Standardisation of the Manufacturing Process : the STEP-NC project

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IPLnet Workshop 2002, Saas-Fee,
September 10-11, 2002

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STEP

- STEP (***ST****andard for* ***E****xchange of* ***P****roduct Data*) was initiated by CAD users in 1984, with the intention of
  - improving CAD data exchange
  - replacing IGES, SET and VDAFS
- It is now an International Standard (ISO 10303) for exchange of
  - Geometry and topology
  - Assembly and configuration information
- More then one million CAD stations use STEP
  - All major CAD systems have STEP interfaces

STEP and STEP-NC

- STEP-NC extends STEP for CAM and CNC control
- Currently under deliberation by ISO TC184/SC1 as a Draft International Standard (DIS) called ISO 14649

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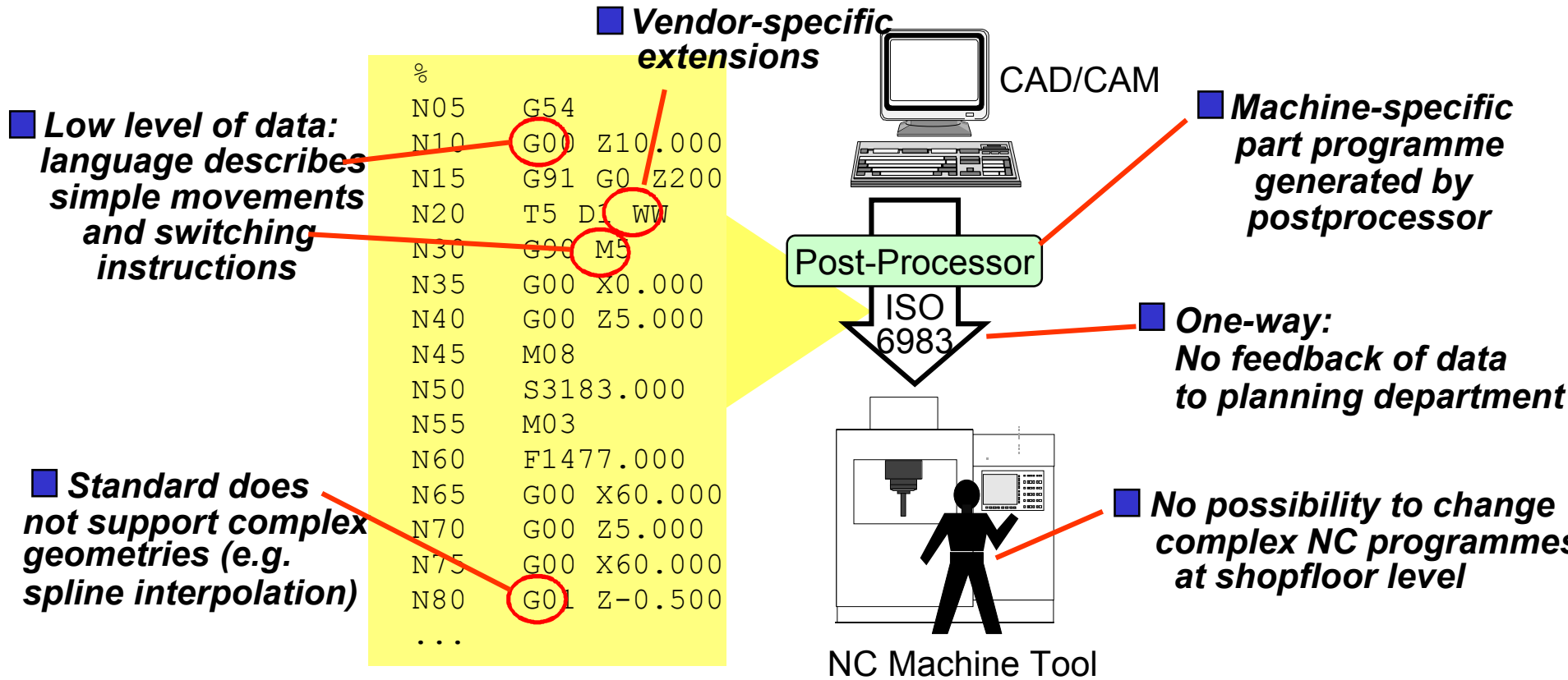
ISO 6983

- Developed many decades ago
- Doesn't meet modern NC technology requirements
- Uses low-level codes to describe tool movements (G01 for a straight line) and switching instructions (M5)

Problems with ISO 6983

- No support of complex geometries (e.g. spline)
- No support of 5 axis milling, high-speed cutting
- Creates large programs, difficult to handle
- Changes are difficult to manage
- One way : from CAD to shop-floor. No feedback
- CAD description has to go through a post-processor specific to the machine (5,000 exist)
- Degrades information

Current situation of NC programming



To improve the interface between planning and shopfloor, a new data model is needed, not just an extension of ISO 6983!

