

# ISO 23952 QIF – Enabling DX through standardization of manufacturing, test, and inspection data created both internally and by our supply chain

**Presenter:**  
Ray Admire



## Abstract:

Overview of the QIF ANSI/ISO Standard, demonstrating a digital thread that links engineering, manufacturing, test, and inspection data, enabling organizations to easily share and link MBD and Engineering requirements between different departments and organizations, both internal and external (both supply chain and customers). These artifacts will be key to the enabling of our other DX projects, including the as-built digital twin and statistically driven decision making.

# Ray Admire - Bio

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- Ray has worked for Lockheed Martin and its predecessor companies since 1985. Ray is a Quality practitioner serving program quality and supplier quality technical lead at various capacities. Ray is a Coordinate measurement specialist with over thirty-five years combined experience in the quality organization.
- Ray has GD&T Level-4 and Lean Six Sigma Green Belt Certifications. Ray served as the treasurer of the DMSC (Digital Metrology Standards Consortium), has served as representative for Lockheed Martin on several other standardization activities since 2000 (I++, DMIS, QIF & MBC) and is the Chairman of the Quality Standards Committee which oversees progression to ANSI and ISO for all DMSC standards. Ray has also led two global collaborative groups for Lockheed Martin Missiles and Fire Control, CAV/DISCUS-FAI and the CMM Programming teams.
- He serves on the board for the Lockheed Martin Management Association and chaired the Quality Mission Success Golf Tournament for 8 years that brought in over \$40,000 for local charities.
- Ray enjoys golfing, traveling drinking wine, fine cigars and spending time with his family.



# What is Digital Transformation

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- Digital transformation (DX) is the adoption of digital technology by an organization. Common goals for its implementation are to improve efficiency, value or innovation. (Wikipedia)
  - Digital transformation entails considering how products, processes and organizations can be changed through the use of new, digital technologies.
    - MBD
    - Manufacturing Processes
    - Inspection Plans
    - Measurement results
    - Test Plans
    - Test Results

**Any or all requirements can be defined in QIF and Results can be carried within QIF**

# Moneyball



- Anyone know and understand American Baseball?
  - Baseball is a very statistical and strategic sport.
- Oakland Athletics was one of the biggest underestimated teams in 2002.
  - Ownership was unable to fund the GM enough money to be competitive.
  - During a scouting visit to the Cleveland Indians, Billy Beane (GM of the Oakland Athletics) met Peter Brand.
    - A young Yale economics graduate with radical ideas about how to assess player value.
    - Peter didn't know anything about the game of baseball but he knew economics and statistics.
  - Oakland Athletics won the 2002 division title for 18% what it cost NY Yankees to win the same amount of games. Talk about being affordable.
  - Boston Red Sox owner said “Anybody who's not building a team right and rebuilding it using that model, are dinosaurs.”
- [https://youtu.be/FMA\\_UKX0IZU](https://youtu.be/FMA_UKX0IZU)

**What was the key ingredient to the success of “Moneyball” concept?**



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# INFORMATION

Which Provides?



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# Knowledge

Which Provides?



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# Power

To Make Valuable Decisions

# 37 Years with No Consistency



- **Technology has progressed**
  - Migrated from Manual Single Axis Measurements
  - Create Part Program rapidly
  - Measure components with speed and accuracy
  - Automation is affordable
  - Provide Data very quickly
- **What's Missing?**
  - Interoperability
  - Measurement Plans
    - Software is Proprietary Specific
  - Data is not in a format that allows transfer into corporate database for system analysis





# Current Process

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- What does the current data from suppliers look like?
- How valuable is that data?
- What type of decisions can you make from this data?
- How can this information help you with your products?
- Here are some actual documentation provided from suppliers.

# Current Process



<p>Disposition details.</p> <p>A fit check has shown that the as-built T-seal will function as designed. Test deviations are for properties which are irrelevant to this particular application. Corrective action is acceptable. Accept parts and continue processing.</p>				
<p>Repair Order</p> <p>Repair Order Nr</p>		<p>Classification</p> <p>Criterion</p>	<p>Identify part with report no.</p> <p>Further work</p>	
<p>Design</p> <p>13/05</p>	<p>Quality Control</p> <p>Smith</p>	<p>Other dept</p>	<p>Customer</p> <p>Yellow</p>	<p>Off. Author</p> <p>Tob</p>

# Current Process



OP 作業 Operation	工作中心 Workstation	控制碼 Ctrl.co	作業短文 Operation Description	作業數 PC	加工數 Act. PC	加工日 時間Start Time	完工日 時間Finish Time	操作者 Operator	放行者 Supervisor	備註 Note
0010		ZP01	ZLM504686-2 元件製做/領料 (RP)	5	5	4/1 09:00	4/1 09:00	宋達宏	王鎮國	
0020	打光機	ZP01	ZLM504686-2 組裝.打印 (MA)	5	5	4/27 08:30	4/27 12:00	王鎮國	王鎮國	
0030		ZP65	ZLM504686-2 FQC	5	5	2011.4.29	2011.4.29	CFQC 025	CFQA 008	
0040		ZP99	ZLM504686-2 入庫 (WA)	5	5	2011.5.4				

# Current Process



5. Char. No.	6. Reference Location	7. Characteristic Designator	8. Requirements	9. Results	10. Designated Tooling	11. Non-Conformance Number	14. Comments
1.0	1-H8		MATERIAL SHALL BE Ti-6AL-4V INVESTMENT CASTING IAW AMS-T-81915, TYPE III, COMPOSITION A, ANNEALED OR IAW AMS4991, ANNEALED. ANNEAL SHALL BE IAW AMS-T-81915 OR IAW AMS4991. EXCEPTION TO AMS-T-81916 AND AMS4991	HEAT TREATED TO A TEMP. OF 1525-1575F.		200193035	HEAT TREAT: AMS 4991 PARAGRAPH 3.5.2 SPECIFIES RANGE OF 1300-1550 F. ACCEPTED ON WAIVER 2/10/193035.

