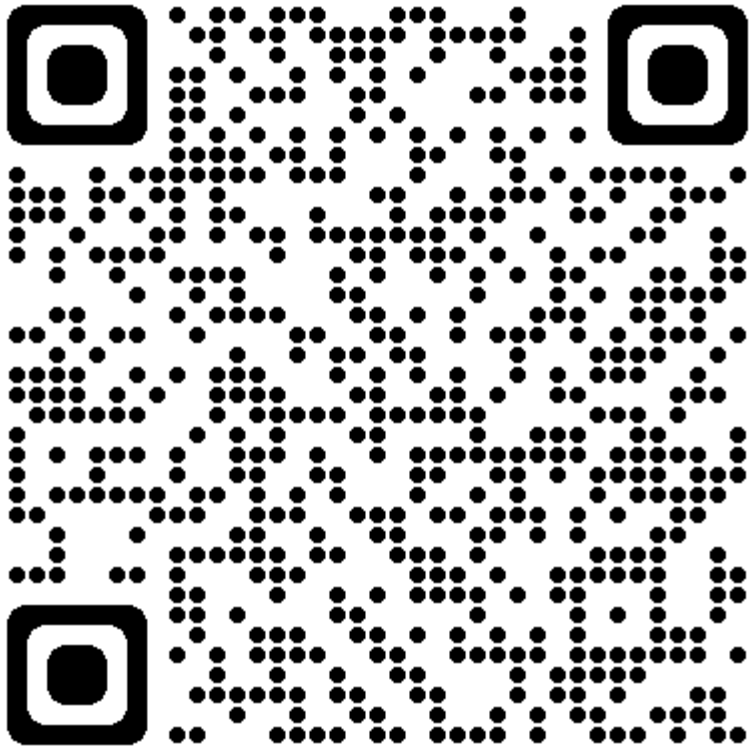
Example: PC Reference Tag with Every Augmentations

- Who is the DMSC?
  - A professional **group** of manufacturing **metrologists**, **software** engineers, and **digital** innovators worldwide.
- What is the DMSC currently doing?
  - Defining & maintaining quality **information exchange standards** like:
    - Dimensional Measuring Interface Standard (DMIS),
    - Quality Information Framework,
    - Model-Based Characteristics
  - QIF Training and Certification
  - QIF 4.0 Enhancements
  - Roadmap Planning
- How will DMSC membership benefit your company?
  - Next Slide
- How do I join the DMSC?
  - Final Slide

Benefits of DMSC Membership

- **Participate** in the development of new / enhancing standards through DMSC's active Working Groups
- **Have a direct influence** on the direction and development of the worldwide QIF (and ISO) standard
- **Have access to Subject Matter Experts** (SMEs) already doing QIF production implementations
- **Share Best Practices** through educational Webinars, Technical Workshops and Round Tables
- **Engage major OEMs** that have adopted QIF as part of their Model-Based-Enterprise (MBE) Strategy
- **Solve mutual metrology industry issues** through collaboration with other DMSC members
- **Build relationships** with key vendors that have proven technology products and services
- **Advance national and international standards** for product quality data exchange
- **Gain an understanding** of how QIF relates to other accepted standards (e.g., STEP, MTConnect)
- **Establish yourself and your company** as an industry thought leader
- **Promotional opportunities** (no-cost webinars for Solution Providers) to reach scores of potential new customer
- **Early access** to innovative specifications and thinking.

Join the DMSC



www.dmsc-inc.org