Measurement Data Analytics using QIF

How the Quality Information Framework (QIF) serves as an enabler for big data analytics
Overview

The Quality Information Framework
What is QIF?
An overview

Why QIF?
What is it that makes the Quality Information Framework so important?

QIF Workflows:
Data Aggregation and Analytics
How QIF can be used to enable analytics on massive amounts of measurement results data
The Quality Information Framework

What is QIF?
An overview
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Feature-Based Ontology of Manufacturing Quality Metadata

XML Technology: Simple Implementation and Built-In Code Validation

Data semantically linked to Model for full data traceability to CAD

CAPVIDIA
What is QIF?

Feature-Based Ontology of Manufacturing Quality Metadata

XML Technology: Simple Implementation and Built-In Code Validation

Data semantically linked to Model for full data traceability to CAD

Semantic, software readable data structures.
Not dumb text…

XML provides modern benefits like: simplicity, built-in validation, software-readability, distributed data, etc.

Since QIF is built on MBD structures, links to Authority CAD can be maintained to make all measurement data an integral part of the MBD
QIF Application Areas

1. QIF MBD
   - CAD and PMI data

2. QIF Plans
   - Bill of Characteristics ("what") and Measurement Plan ("how") data

3. QIF Resources
   - Measurement Resource information

4. QIF Rules
   - Measurement templates, macros, and best practices

5. DMIS
   - ISO/DMIS 5.3 is fully linked to QIF

6. QIF Results
   - Measurement result data

7. QIF Statistics
   - Statistical process control using QIF
Create measurement templates—e.g.: 
*If a Surface Profile tolerance value is less than \( x \), use at least \( y \) number of points/sq. in. for CMM measurement*

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:
- Bill of characteristics
- Assign measurement resources
- Specify sampling point locations

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

DMIS is **not** part of QIF, but it has been updated to harmonize with the data traceability mechanisms in QIF.

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.

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.
Workflow Example

Process Stage 1:
Search the PMI applied to the QIF MBD model, and identify the necessary measurement tasks. This list of tasks is called a Bill of Characteristics.

Process Stage 2:
Using a set of organizational Measurement Rules and a list of available Measurement Resources, assign measurement resources to measurement tasks.

Process Stage 3:
Generate a DMIS inspection program from the high level plan for any CMM measurement tasks that have been assigned.

Process Stage 4:
Evaluate the point clouds from the CMM or other dimensional measurement equipment against the GD&T assigned to each feature.

Process Stage 5:
Carry out statistical analysis of a set of measurement results according to organizational procedures.

All QIF data generated throughout the entire process is linked to the authority model. This fulfills traceability requirements, and provides fertile opportunities for data mining.
Features & Characteristics

The fundamental constructs behind QIF:
Features & Characteristics

- CAD geometry is wrapped by **Features**
  - Different concept from CAD features!
  - Sometimes referred to as:
    - Tolerance Features
    - Metrology Features
    - Measurement Features
- Features are referenced by **Characteristics**
  - Usually, these are GD&T
Why QIF?

What is it that makes the Quality Information Framework so important?
These are all about using **DATA** to solve business problems

*(Data, not software)*

It’s all about **Digital Transformation**

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**Model Based Definition (MBD)**

**Model Based Enterprise (MBE)**

**Industry 4.0**

**Digital Enterprise**

**Advanced Manufacturing Enterprise**

**Digital Twin**

**Digital Thread**

**Digital Tapestry**

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*Not all data is created equal. Consider:*

dat  txt  tif  csv  xls

pdf  xml  prt  stp  jt
“This hole size is out of tolerance; the mating pin will not fit into this hole during assembly”

“Remove more material”

Data with context

Applied Information

Application of Knowledge towards a specific goal

Wisdom

Knowledge

Information

Data
Without context, data cannot be transformed into knowledge. QIF provides this context.

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QIF Workflows: Data Aggregation and Analytics

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Digital Twin

- Digital representation of a product or process
- Use computer modeling and simulation to gain product knowledge *a priori*

...a digital twin is a set of computer models that provide the means to *design, validate and optimize* a part, a product, a manufacturing process or a production facility *in the virtual world.*

Zvi Feuer
Senior VP of Manufacturing Engineering Software
Siemens PLM Software

Source
Foundations of Digital Twin

These are the key elements to a successful approach to Digital Twin.
The quality of the data is paramount.

Meaningful, contextual information

Data traceability to authority model

Analytics & simulation

These are all about using DATA to solve business problems
(Data, not software)
It's all about Digital Transformation

Digital Transformation of Industry

Model Based Definition (MBD)
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Industry 4.0
Digital Enterprise
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Not all data is created equal. Consider:
det txt tbl cvx xlsx
pdf xml ppt zip txt

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Data Aggregation and Analytics with QIF

Smart Devices
Supplier Data
Internal Quality
Aggregate QIF Data

Ingest

Data Archival

Request Data
Role-based Access Control

Measurement Data Archive
Fully Associated and Traceable to Authority CAD

CAD with QIF Plugin
Analytics/BI Software
Capvidia Web Viewer
QIF Benefits

- ANSI Standard
- Rich Data Model
- Traceability to native authority CAD
- 100% Interoperability
- XML Based (smart data)
- Integrity controlled through XSD/XSLT schemas
- Compactness; smaller than native CAD & compressible
- Web-based visualization
- Easy PLM integration
Any questions?

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Thanks!