QIF 2.0: Supporting the metrology life cycle

Edward Morse

The Center for Precision Metrology

UNC Charlotte

UNC CHARLOTTE

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Overview

- What is QIF ?
- What is XML ?
- Overview of Resources Structure
- Relevance to Portable Metrology
- Conclusion

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What is QIF?

- An ANSI standard
  - ANSI/QIF 2.0 – 2014
  - DMSC is the Standards Development Organization for QIF

- An information model
  - Describes what information to put where
  - Is both human and machine readable (xml)

- The future
  - Supports interoperability
  - Economic benefits realized through verifiable and accurate transfer of quality information

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Product realization workflow
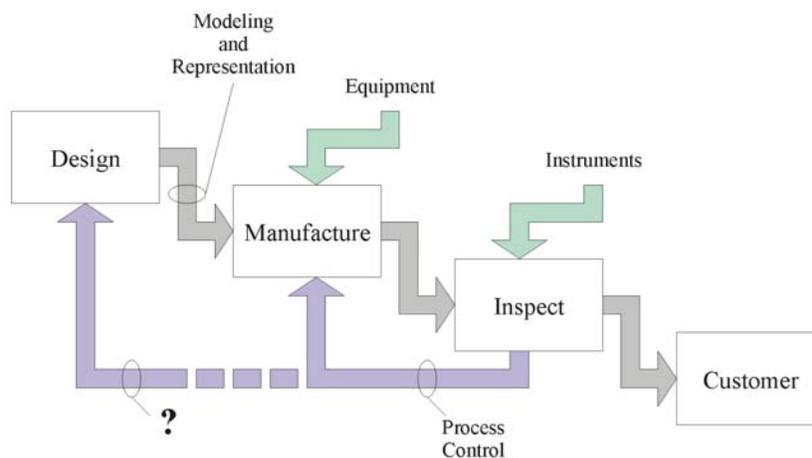
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Data modeling and management

