Using STEP-NC for CAM/CNC Data Exchange

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Presentation Outline

- Your Speaker
- Traditional Data Flow
- Advanced Data Flow
- Applications for Advanced Data Flow
- Present/Future Efforts

Your Speaker

Boeing

- **1984-1985** Electronics Technician, Rockwell, El Segundo
- **1985-1990** Maintenance Engineer, Rockwell, El Segundo
- **1990-2005** Controls Engineer, Rockwell/Boeing, Tulsa
- **2005-2015** CAD/CAM Development Boeing, Everett
- **2011** Associate Technical Fellow, Boeing

Outside

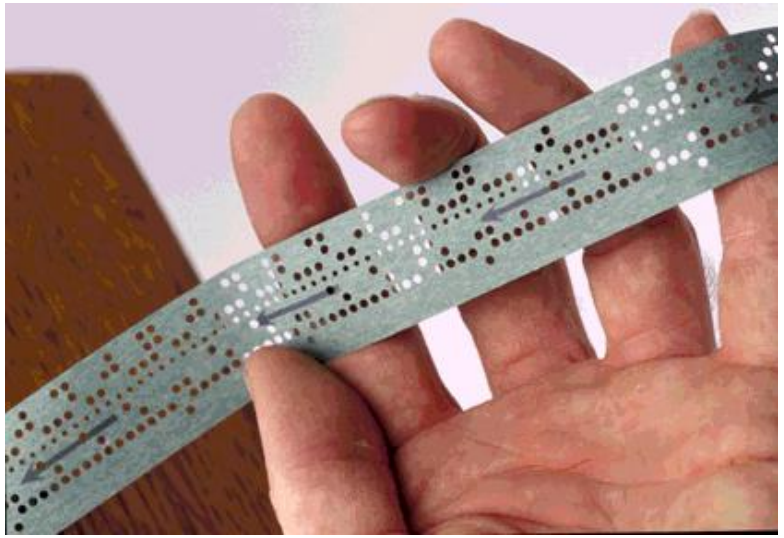
- ISO TC184/SC4/WG3 (STEP Manufacturing)
- OMAC Machine Tool Workgroup