Very little can be learned from current information.

ITEM	PARAM	TEST RESULT	REMARKS
1	CARBON STEEL PLATE	1.50	(CERTIFICATION ENCLOSED)
2	2.00	2.025	
3	14.4.0 ± .06	14.335	
4	18.00	18.008	
5	1.00 ± .25	1.175	
6	14.33 ± .06	14.365	
7			

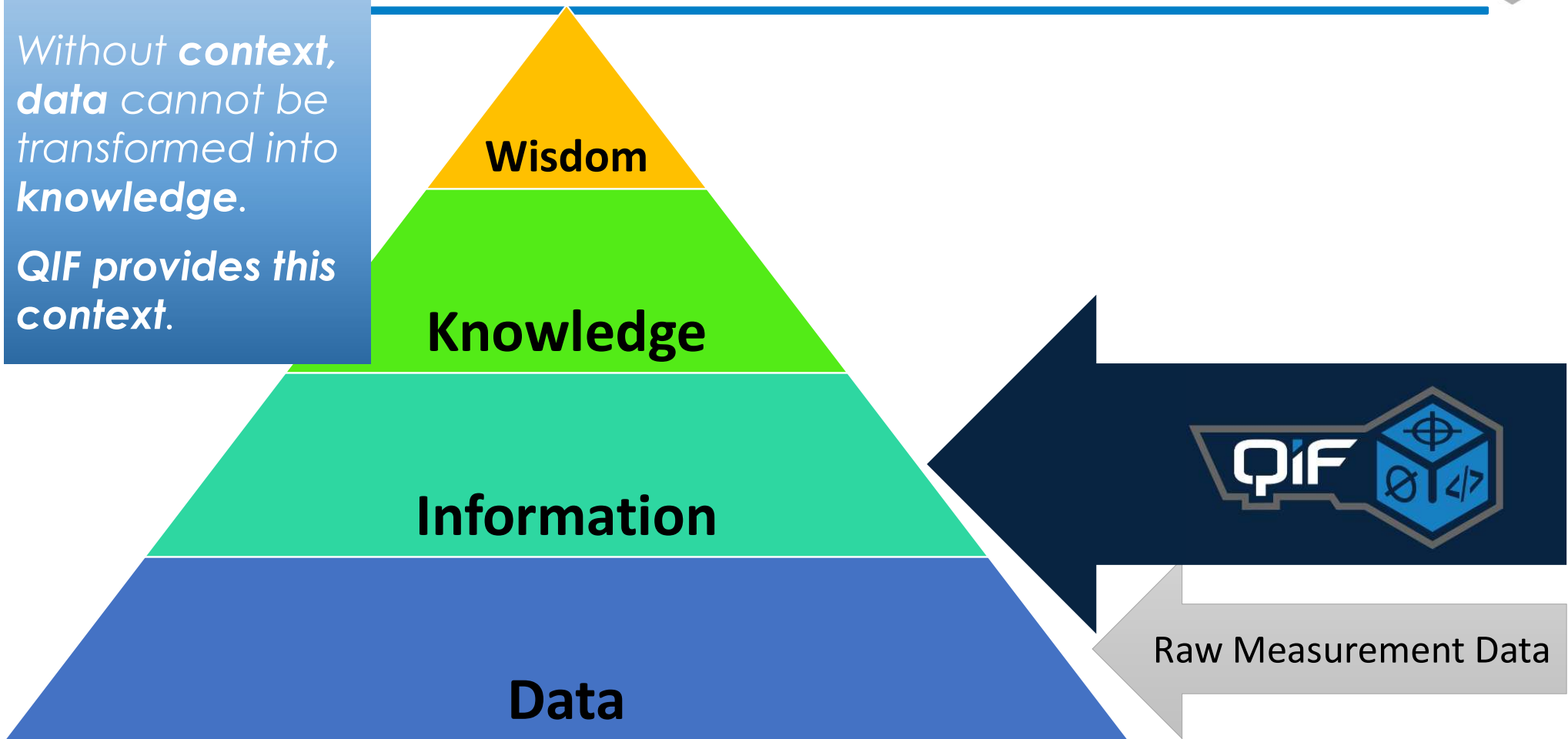
ED —  
4th PART

# DIKW Pyramid & QIF



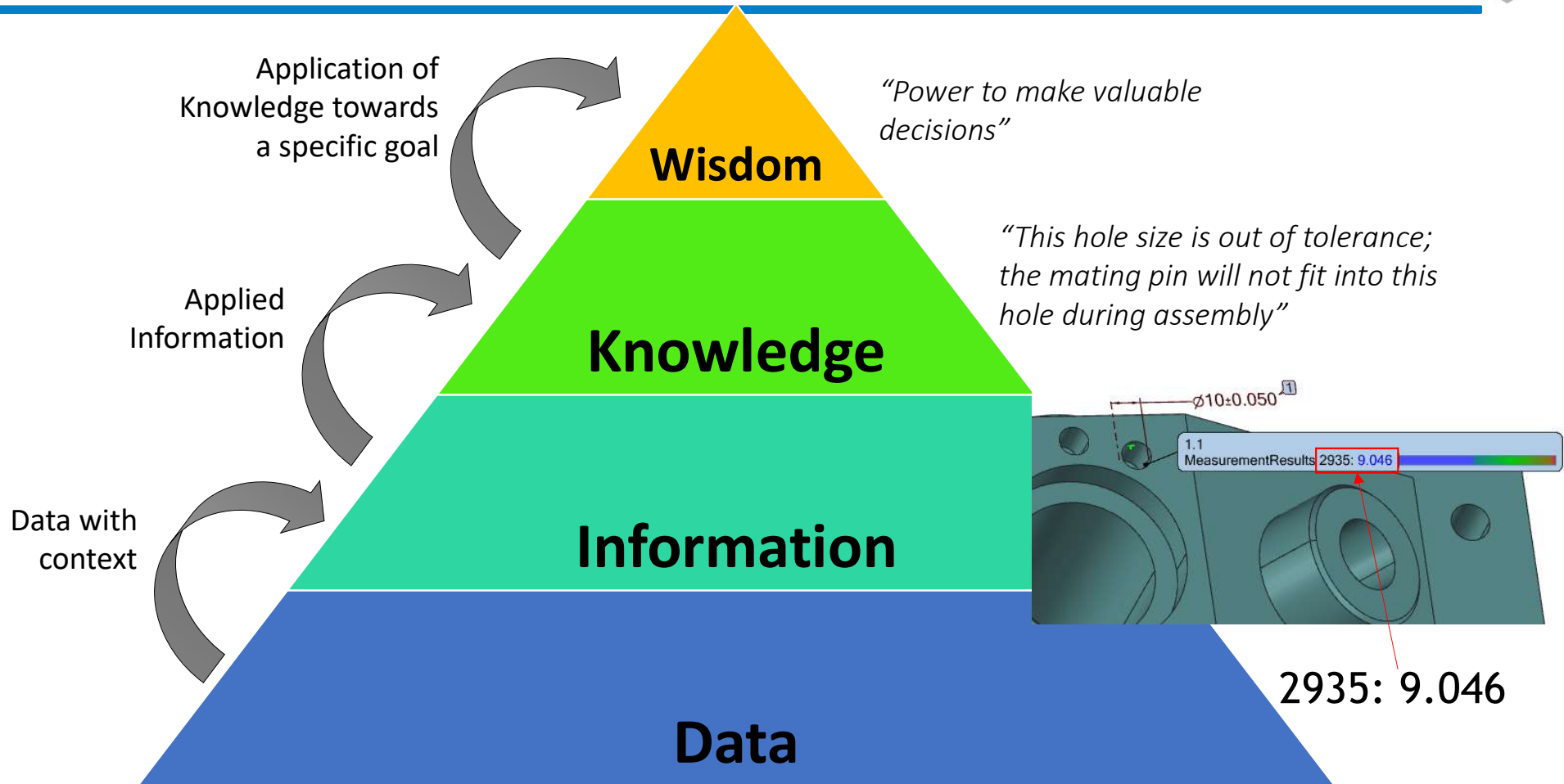
*Without context, data cannot be transformed into knowledge.*

*QIF provides this context.*



Raw Measurement Data

# DIKW Pyramid & QIF



# WHY QIF

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- **Mature** ANSI Standard (v3.0) and ISO (2020)
- Solution providers that have **Implemented** QIF
- Realized from Software Scientists and Metrology Experts
- Reflects the **state-of-the-art**
  - Model-Based Definition
  - Feature-Based Tolerancing