Source : WZL

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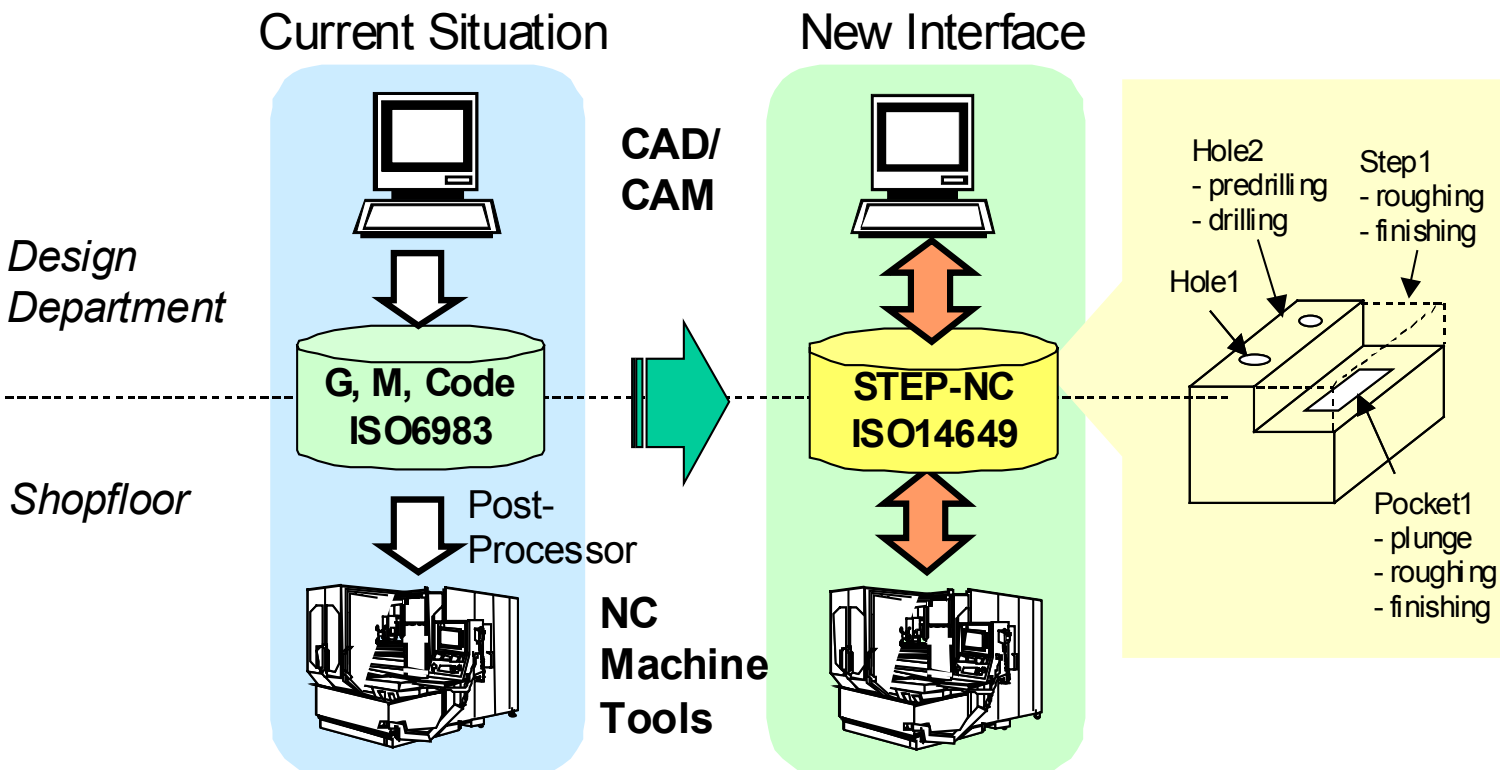
Goals for STEP-NC

- Enable a fast-track process chain from CAD to product realisation
- Provide an effective link between CAD/CAM and CNC
- Enable exchangeability of programs
- Build on geometry from CAD ; and add a description of what to do: “drill a hole”
- High-level description of machining process - instead of tool movement G01 x y