CNC Machine Tools

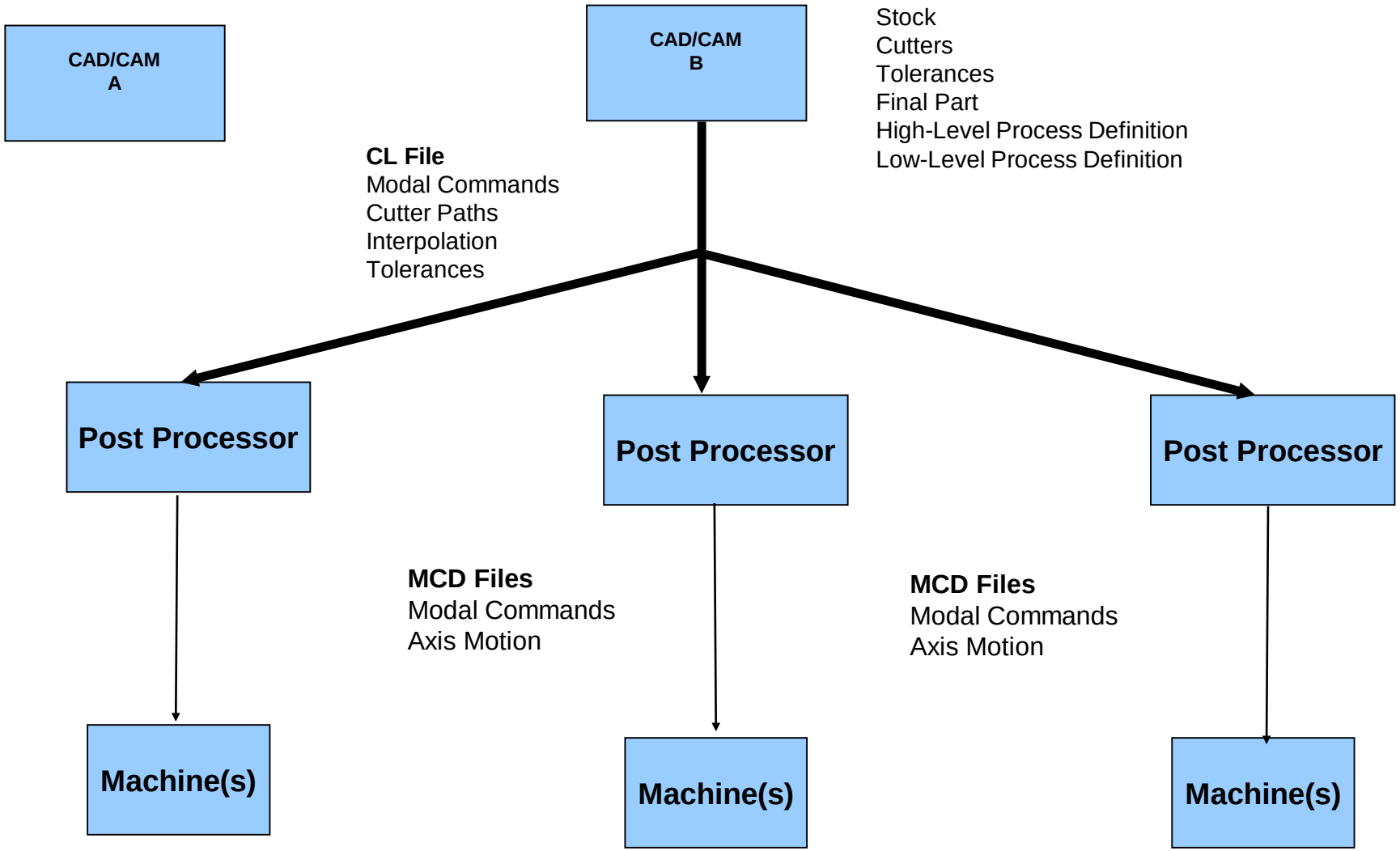
- **Around since 1950s**
- **Ubiquitous in modern manufacturing**
- **Execute simple process data**

Typical CNC Data


```
;T_9077451_105_MPF
MSG ("114W5414-2 1MF-05 T-9077451 03/18/02 11.23 STATUS=SOLD ")
N2G17G70G40
N38T2
N40G0X-12.Y-3.585
N42Z12.175
N46Z10.305
N48G1G94Z10.205F150.
N50Y-1.835
N52X5.F120.
N106Y-.4683F150.
N174G0X-23.5Y-15.5A0.C0.
N10650G74C0.0
N10656M2
```



Traditional CNC/CAM Data Flow



About the Typical CNC Data Flow

The Good:

- Works
- Expected and familiar

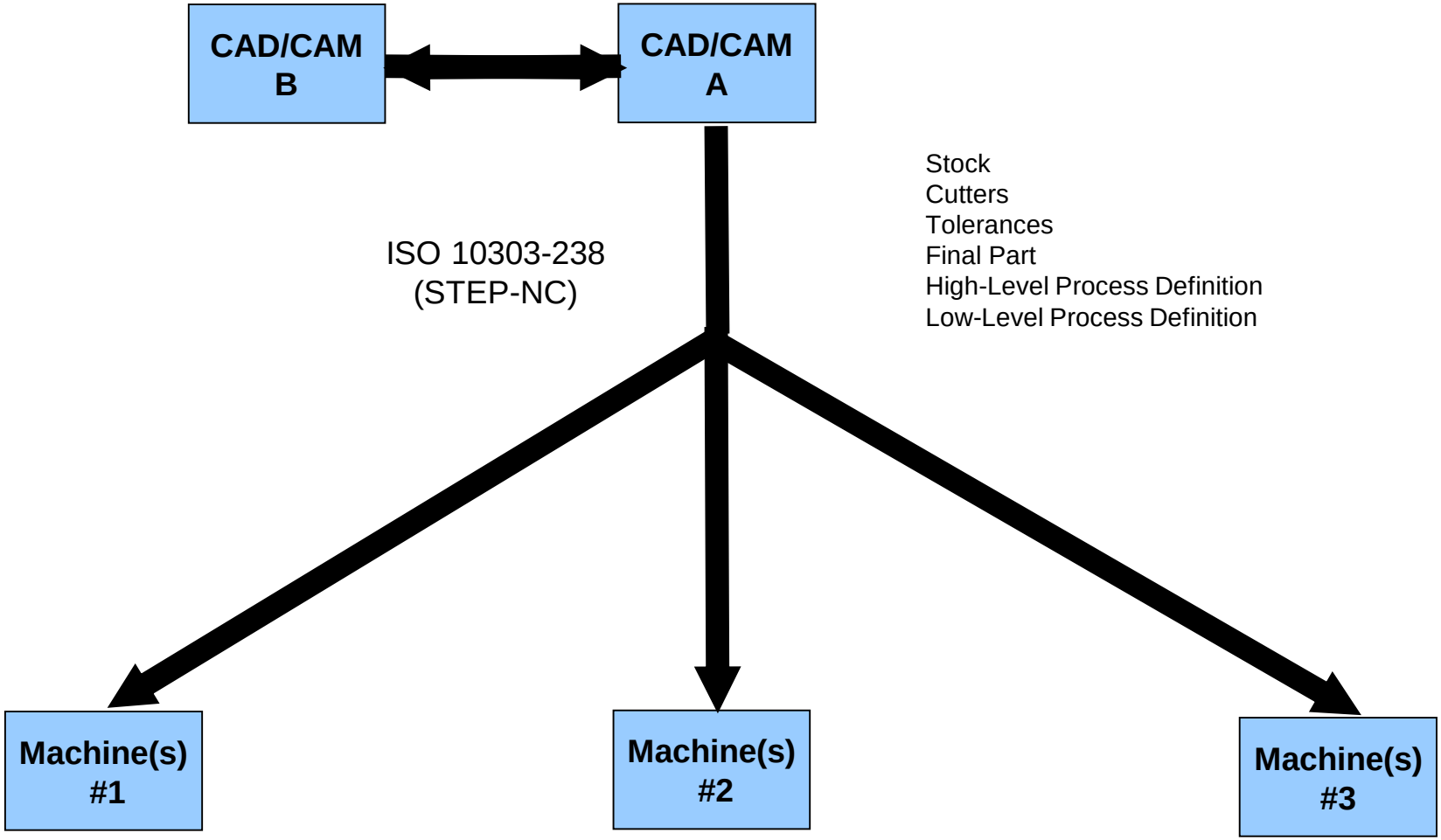
The Bad:

- No high-level process information at machine
- Data standards are weak and primitive
- Reinforces existing practices
- Work-arounds are limited and non-standard

Consequently:

- Advanced CNC capabilities underutilized
- Data is non-portable
- Larger infrastructure required
- Equipment standardization not seen as important