  - Characteristic-Centered
  - Quality Planning with Bill of Characteristics (BoC)
  - Robust Measurement Results with Persistent IDs
  - Modern Software Development Techniques
- 500+ Years of **Experience** in Metrology, GD&T, Software Development
- **Value-Added** proposition to Manufacturing and Design
- Energizing the **digital/dimensional metrology** development community

Curtis W. Brown, 2016

# QIF Enables a Quality Digital Thread



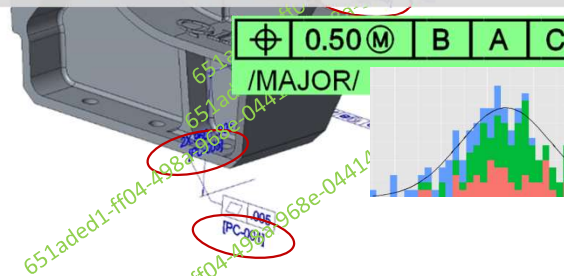


# Model-Based Product Characteristics



## Persistent Product Characteristic Designators w/ Criticalities

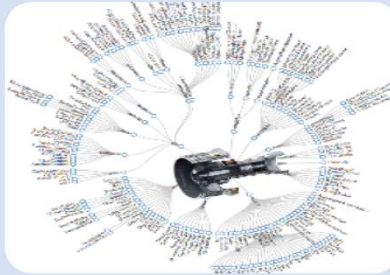
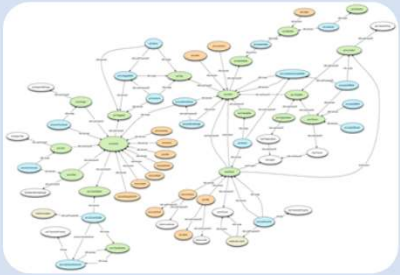
**Model-Based Product Characteristics (MBPC):** the use of a Model-Based Definition with *persistent product characteristics designations*.