The Project Target



Source : WZL

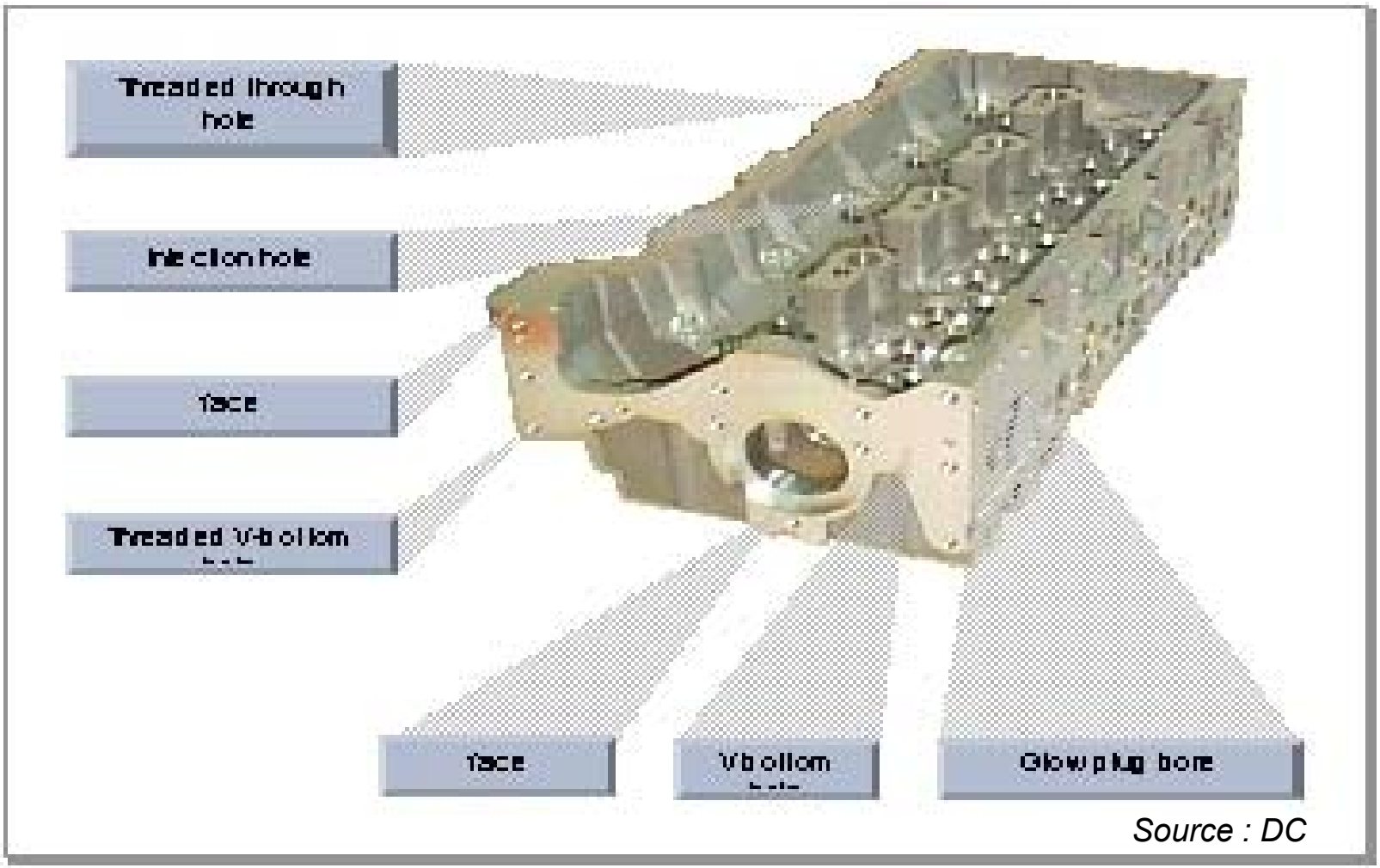
The New Interface : STEP-NC (ISO 14649)

- What does the well-structured interface look like?
  - Workingsteps
    - describe the sequence of work
  - Object oriented description of features
    - features are: hole, plane, profile, pocket, ..
  - Operations
    - tell the control how to do that

Status of STEP-NC (ISO 14649)

- The drilling and milling datasets are described in a data model using a special language which can be processed directly by software tools.
- ISO 14649:
  - Part 1: Overview and fundamental principles
  - Part 10: General Process Data
  - Part 11: Process Data for Milling
  - Part 111: Tools for Milling
- In preparation:
  - Part 12: Turning
  - Part 13: EDM
  - Part 14: Contour cutting of wood and glass
  - Part 15: Inspection

Features on an Engine Part



Program Structure

File:

Header

#1=Project(Workplan #10);

#10=Workplan(#20,#35,#71,.....);

.

