Why QIF has been the catalyst for the digital thread

MBD Summit

April 16th, 2024

LOCKHEED MARTIN

Sam Gambrell, Quality Engineer

PIRA CET2024030125

Who Am I

- Sam Gambrell, samuel.r.gambrell@lmco.com
- Started at Sikorsky Aircraft, which is now Lockheed Martin Rotary and Mission Systems
- Started as a Design Engineer for ~8 years, switched over to Quality Engineering ~11 years ago
- Currently working Digital Transformation as part of 1LMX
- Active member of the Digital Metrology Standards Consortium and on the BoD

Lockheed Martin – Digital Transformation

"1LMX, our mission-driven business and digital transformation program. With 1LMX, we're transforming our end-to-end business processes and systems. We're also creating a model-based enterprise with a fully integrated digital thread throughout the design, build and sustain product lifecycle."

https://www.lockheedmartin.com/en-us/capabilities/digital-transformation.html

QIF Benefits

- Remove the need to transcribe data between steps and systems
  - Time savings and reduces risk of error
  - Allow for creation of the digital thread
- Standards allow for a software agnostic format
  - Allow teams/suppliers to use the tools they are most familiar with
  - Develop analytical tools that can process data from multiple sources
- Can be gradually implemented, doesn't require a big bang approach
- Consumable as built data, the digital twin

© 2024 DMSC

LOCKHEED MARTIN

Quality Builds Off Of Engineering Requirements

- Engineering requirements are used to generate quality documentation
  - Engineering doesn’t fall under the Quality organization, cross disciplinary
- Differences Extend Digitally
  - Different software packages used to complete work
  - Different data formats in use
  - Multiple brands and versions of CAD in use
- Data needs to be semantic/machine readable to allow for automation
  - Manufacturing could benefit from semantic GD&T, quality needs it
- If we validate product against QIF, how do we validate QIF against CAD

Quality Data Is Not Single Source

- Inspection process can occur in multiple operations, locations, and times
  - All inspections are needed to validate the product
  - Each step may contain a different type of tooling or software
- Components in an assembly also need validation
  - A technical data package can cover the full bill of material
- Supplier inspection data is just as important
  - Less control over tooling and software used
  - Different suppliers have different systems in place
  - Consistent handling of data would allow for a single solution for both internal and external information

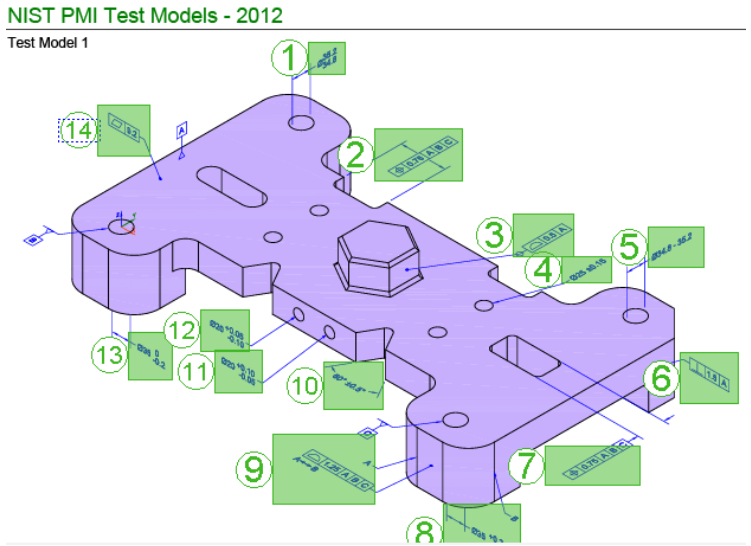
Some of the file formats that can contain dimensional data

- ac
- asc
- ascii
- apt
- bin
- bre
- btx
- cpe
- csv
- Cwk
- dmo
- e57
- fls
- fws
- g3d
- grk
- gti
- hvi
- Iges
- igs
- iQsca
- isproj
- ixf
- las
- mdf
- met
- mgf
- mmd
- mvs
- mxd
- obj
- off
- os3d
- pcd
- pct
- pf
- pif
- ply
- pnt
- psl
- pt
- pts
- ptx
- pwk
- qif
- ref
- rgv
- rtpi
- sab
- sab2
- scn
- scs
- spp
- stl
- stlb
- surf
- swl
- txt
- Vda
- xlsx
- xyz
- zfs
- zmp