Advanced CNC Data Flow

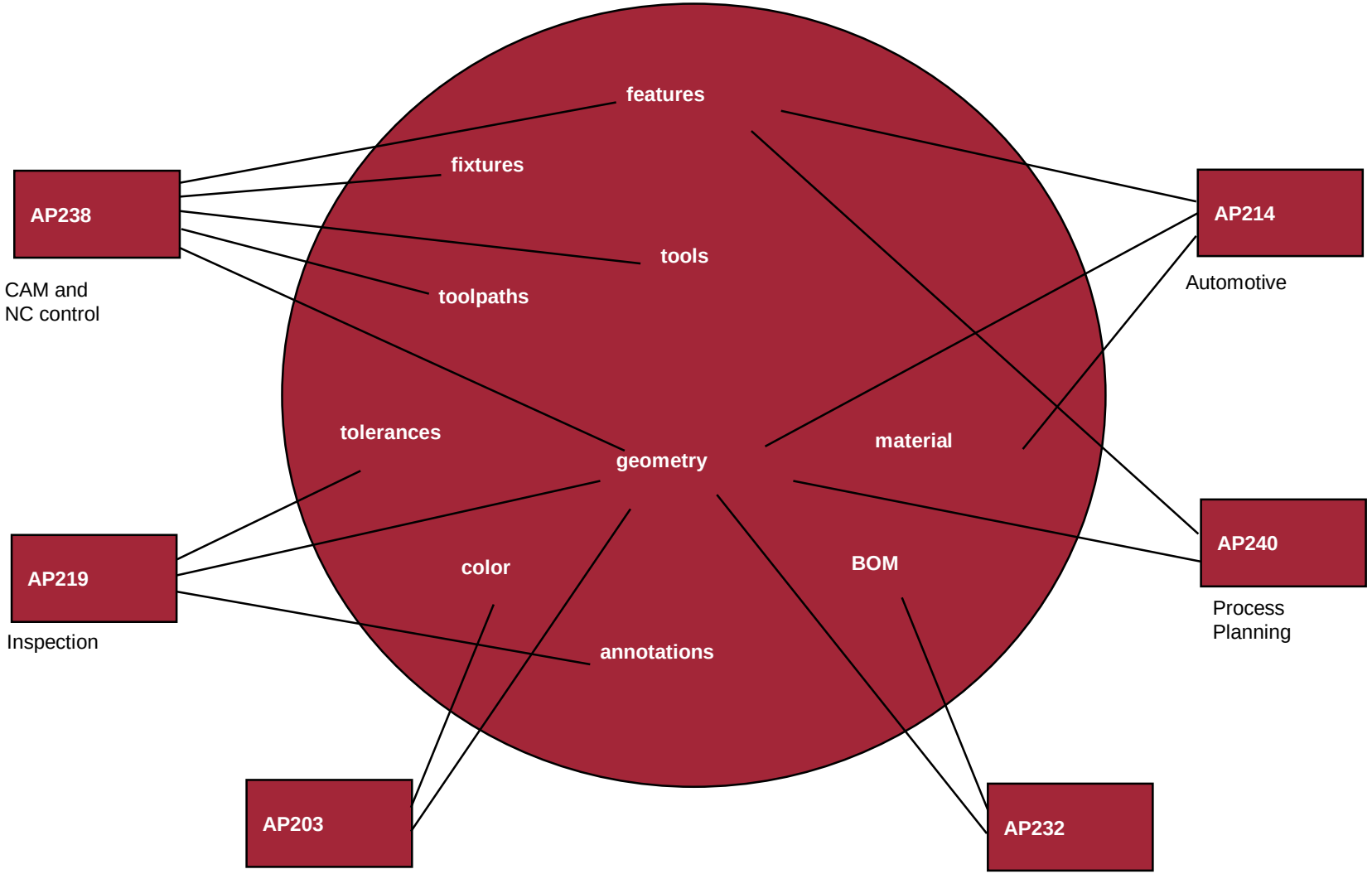


What is AP238 or “STEP-NC” ?