- Design, manufacturing, and measurement generate an enormous amount of data.
- Not all data are recorded, and most recorded data are never reviewed.
- There is power in extracting information from these data, but the data must appear in a predictable way.
- Data modeling organizes data, and also anticipates the form that future unknown data might take.
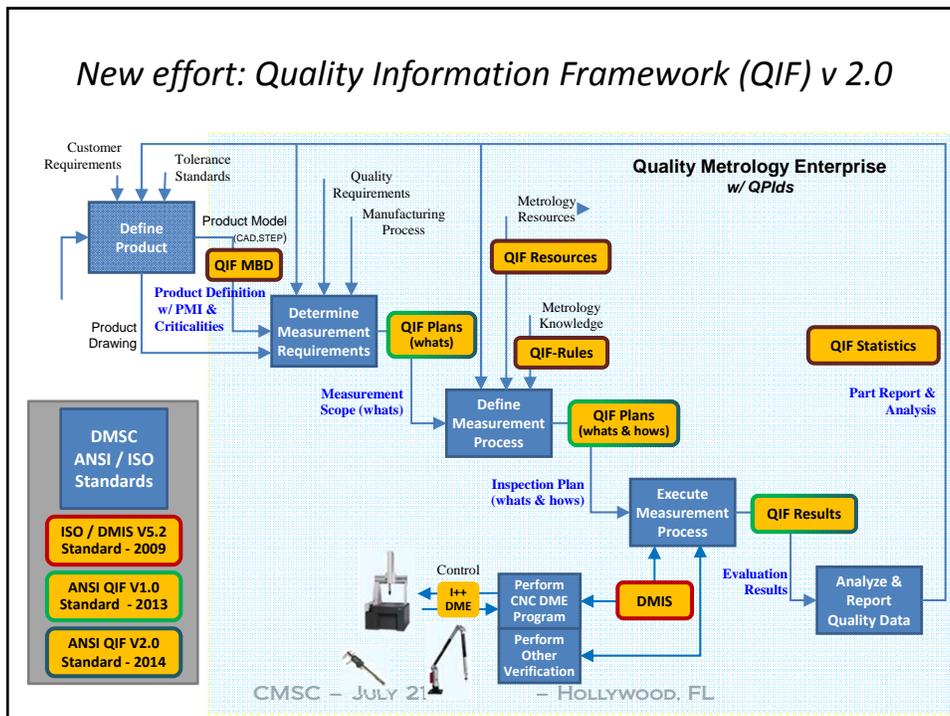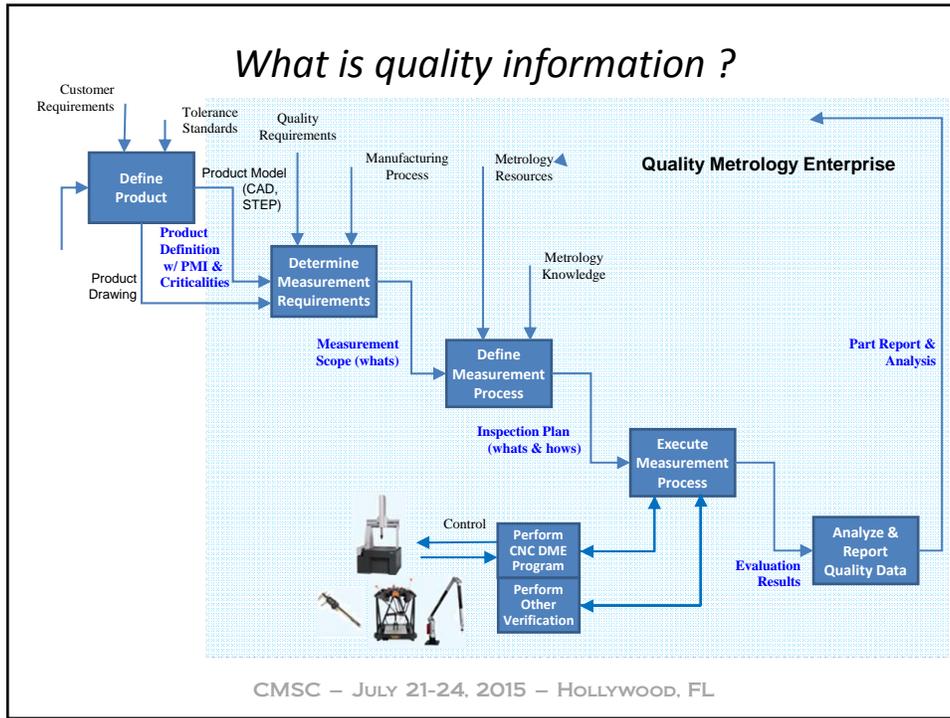
What does QIF do?

- It provides a set of XML schema to standardize the storage and transfer of information related to metrology.
  - XML: extensible markup language
  - Schema: a template

- We're familiar (maybe) with DMIS that describes commands and reporting for CMMs, but QIF will capture much more of the product manufacturing information (PMI) associated with the design, manufacture, and inspection of workpieces.

More information at http://www.qifstandards.org

What is quality information ?

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New effort: Quality Information Framework (QIF) v 2.0

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QIF v2.0 Metrology 'Life Saver' Architecture
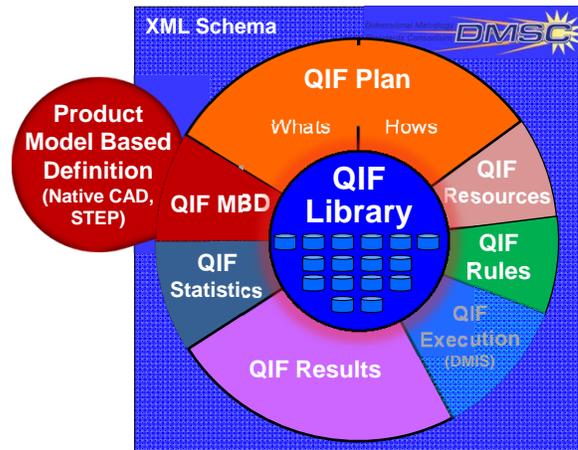
QIF v2.0