PIRA CET2024030125

Digital thread, linking associated data

- Quality data grows off existing data
  - Drawings are ballooned and references are usually maintained: starting with planning, going to programs, and ending with results
  - QIF allows for linkage between documents through the use of QPIDs (UUIDs) and xIDs
- Persistent IDs will allow an automated approach that can span formats
  - Current projects looking into native CAD, STEP AP242, and QIF
  - Future opportunities with linking to system engineering and standards



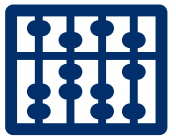
Data Storage

- Quality records require retention for a specified period of time
  - Records need to be retrievable and unaltered
  - Multiple sources of data (see previous slide)
- Persistent IDs only work if data is persistent
  - Single documents don't always tell the full story
- Quality records are used by many groups, even if they aren't directly accessed
  - Certificate of Conformance
  - Manufacturing Rework and Repair
  - Process Improvements

AS9100D and **ISO9001**, 7.5.3.1

Documentation must be "available and suitable for use" and "adequately protected"

Data Analytics



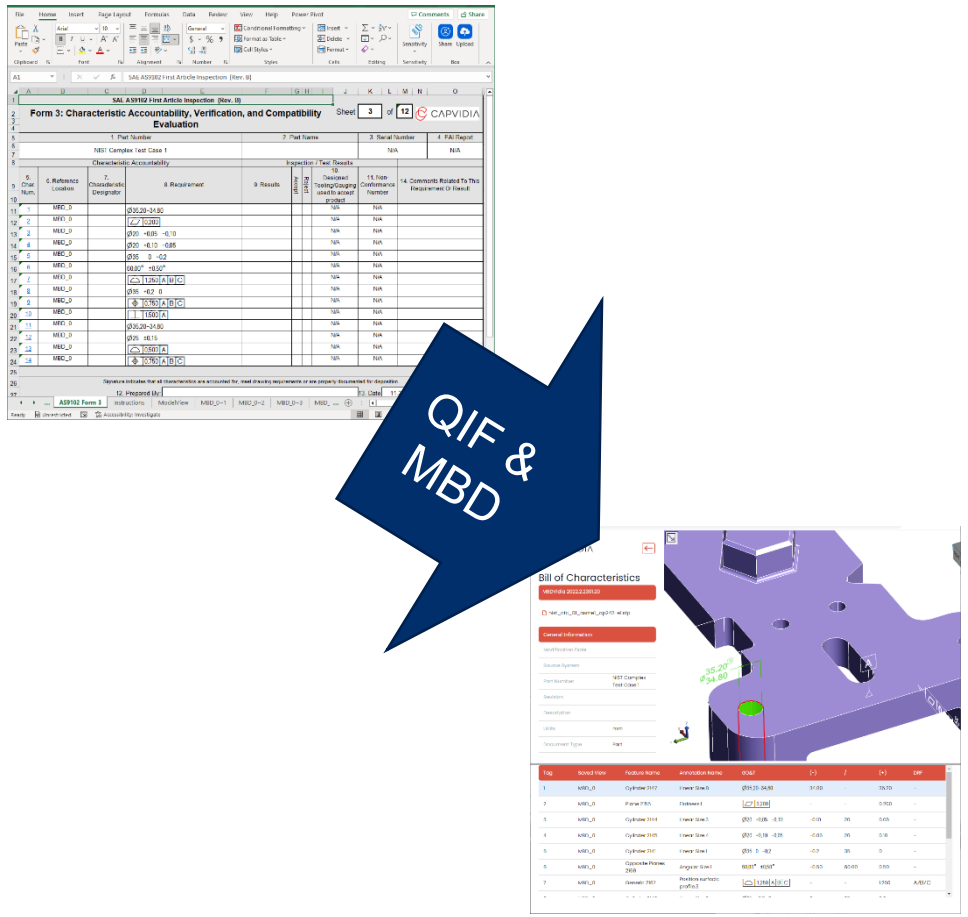
- Quality data is already calculation heavy
  - Features are calculated from point data
  - Characteristics are evaluated using feature data
- Quality data is used to monitor manufacturing
  - Statistical Process Control
- Industry 4.0 is built around the idea of more data that will be easier to consume
  - Machine Learning / Artificial Intelligence

Smart Manufacturing (SM) is the **information-based**, event-driven and collaborative orchestration of business, physical and digital processes that efficiently drive plants, factories and the entire value chain.

-CESMII

Rethink the deliverable, not just the process

- Digitizing paperwork is not digital transformation
- Manufacturing cannot be MBD ready without equipment and training
  - Includes both shop floor and engineering
- First Article Inspections (AS9102)
  - It's not about making the form faster
  - It's about collecting and reusing the underlying data as efficiently as possible



LOCKHEED MARTIN

LOCKHEED MARTIN