MBD for CMM

CMM Automation and Optimization using Model Based Definition
Takeaways: Model-Based CMM Measurement

Current CMM processes are manual and expensive

- Highly manual process, risking transcription and interpretation errors
- Resulting quality of CMM program depends on skill, experience, and practices of CMM programmer

Automation and optimization are possible with MBE

- Process can be automated, massively decreasing time spent to create the program
- Resulting program can be optimized for the job based on measurement resource availability and measurement uncertainty requirements

Technology is ready and already showing ROI

- Off-the-shelf software applications can carry out this workflow
- Workflow demonstration: how does it work?
- Workflow automation results: time saved
CMM Programming: Current State

Issues with current Computer Aided Inspection Process

- **Manual transcription** of GD&T / PMI into inspection software can lead to conflicts and inaccuracies
- High risk of CAD translation or interpretation errors with GD&T
- Requires a **skilled CMM technician** with expert knowledge of GD&T, CAD and measurement
- Personnel and machine dependent
- **Labor intensive** - can take weeks to program a single part

**Enterprise measurement data is siloed:**

- Multiple, **proprietary data formats** are used
- **Not** linked to “**single source of truth**” – the design model and PLM
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
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
MBD-Based CMM Workflow

Watch the workflow here
Video demonstration

Automatic Optimized CMM Inspection Programs

- Authority Model
- Create QIF Data
- Optimize CMM Plan
- Run CMM & Analyze Results
- Visualize Results on Model

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Raytheon Pilot Workflow

1. Starting point:
    MBD model in Creo
2. Export to Quality Information Framework (QIF) standard using “MBDVidia for Creo” plugin (Capvidia)

Less than 1 minute

1. Load the QIF MBD model
2. Check and heal the PMI – make sure that it is machine readable

5 minutes (but can be automated)

1. Import the machine-readable QIF MBD model
2. Enter essential information: probe configurations, CMM setup, etc.
3. Auto-generate the CMM program
4. Clean up and verify

Less than 3 hours – pilot processed can be drastically streamlined from this baseline effort
Simple ROI Analysis

<table>
<thead>
<tr>
<th>Current Workflow</th>
<th>Total hours, existing manual workflow</th>
<th>16 Hours</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>New MBD Workflow</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>MBDVidia</td>
<td></td>
<td>5 Minutes</td>
</tr>
<tr>
<td>FormatWorks import of Creo file</td>
<td></td>
<td>5 Minutes</td>
</tr>
<tr>
<td>Checkmate Setup Parameters</td>
<td></td>
<td>5 Minutes</td>
</tr>
<tr>
<td>Checkmate Auto Programming</td>
<td></td>
<td></td>
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<tr>
<td>Accessibility</td>
<td></td>
<td>15 Minutes</td>
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<tr>
<td>Sorting for dependencies</td>
<td></td>
<td>1 Minute</td>
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<tr>
<td>Auto Coordinate Systems</td>
<td></td>
<td>1 Minute</td>
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<tr>
<td>Probe moves/rotations</td>
<td></td>
<td>1 Minute</td>
</tr>
<tr>
<td>Collision detection</td>
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<td>20 Minutes</td>
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<tr>
<td>Manual editing (estimate)</td>
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<td>120 Minutes</td>
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<tr>
<td>Post process program</td>
<td></td>
<td>5 Minutes</td>
</tr>
<tr>
<td>Total, New MBD Workflow</td>
<td></td>
<td>178 Minutes</td>
</tr>
<tr>
<td><strong>Total, New MBD Workflow</strong></td>
<td></td>
<td><strong>2.97 Hours</strong></td>
</tr>
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</table>

Today’s traditional, manual workflow for this part is estimated at about 16 hours.

The MBD pilot workflow took less than 3 hours.

**ROI Analysis**

**Time reduction**

MBD Workflow time vs. Manual Workflow Time 19%

MBD Workflow decreases total time by: 81%

**ROI Analysis**

Hours saved on MBD Workflow 13.03
Number of parts programmed per year 80
Total yearly labor reduction 1,042 hours

81% Reduction in Time
Value of MBD Measurement

- **Reduce inspection costs**
  Inspection planning is a laborious task involving skilled technicians – automation decreases its cost significantly.

- **Faster time-to-inspection**
  Faster product delivery. Inspection is typically a bottleneck in production – this approach can streamline manufacturing processes.

- **Increase inspection quality**
  • Utilize measurement uncertainty simulation
  • Implement organizational guidelines — rely on corporate process, not personnel

- **Bring measurement data into the digital thread**
  Measurement data has immense value – don’t use it for PASS/FAIL inspection and then discard. MBD traceable data is ready for analytics.

- **Lower risk for transcription & interpretation errors**
  Software automation lowers the risk of transcription or interpretation errors of data, and creates opportunities for validation of data.
Thanks!

Any questions – contact us!

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