**QIF allows** Persistent Model-Based Product Characteristics:  
**Enables** Measurement Results to be Traceable Back to the Model



# What is the QIF?



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, GUID)

Approved ANSI  
Digital  
Interoperability  
Standard

ISO Harvesting  
via A-Liaison?

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

Digital Metrology  
Standards Consortium **DMSC**



## QIF Benefits for OEM and Suppliers

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QIF offers the following benefits:

- Innovation (New Non-Proprietary Standard)
- Traceability (UUID)
- Better control of supply chain
  - Possible to now monitor suppliers in real time
- Smooth flow of information to/from supply chain
- Increase overall quality of the processes
- Minimize costs
- Elimination of human errors
- Eliminate information loss due to translations
- Creates Agility in Engineering processes and test plans
- Quality data can help make your products more affordable.

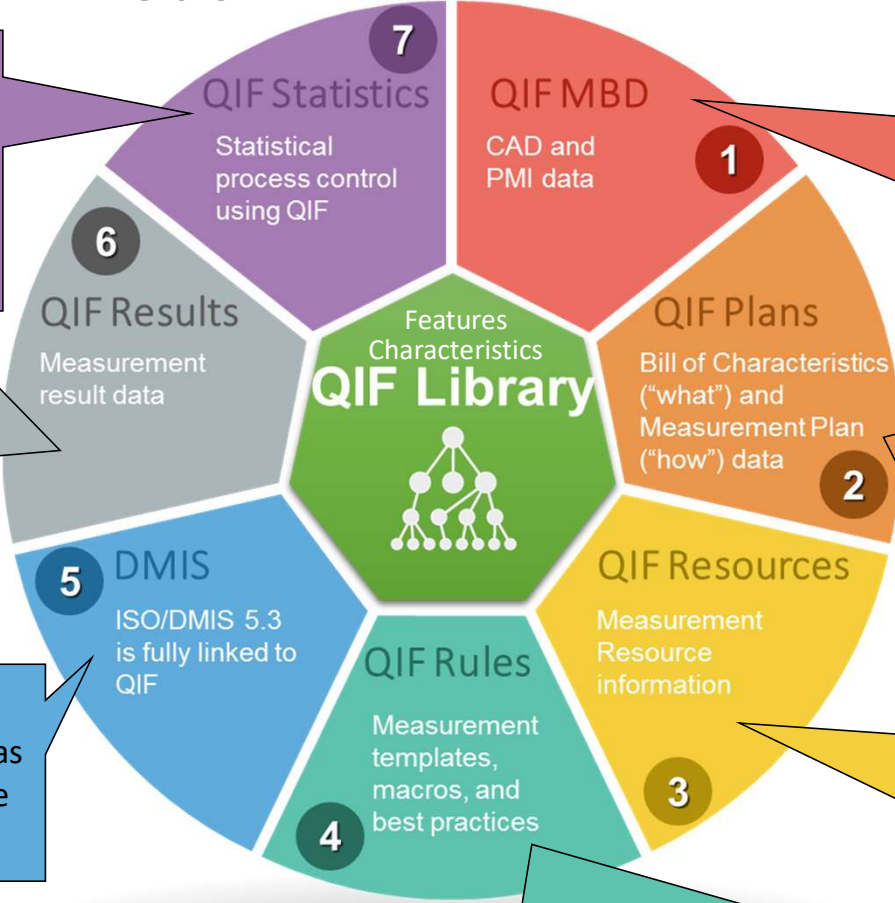
# QIF Application Areas



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

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.

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



QIF MBD is the base 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.

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

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

Create measurement rule templates. (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.*)

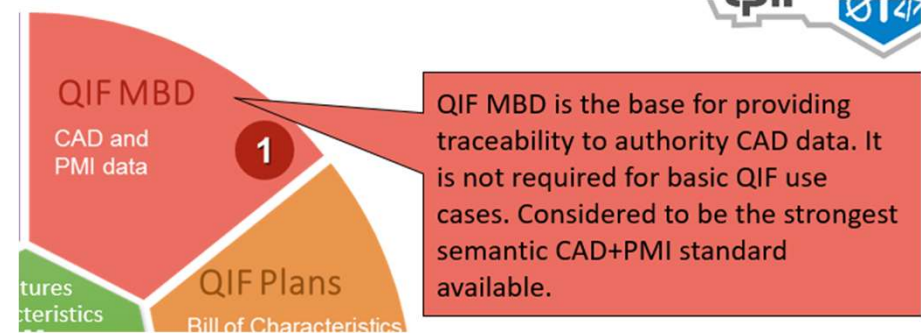


# What about performance Specs and SOR's

When we think of MBD we think of the engineering drawing.