#20=Machining_workingstep(, #21(Feature),#22(Machining));

#21=Round_hole('Hole M6',,,,,,,,,,,);

#22=Drilling(#..(Tool),,,#..(Technology),#..(Machine_functions));

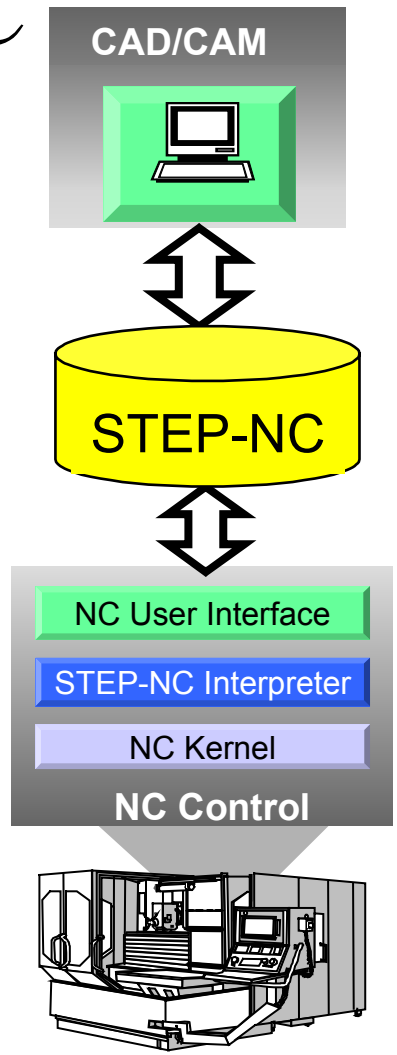
.

#35=Machining_workingstep(.....);

END-ISO-10303-21;

Benefits of STEP-NC

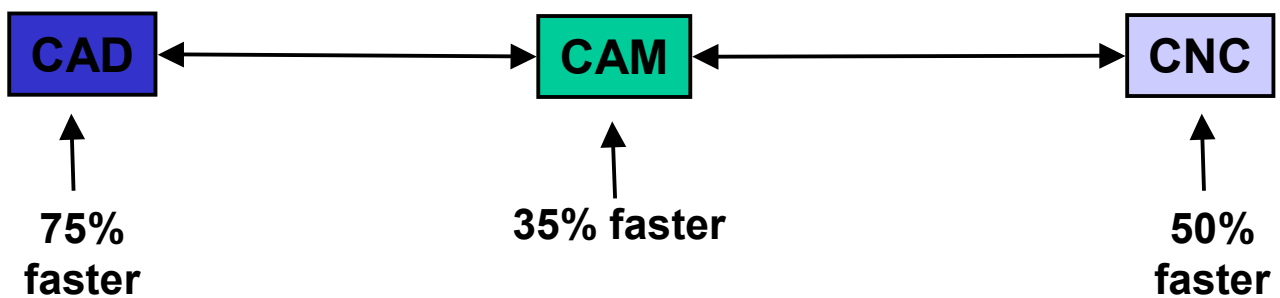
- A closed process chain from CAD to CNC
- No geometry programming
- No post-processing
- A complete product model in the CNC
- Easy editing at the shop floor
- Upload of CNC file and easy reuse
- An open solution, open for customers cycles
- Well suited to e-engineering



Source : WZL

STEP-NC : Target

- 35% reduction in CAM planning time
- 75% reduction in number of drawings sent from CAD to CAM
- 50% reduction in machining time for small to mid sized job lots



Source : Step Tools

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STEP-NC projects

- European “Optimal” project ” (1994-1997)
- EP29708 Esprit “STEP-NC” (1999-2001)
- IMS “STEP-NC” project (2002-2004)

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Project Team

- From a European Project
  - Belgium, France, Germany, Italy, Sweden, Switzerland
- to a global IMS Project
  - Europe
  - Korea
  - Switzerland
  - USA

EP29708 Project Members

Control Manufacturer
- Siemens (D)
- OSAI (I)

Machine Tool Manufacturer
- CMS (I)
- AGIE (CH)
- Starrag (CH)

CAM Manufacturer
- Open Mind (D)
- Dassault (F)
- CADCAMation (CH)

Research Institute
- WZL (D)
- ISW (D)
- EPFL (CH)
- EIG i-tech (CH)

Association
- CECIMO (B)

Consulting
- AMT (CH)