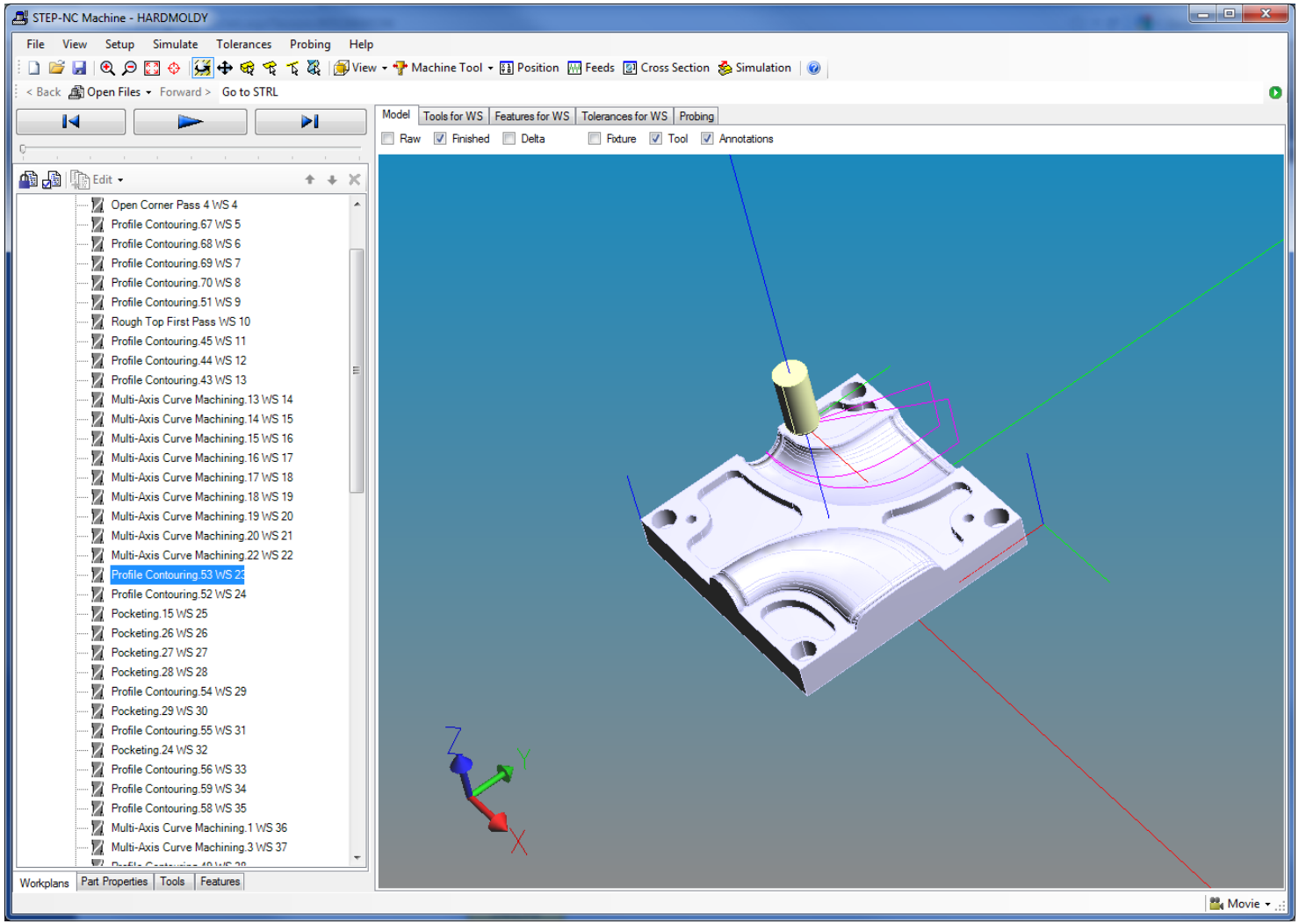
- A part of the ISO suite of STEP (**ST**andard for the **E**xchange of **P**roduct **D**ata) standards

- A standard way of transmitting **process and geometry** information to/from CNCs and CAM systems

STEP: STandard for the Exchange of Product Data

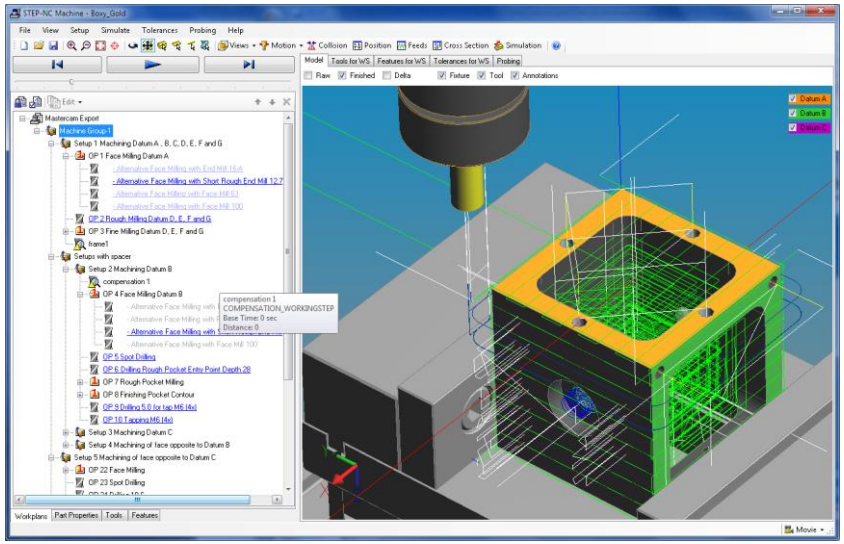


Advanced CNC Data Example



About Advanced CNC Data Flow

- **The Good:**
  - **High-level process information available at machine**
  - **Well-defined, modern data structure, optimized for modern data storage/transmission capabilities**
- **The Bad:**
  - **Not yet in production use**
  - **Unexpected and unfamiliar**