What if we digitized?:

- Performance Specs
- Statement of Requirements (SOR)
- Test ATP Requirements



# QIF Definition

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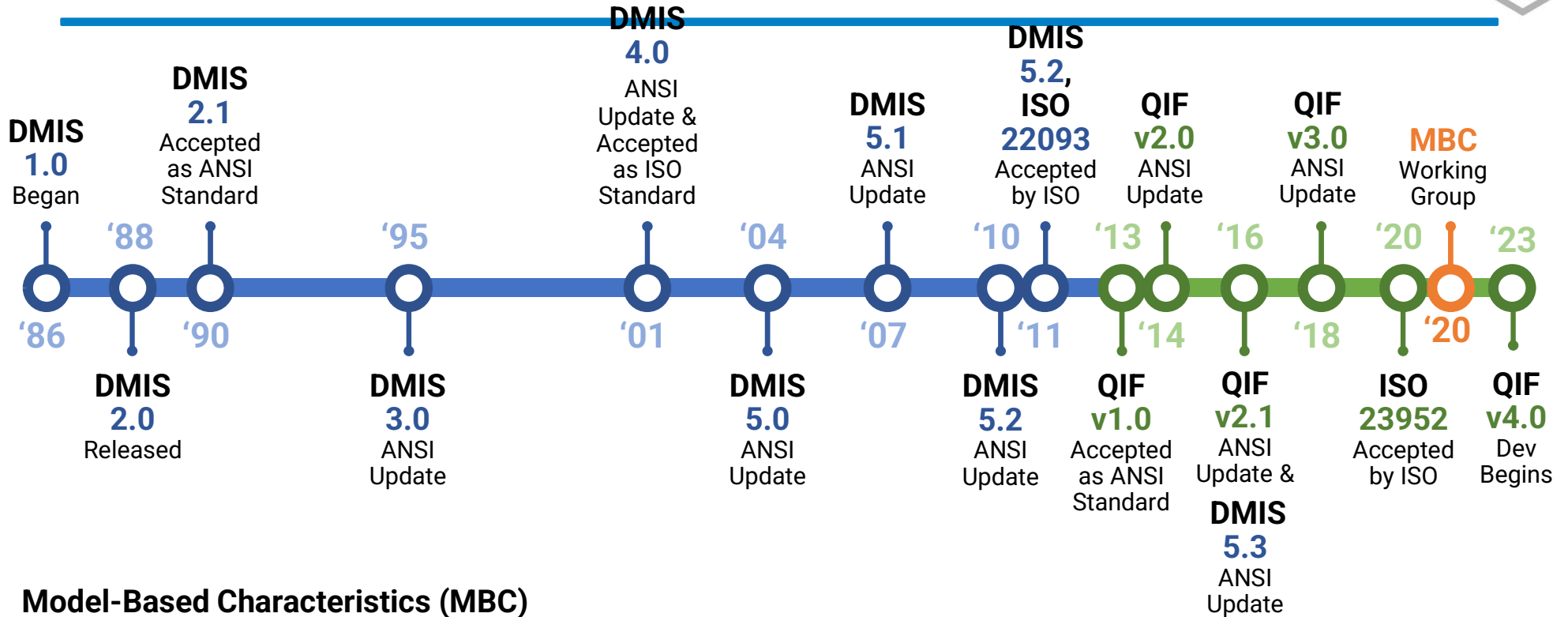


The **Quality Information Framework (QIF)** is a unified XML framework standard for computer-aided quality QIF systems, available free to all implementers.

QIF enables the capture, use, and re-use of metrology-related information throughout the Product Lifecycle Management (PLM) and Product Data Management (PDM) domains.