Enduser
- DaimlerChrysler (D)
- Volvo (S)
- Franci (I)
- Progetti (I)
- Derendinger (CH)
- Wyss (CH)

Source : CECIMO, WZL

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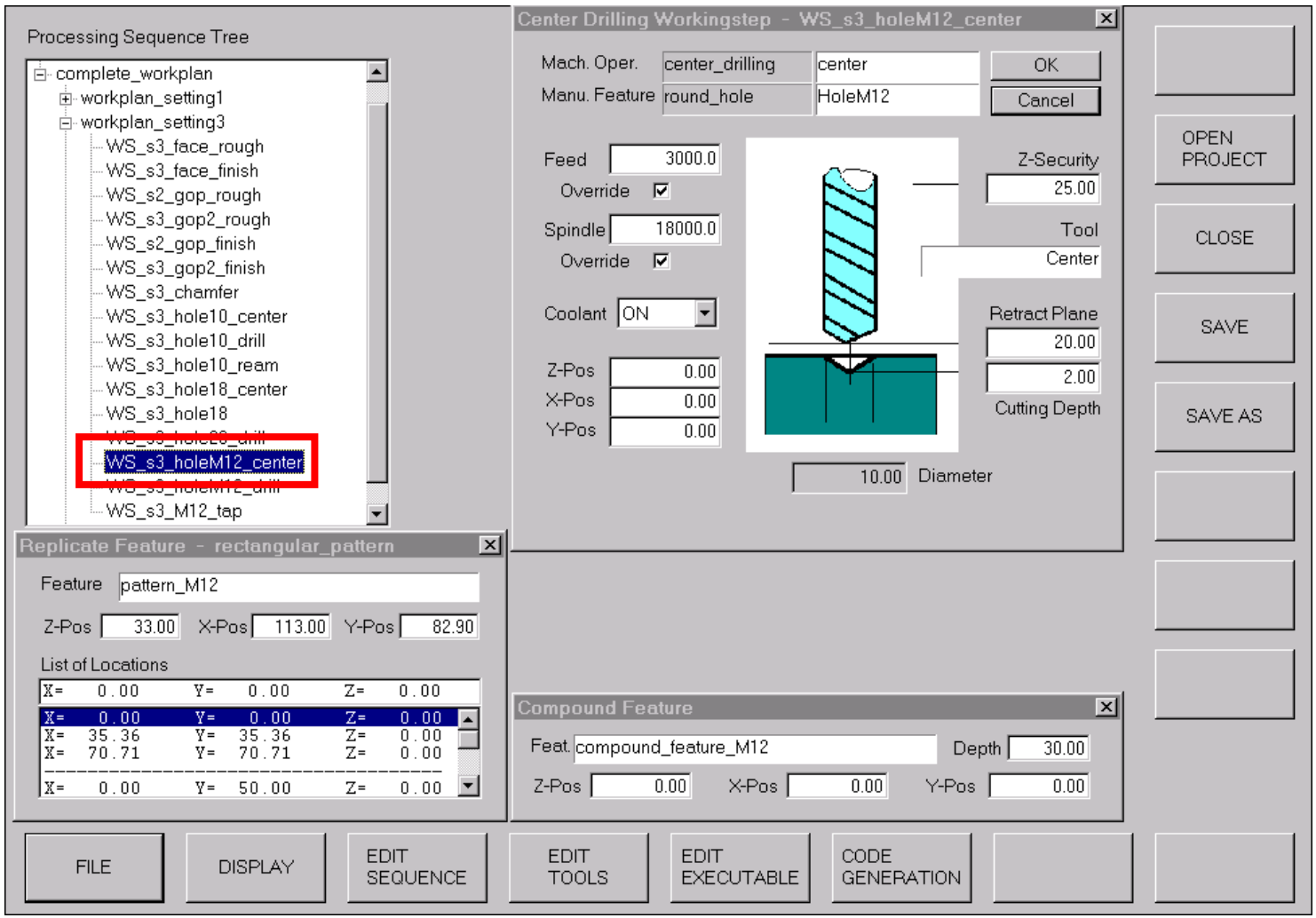
Prototypes Implemented