Archiving/Long Term Support

- Aircraft have long life spans, but must still be supported
- Support becomes more challenging over time
  - Aircraft no longer in production
  - Infrastructure no longer available
- Old, low-level process information (“G-code” data) of little use
- Using STEP-NC, process information is preserved
- Complete redevelopment of process avoided

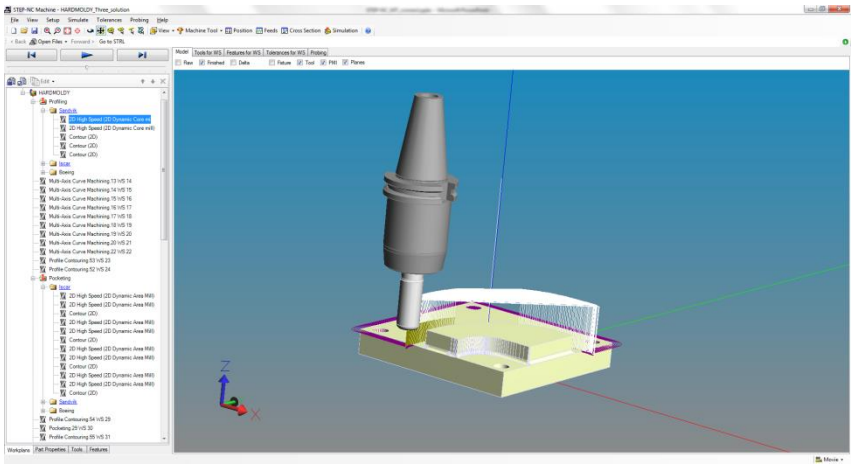
Process Optimization: IMTS 2014

1. Base process developed by Boeing in CATIA V5

OEM CAM

2. Export process as STEP-NC

STEP-NC File



Cutter Supplier

Sandvik Iscar

3. Improved process and cutter recommendations generated in MasterCAM

STEP-NC File

4. Export new process as STEP-NC

Machine Tool

Job shop

5. Merge processes and machine

ELYSIUM Parker NORTHROP GRUMMAN BOEING

GLOBAL PRODUCT DATA INTEROPERABILITY SUMMIT 2015

Other Potential Applications

- Long-Term Archiving
- Part inspection
- Closed-loop machining
- Tool migration
- End Users
- Standardized machine behavior
- Reduced overhead for outsourcing/insourcing work
- Adaptive control

Active Participants

- Standards Organizations
  - ISO, NIST, OMAC
- End Users
  - Boeing, Airbus, GE, Scania
- Technology Providers
  - Scania, Iscar, Sandvik Cormorant, Okuma, Makino, STEP Tools, Mitutoyo
- Academia
  - RPI, KTH, Vanderbilt, Penn State, U of Bath
- U.S. Government (DMDII)

Present Activities

- Digital Manufacturing and Design Innovation Institute
http://dmdii.uilabs.org/

- “Mind the Gap”

- “OOO”

“Mind the Gap”

- Project Call DMDII-14-02
- Purpose:
  - Use standards to allow usage of third party services for CNC process optimization, NC code generation, and process planning
- Participants:
  - GE, STEP Tools, Inc, Boeing, Vanderbilt, Penn State, Boeing
- Test part: Aircraft engine mount

“O3”

- Project Call DMDII-14-06
- Purpose:
  - Use standards to allow usage of third party measurement services for real and virtual machining models
- Participants:
  - ITI, Mitutoyo, SystemInsights, STEP Tools, Inc
- Test part: Aircraft engine mount, Circle-Diamond-Square, Moldy

Upcoming Opportunities For Participation

- ISO TC 184/SC 4 Meeting, October 18-23, Baltimore, MD www.eccma.org (Industry Day is October 21st)
- AP238 Edition 2
- Potential integration with AP242