# DMSC's Quality Standards Pedigree



**Model-Based Characteristics (MBC)**

**Quality Information Framework (QIF)**

**Dimensional Measuring Interface Standard (DMIS)**

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

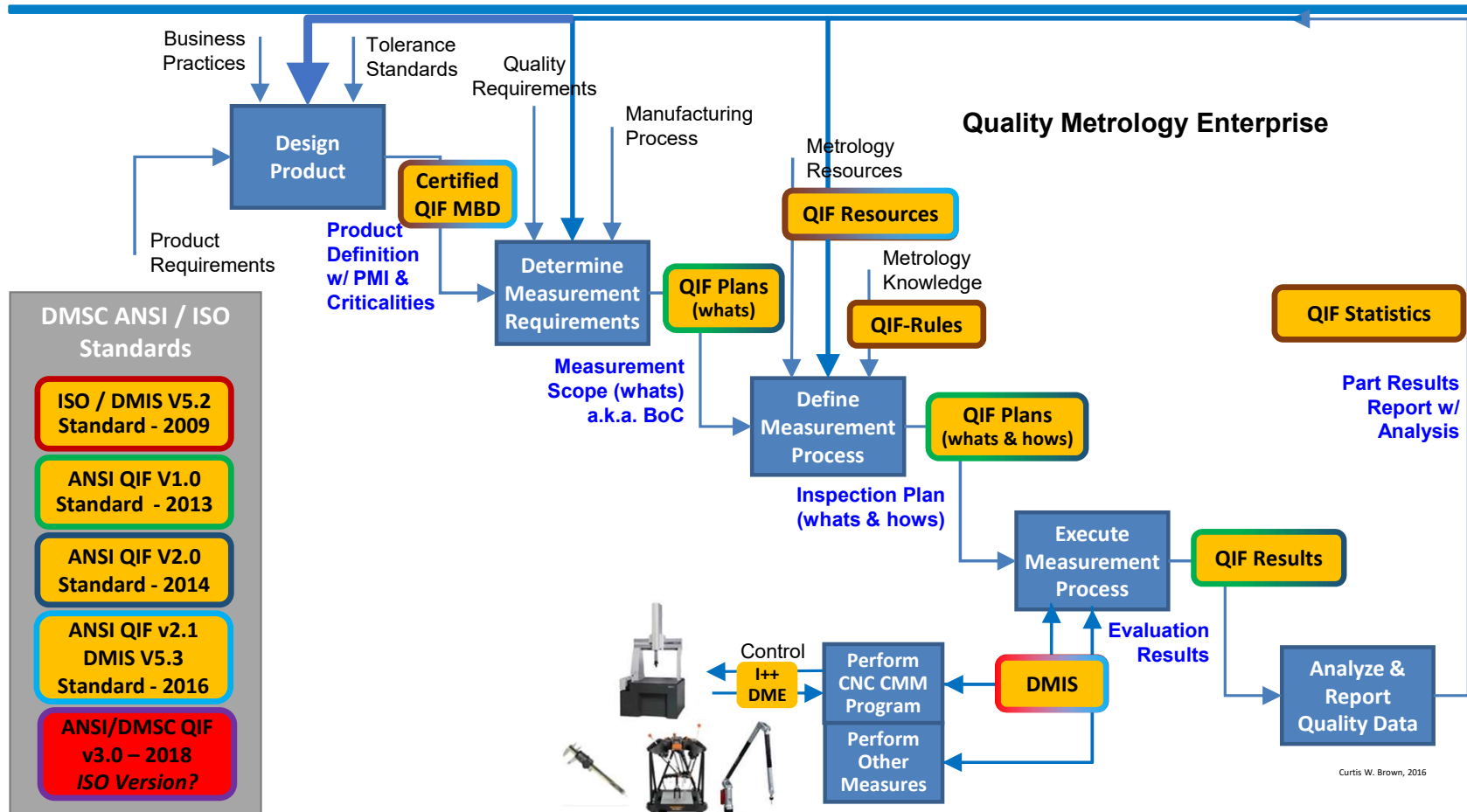
**Slide 23**

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**RS1**      Should add MBC working group to the time line.  
Ray Stahl, 6/9/2023