- Milling
  - Siemens
- EDM
  - Agie-Charmilles

Prototype : Milling

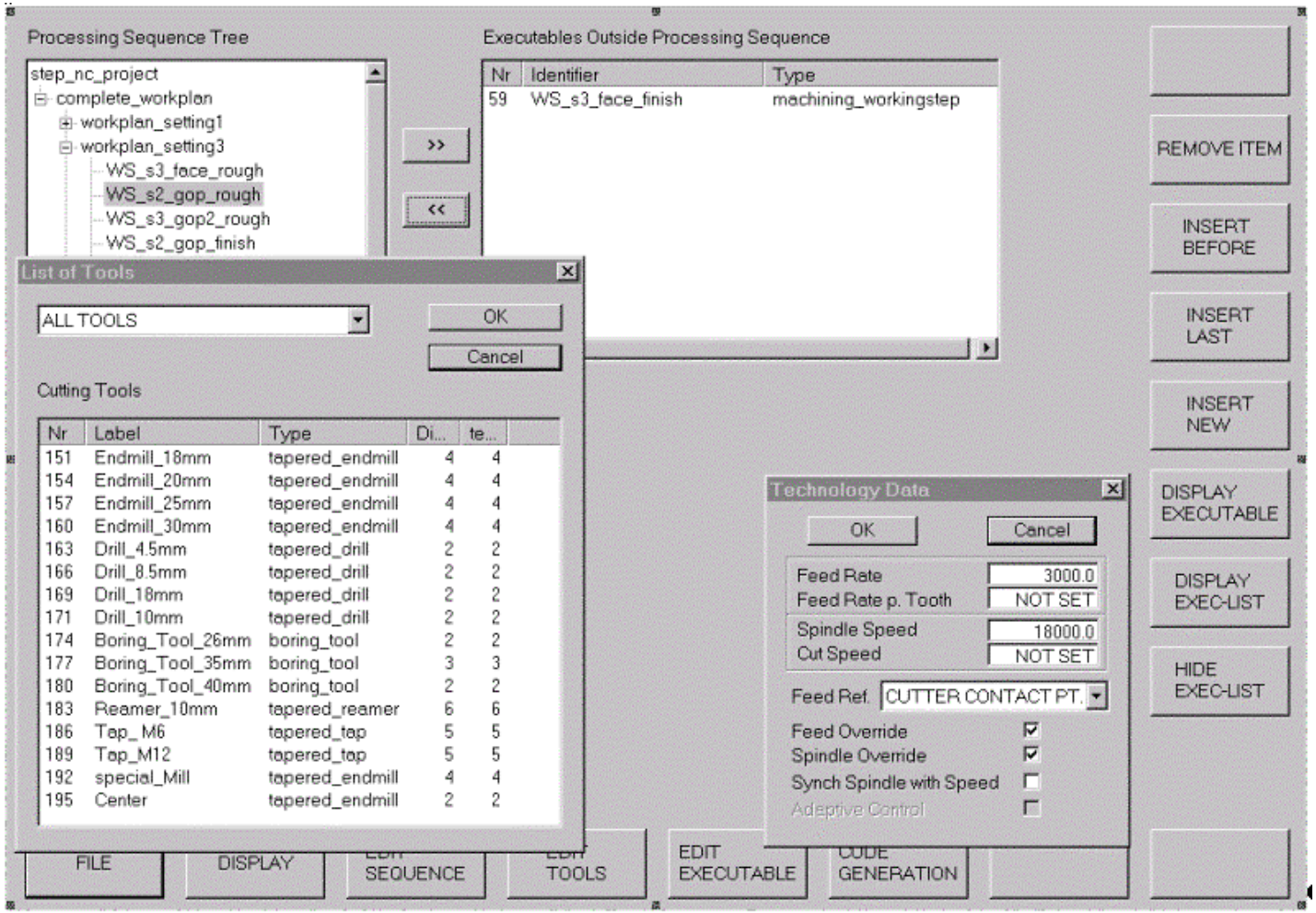
Source : Siemens

Feature display, compound feature



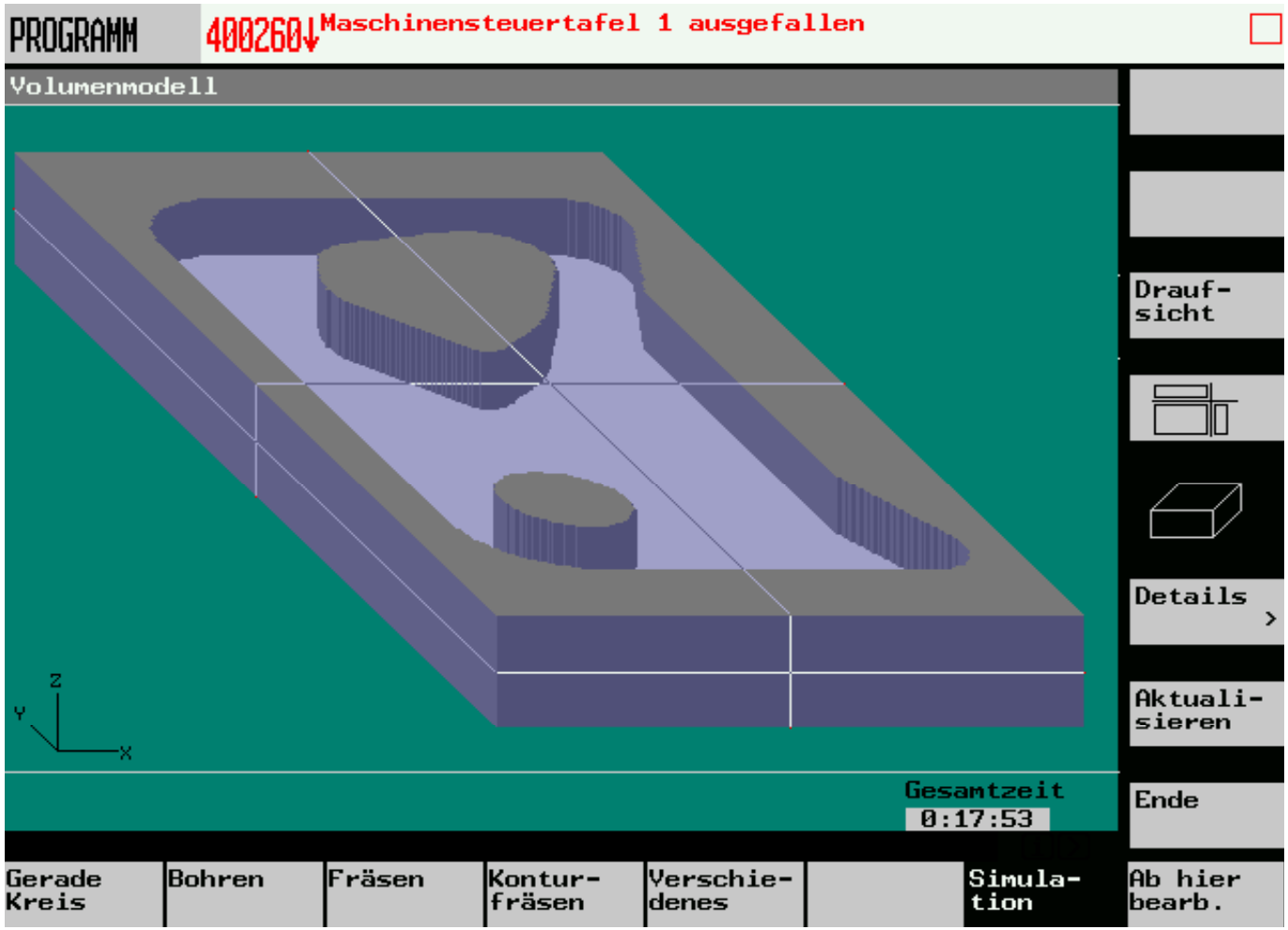
Source : Siemens, OpenMind

Tool display and sequence editor



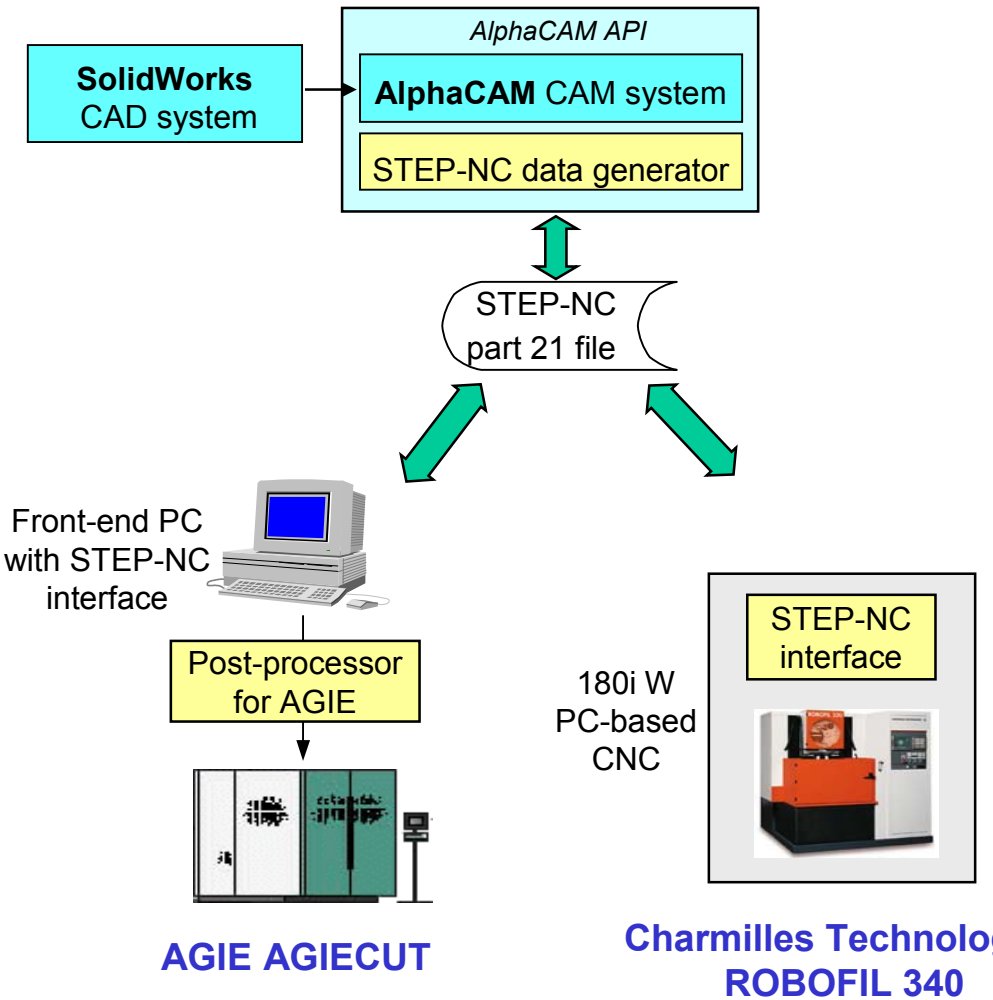