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The pieces of QIF

Common QIF Library (In the middle)

These are basic, shared Information Models

QIF Application Information Models (use the QIF Library)
- QIF Document (Parent structure)

- QIF MBD (Product Definition w/Feature-Based PMI)
- QIF Plans
- QIF Resources
- QIF Rules
- QIF Results
- QIF Statistics

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QIF Library

- Common Data Framework assures Interoperability
- XSD Schemas Files for
  - Auxiliary
  - Characteristics (e.g., Tolerances)
  - Expressions
  - Feature Types (Metrology/Measurement)
  - Generic Expressions
  - Geometry
  - IntermediatesPMI
  - Primitives
  - PrimitivesPD
  - PrimitivesPMI
  - Statistics
  - Topology
  - Traceability Information
  - Units
  - Visualization
- Supports all QIF Application Models
- Benefits
  - Avoid Multiple and Conflicting Definitions
  - Reuse of common / shared data elements
  - Eliminate Point-to-Point Harmonization and Mapping with other specs.

QIF Library
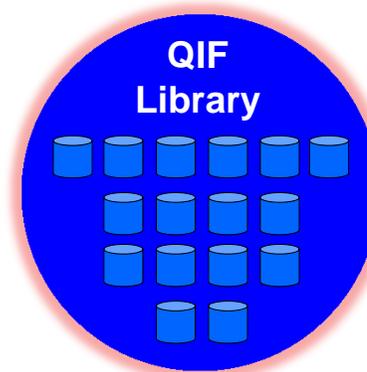
QPIds – A Persistent UUID used within the QIF

QIF Persistent Identifier (QPId)
- Important Mechanism that helps facilitate full lifecycle MBE
- Universally Unique Identifier (UUID) (aka GUID within Microsoft)
  - ISO/IEC 9834-8
  - 550e8400-e29b-41d4-a716-446655440000
  - 3.4×10^{38} possible UUIDs
- Chances of generating two that are the same within the universe are practically nil.
- Many software development libraries generate UUIDs
- Allows information to be combined later without resolving identifier conflicts
- QPIds uniquely identify
  - QIF Plan
  - QIF Result
  - QIF Rule Set
  - Feature Item
  - Characteristic Item
  - Product Item
  - Resource Item

QIF research

- Validation
  - A tool that is claimed to produce files the correspond to QIF should meet certain criteria.

- Test cases
  - Most often, validation is accomplished through a set of (increasingly difficult) test cases.

- Structure for new areas
  - Rules and Resources, for example
    (What is a metrology rule? Is the operator a resource?)

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Measurement resources
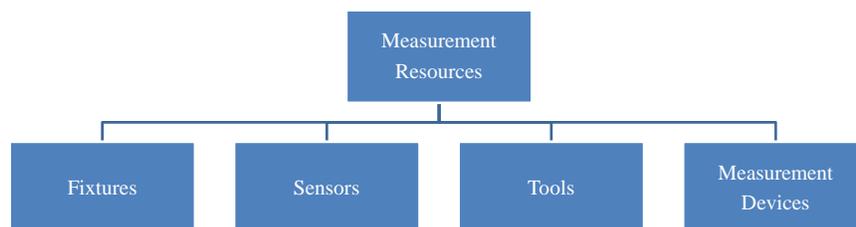
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## How the top level of this hierarchy looks in a schema definition

```
- <xs:complexType name="MeasurementResourcesType">
  - <xs:annotation>
      <xs:documentation> The MeasurementResourcesType defines a set of measurement resources. </xs:documentation>
    </xs:annotation>
  - <xs:sequence>
    - <xs:element type="FixturesType" name="Fixtures" minOccurs="0">
      - <xs:annotation>
          <xs:documentation> The optional Fixtures element is a list of fixtures. </xs:documentation>
        </xs:annotation>
      </xs:element>
    - <xs:element type="MeasurementDevicesType" name="MeasurementDevices" minOccurs="0">
      - <xs:annotation>
          <xs:documentation> The optional MeasurementDevices element is a list of measurement devices. </xs:documentation>
        </xs:annotation>
      </xs:element>
    - <xs:element type="SensorsType" name="Sensors" minOccurs="0">
      - <xs:annotation>
          <xs:documentation> The optional Sensors element is a list of sensors. </xs:documentation>
        </xs:annotation>
      </xs:element>
    - <xs:element type="ToolsType" name="Tools" minOccurs="0">
      - <xs:annotation>
          <xs:documentation> The optional Tools element is a list of tools. </xs:documentation>
        </xs:annotation>
      </xs:element>
    </xs:sequence>
  </xs:complexType>
```