# Quality Information Activity Workflow





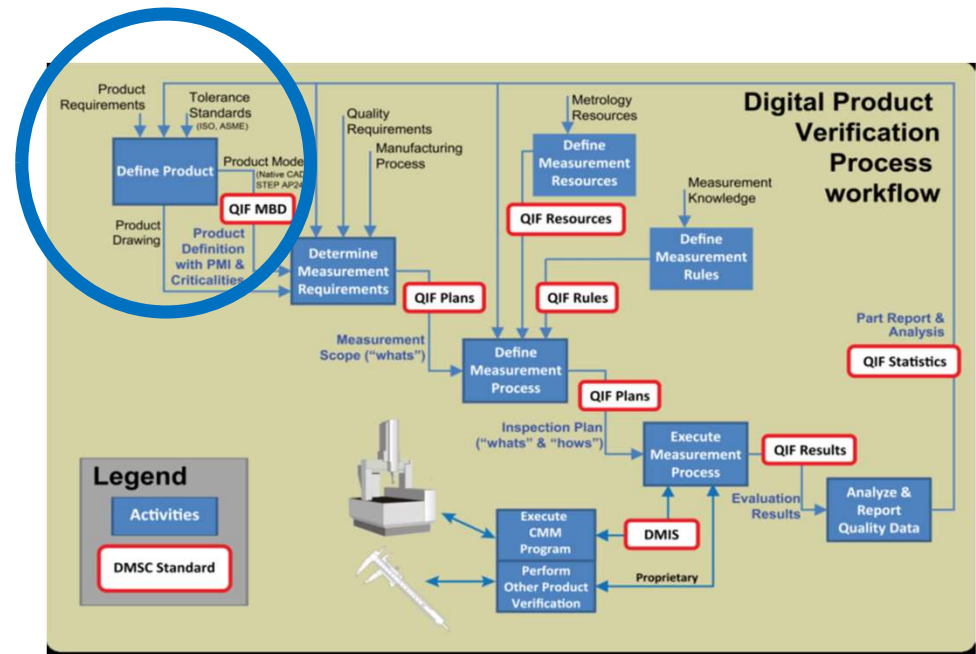
# Why good engineering data is key

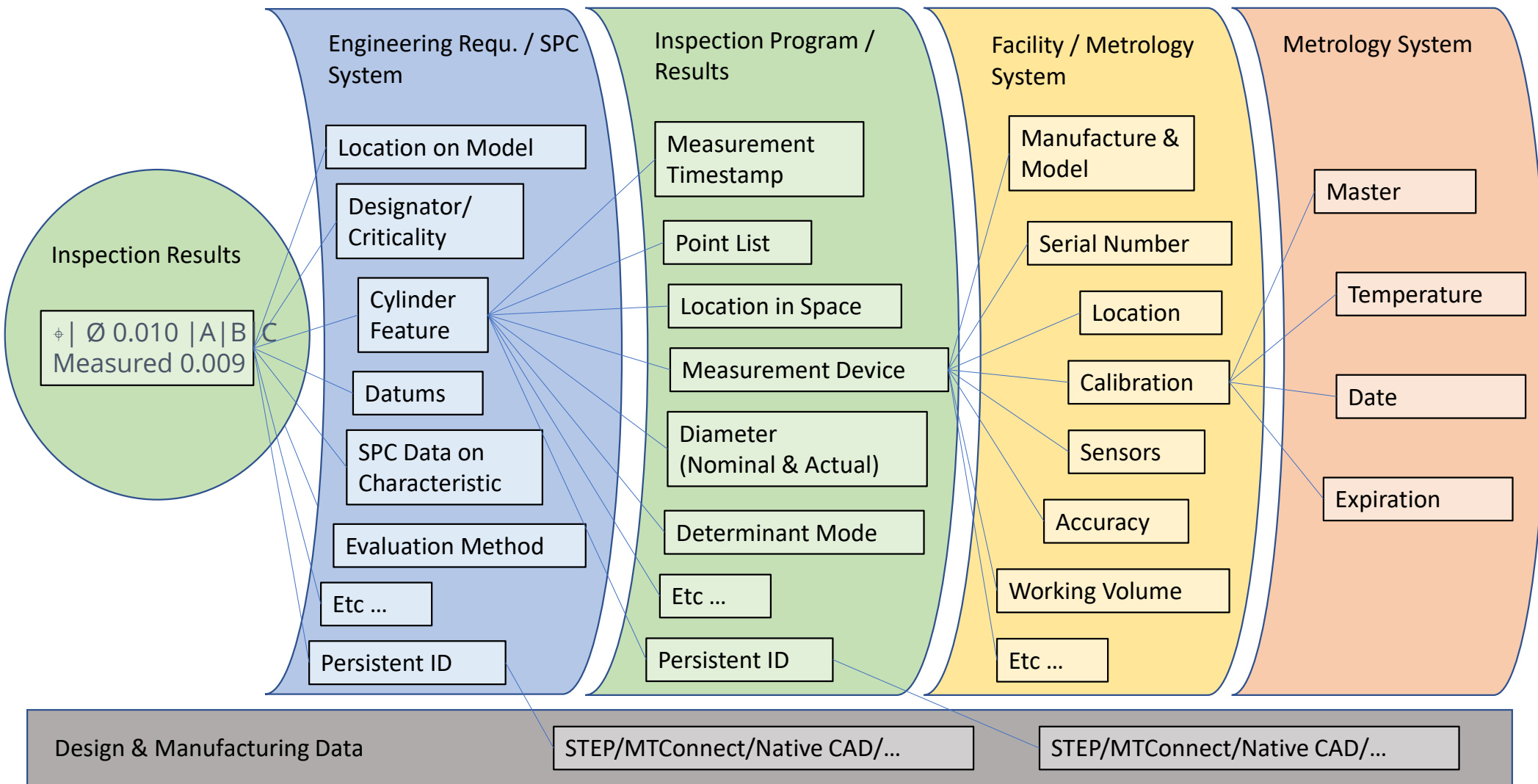
Almost all information in the workflow builds off of the product definition.

Engineering data that is clean and semantic is essential for the rest of the work flow to work.

Through the use of persistent IDs this will also allow for the linking of Quality data back to design and manufacturing data.

This is the first bridge we need to cross.





# Digital Threads

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Threads can be quickly navigated to pull in additional relevant data.

- In what direction was the feature off?
- What was our inspection strategy?
- What tool was used? Did it pass calibration?

Allows for bigger questions, data can be queried.

- What are all the features and parts that this tool was used to inspect?
- Have any tools been used outside their calibration window?
- What is the most common measurement strategy we use for this type of feature?

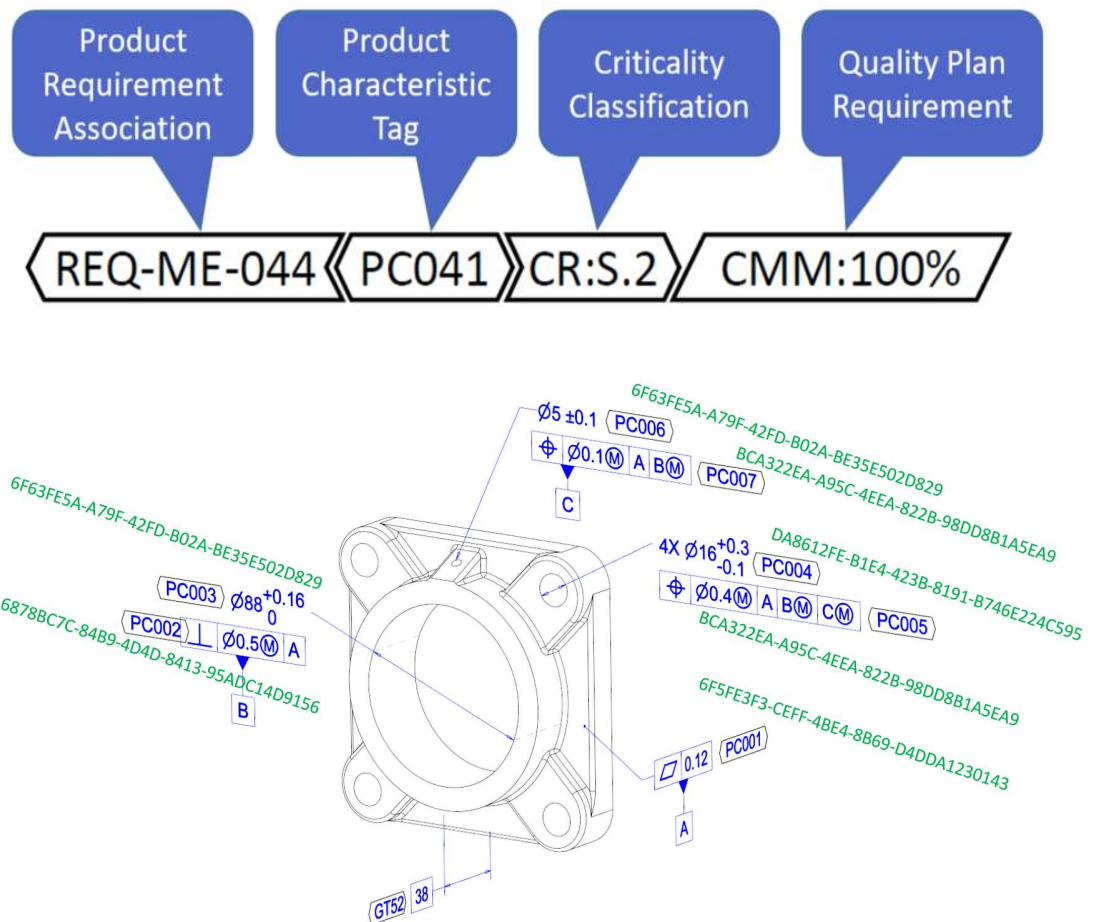
Threads can be tied together, persistent IDs can be used to tie in Quality data with data from design and manufacturing.