Source : Siemens, OpenMind

Simulation of pocketing



Source : Siemens

Prototype : Wire EDM



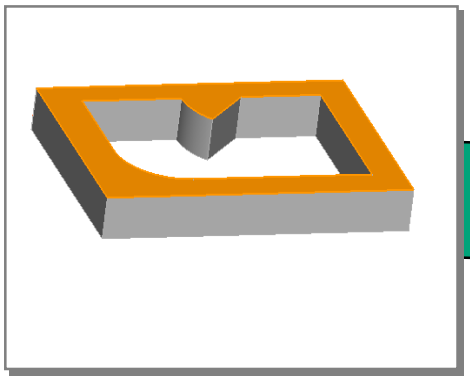
Implementation in CAM system

2 different implementations in CNC

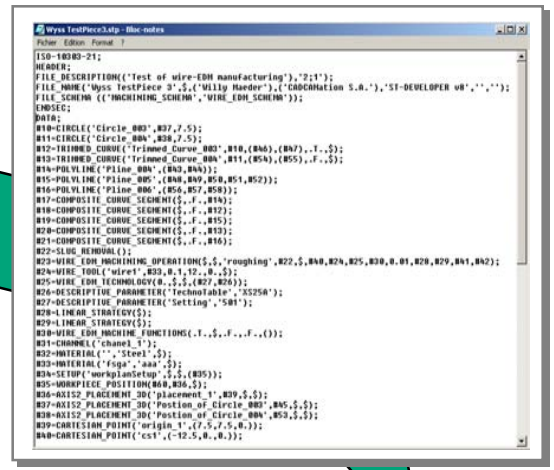
Source : Cadcamation, i-tech EIG

The new Wire EDM controller

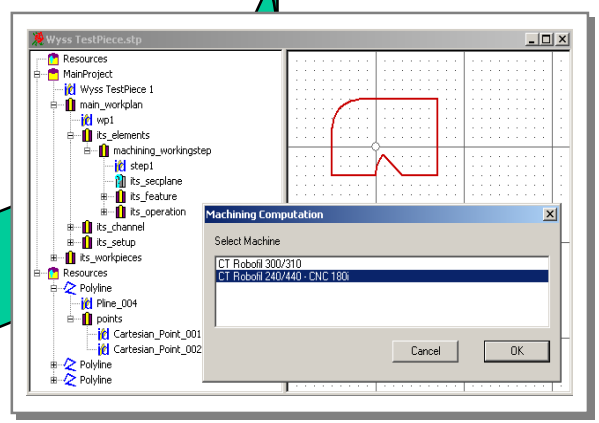
Wire EDM results



CAD system: SolidWorks
CAM system: AlphaCAM



STEP-NC file
ISO 14649



STEP-NC interface
TestEDM prototype software

Charmilles ROBOFIL 430

Source : Cadcamation, EPFL

eig

Hes·so

More information?

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