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Example of device hierarchy (an early version)
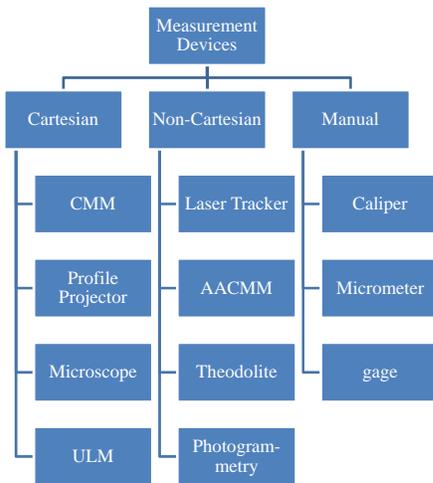
Although we have changed our thinking about classifying coordinate measuring systems, having a hierarchy such as this allows us to better convey how the classification works.

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Properties of measurement devices

- Measuring volume
  - Type (prismatic, spherical, etc.)
  - Choice of L x W x H or an explicit geometric description of the measuring volume.
- Calibration status
  - Verification method
  - Verification results
- Extrinsic requirements
  - Environment
  - Operator training?
- More detailed information
  - Type of controller?

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Measurement Devices

- 2.0 version: Caliper, CMM, 'Comparator'

- Evolving hierarchy of instruments
  - CMMs
    - Cartesian
    - Non-cartesian
    - Portable
    - Frameless (iGPS, Photogrammetry)
  - Hand tools
    - Calipers
    - Micrometers
    - Other Gages

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What about portable devices?

- Captured under CMMs / Portable or CMMs / Non-cartesian

- Open questions
  - Measuring volume vs. access
  - Uncertainty based on sensor type
  - Sampling and filtering
  - Software contribution

Remember, we are not defining the devices, but trying to provide the appropriate data model so that these classes of instruments *can* be defined.

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Conclusion

- ANSI/QIF 2.0 has been released
  - Expertise for contributing to the next revision is welcome.
  - Early adopters welcome.
    - For example, can you describe your company's measuring devices using QIF?
    - If there are attributes of your devices that you need to model, but can't, we want to know!
  - There are many opportunities for applications that utilize QIF.

- Ultimately (in my opinion), the value of QIF is the knowledge that we can capture and model within the framework.

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acknowledgements

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- The DMSC and the QIF Resources working group

- Saeed Heysiattalab, who has shared (endured?) many long philosophical conversations about "what exactly *is* a metrology resource?"

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QIF SYMPOSIUM

During the 2015 DMSC / QIF Summit
October 5-9, 2015

Hosted at UTARI

University of Texas at Arlington Research Institute

The Dimensional Metrology Standards Consortium, Inc. invites you to join us in Arlington, Texas for this Special Conference on **QIF: the Quality Information Framework Standard.**

- DMSC Membership (www.DMSC-Inc.com)
  - bsquier@dmsc-inc.com to Request an Application
- QIF Involvement (www.QIFStandards.com)

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Thank you

Professor Ed Morse
UNC Charlotte
emorse@uncc.edu

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