- What tool was used to fabricate the feature? What other features did this tool fabricate? Is it trending?
- Was the feature revised? Does the revision correlate to a change in producibility?

Enables machine learning / AI due to data being machine consumable.

# Model-Based Characteristics

- Nomenclature,
- Definitions,
- Designations,
- Symbols,
- Data Structures, and
- Practices for Product Definition
- Augmentations
- Includes Model-Based Definition with Persistent Identification



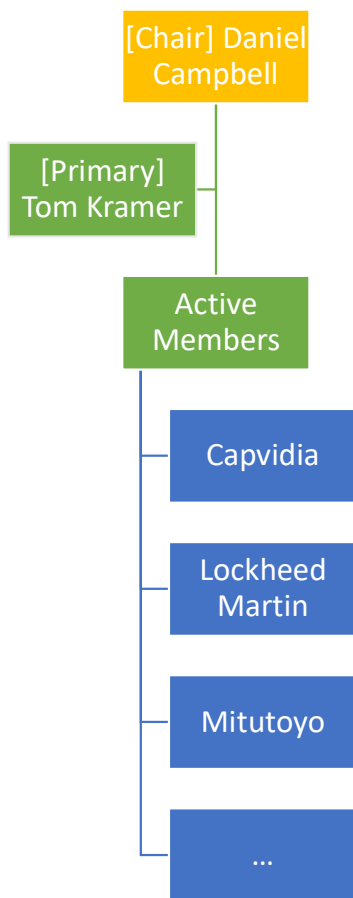
## Slide 28

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**RS3** This slide should provide context on why the DMSC is creating this standard and not just what the standard is addressing.

Ray Stahl, 6/9/2023

# QIF 4.0 Development



Status	Item	QIF Information Model Area Implemented in
Done	Improved UUID usage through references	All
Done	The term QPId is being retired	All
Done	Increased unit usability and quantity, includes SI units	All
Done	Improved assignment capability for identifying a standard at the characteristic level	Instance File
Pending MBPC Release	Updates based on Model-Based Characteristics (MBC) Standard	All
In-Progress	Improve constraint handling with XSLT	QIF Library
In-Progress	Improvements on existing content	QIF Plan
In-Progress	Adding optical digitizer measurement devices	QIF Resources

# QIF Matrix



Organization	MBD	Plan	Resources	Rules	Results	Statistics	QIF-Rev
3DCS	R	R/W	N/A	N/A	W	W	3.0
Applied Automation Technologies, Inc.	R W 3QTR2023	R W 3QTR2023	R W 3QTR2023	R W 4QTR2023	R W 3QTR2023	R W 2QTR2024	3.0
Belcan	W	W	N/A	N/A	R	N/A	3.0
Capvidia	R/W	R/W	R/W	R/W	R/W	R/W	2.1; 3.0
DISCUS Software Company	R Q42023	RW Q42023	R Q42023	R Q42023	RW Q42023	R Q42023	3.0
Elysium Inc.	R/W	N/A	N/A	N/A	N/A	N/A	2.0, 2.1, 3.0
Hexagon	R (W 2023 3QTR)	N/A	N/A	N/A	W 2023 3QTR	N/A	3.0
High QA Inc.	R	W	R	R	R/W	R/W	2.1, 3.0
InnovMetric Software Inc.	R (W 2023 4QTR)	N/A	N/A	N/A	TPD	N/A	2.0, 2.1, 3.0
ITI Global	R	N/A	N/A	N/A	N/A	N/A	3.0
LK Metrology, Inc.	2QTR2023	N/A	N/A	1QTR2024	3QTR2023	N/A	3.0
Metrologic Group Services Inc.	R	2023 1QTR	2023 4QTR	2023 4QTR	W (R 2023 1QTR)	2023 2QTR	3.0
Mitutoyo America Corporation	R	R/W	N/A	N/A	R/W	W	2.1, 3.0
Origin International Incorporated	R	RW	N/A	N/A	R/W	N/A	2.0, 2.1, 3.0
Renishaw Inc.	N/A	N/A	R/W	N/A	R/W	N/A	3.0
Thomas Kramer Consulting, LLC	R	R	R	R	R/W	R	3.0
ZEISS Industrial Quality Solutions	R	N/A	N/A	N/A	R/W	N/A	3.0



# My Prediction

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- QIF will allow Metrology systems to automatically create measurement and test plans
- QIF will allow auto-creation of:
  - PPAP (Production Part Approval Process)
  - FAI (A9102 – First Article Inspection)
  - Failure Mode and Effects Analysis (FMEA)
- QIF will provide the “Moneyball” type data for manufacturing/quality systems that gives the knowledge to make breakthrough decisions
  - “Anybody who's not using QIF throughout the supplychain, will be dinosaurs.”
- Everyone is part of the problem or solution