CAM-CNC CAM-CNC Integration for Maximizing Part Manufacturing Efficiency
Teamcenter provides the backbone for unifying product and production lifecycles.
The most completed Manufacturing Portfolio

Part Manufacturing

Assembly Planning

Plant Optimization

Human Performance

Quality Planning

Production Management

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April 20, 2010
From Plan to Production
- connecting virtual and physical worlds

Virtual

defining the plan...

Physical

...producing the part
Combining Siemens PLM CAM Software and Motion Control Systems

The Leader in Productivity

Productivity, Competitiveness and Profitability for our Customers:

- Right first time manufacturing
  - Improved utilization of equipment
  - Shorten time to productivity
  - Meeting product quality targets

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Combining Siemens PLM CAM Software and Motion Control Systems

Facts about Siemens PLM Software in CAM:
- Over 25 years of market success
- Industry leader with 13.5% market share
- Over 40k+ industrial seats worldwide

Facts about Siemens Motion Control Systems:
- Market leader worldwide, in Europe No 1, in Americas and Asia No 2
- The innovation leader in Motion Control

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PLM innovation to optimize the processes of the End Customer

PLM and CAM optimize the design, engineering and manufacturing processes

Motion Control and Drive Technologies are key drivers for highly efficient and precise production

Machine Tool Builders

End Customers

Aerospace  Automotive  Mold & Die  Machinery

Other Industries

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All in NX – a Unified Solution Set

Provides the NC programmer with full CAD capabilities
- Modeling, assemblies, drafting
- Geometry editing
- Wide range of geometry types

All geometry is in NX (no need for a 3rd party CAD application)
- Part, part assemblies
- Tools and fixtures
- Machine tool assembly

Enables concurrent product design and NC programming
- Offers highly integrated design and NC programming
- Machining simulation
- Excellent value, “all-in” packages

Differentiators:
- Wide range of capabilities
- Proven in depth functionality
- An integrated design through manufacturing solution

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Three Automation Systems for Mechanical Engineering

- The CNC System
- The Motion Control System
- The Automation System

**SINUMERIK**
- Control systems for machine tools using different technologies (turning, milling, drilling, grinding ...)

**SIMOTION**
- New Motion Control system for machines/solutions with high requirements for motion control. Integration of motion, logic and technology.

**SIMATIC**
- The universal control technology for high-performance control and with Motion Control functions

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**Drive Platform**

**Converters**
- MICROMASTER
- SIMODRIVE
- MASTERDRIVES
- SINAMICS

**Actuators**
From Plan to Production
- connecting virtual and physical worlds

Virtual

*defining the plan…*

Physical

...producing the part
From Plan to Production
- connecting virtual and physical worlds

...producing the part

- Right the first time manufacturing
- Improved utilization of equipment
- Shortened time to production
- Standardization of manufacturing resources
- Optimization of manufacturing methods
- Meeting product quality targets

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From Plan to Production
- connecting virtual and physical worlds

Virtual
- Separated departments
- Numerous functions
- Connected by process chains

Physical
CAM - CNC
- a key process chain in part manufacturing

- Right the first time manufacturing
- Improved utilization of equipment
- Shortened time to production
- Standardization of manufacturing resources
- Optimization of manufacturing methods
- Meeting product quality targets

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CAM - CNC Process Chain
- typical issues

- CAD
  Tool Design

- Fixture Design

- CAM - NC programming

- Process Planning
- Work Instructions

- Optimized post processor?

- Order Management

- Resource Management

- Design

- CAD

- DNC

- Machine Tool
- CNC Controller

- Tool Management

- Error free NC program?

- Maximum machine tool value?

- Effective use of advanced capabilities

- Achieving desired machining quality?
A. Controller driven simulation
B. Enhanced tool path processing
C. Optimized CAM output for the Siemens Sinumerik
Standard Machine Tool Simulation
- attempts to mimic the controller

**Approximate kinematics and timings**
**Incomplete simulation**

NX CAM
CAM simulation driver

Standard simulation uses CAM software driver
– attempts to mimic controller
Controller Driven Machine Tool Simulation
- optimized simulation in the CAM system

Unique machine tool characteristics - from real controller

Right first time manufacturing
Improved utilization of equipment

VDNCK inside NX CAM
- a closer match to the shop floor

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Enhanced tool path processing
- Example: synchronized point distribution

Before

Synchronized Point Distribution - “Out of step” points on adjacent passes

Optimized

Improved surface finish

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Optimized CAM Output for the Sinumerik - output of operations and cycles

NX CAM Operation and Cycle

NX CAM
NC Operation Planning

Sinumerik Cycle

Enables fast and easy and cycle based editing

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C - Optimized CAM Output for the Sinumerik
- correct parameter settings

**NX CAM machining planning**

<table>
<thead>
<tr>
<th>Tool Material</th>
<th>Code</th>
<th>(HRc)</th>
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<tbody>
<tr>
<td>SOFT Tool Steels</td>
<td>P20</td>
<td>30-33</td>
</tr>
<tr>
<td></td>
<td>MAT0_00600</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MAT0_00700</td>
<td>45</td>
</tr>
<tr>
<td>H13</td>
<td>MAT0_01100</td>
<td>55-58</td>
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<td>M416</td>
<td>MAT0_01200</td>
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</tr>
<tr>
<td>D2</td>
<td>MAT0_01300</td>
<td>60-65</td>
</tr>
<tr>
<td>Non Ferrous</td>
<td>MAT0_02100</td>
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<tr>
<td></td>
<td>MAT0_02200</td>
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<tr>
<td>HogNose</td>
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<tr>
<td>EndMill HardCut</td>
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<tr>
<td>HogNose Micro Inserted</td>
<td>TMC0_00029</td>
<td></td>
</tr>
<tr>
<td>Slot Drill TiAIN</td>
<td>TMC0_00030</td>
<td></td>
</tr>
</tbody>
</table>

Support CYCLE 832 for roughing, finishing, ...

Sinumerik High Speed Settings

Balance accuracy, speed & finish quality

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CAM - CNC Connection
- closing the process loop

Feed-back CNC to CAM
CAM - CNC Connection
- closing the process loop

CAM

Closed loop feedback with real-time measurement and adaptive programming

Machine Tool

Close connection between controller and CAM system

Improved utilization of equipment
Meet requirement specifications
Enable secondary machining process
Capture and improve best practices
CAM - CNC Process Chain
- at the machine tool

Guaranteed collision free machining?
Operator training without wasting machining time?
Minimum set up time on the machine tool?
A Key Process Chain
- the shop floor end

A virtual machine driven by real software

User interface like the real controller

3D model reacts like the machine tool

Virtual Machine

CNC Controller

Machine Tool

3D simulation software

Controller user interface software

Controller core (kernel) software

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The Virtual Machine Tool
- deliver the potential of your shop floor equipment

Improved utilization of equipment
Right first time manufacturing
Shorten time to productivity
Today - Separate Virtual and Physical Worlds
- disconnected systems, processes and data

Part design has been modified?

Multiple data sources!

Order Management

DNC

Wrong NC File!

Quality Measurement

CNC Controller

Machine Tool

Tool Management

Is this the right tool list?

Which machine tool is this for?

Where is the tool?

Separate niche applications!
From Plan to Production
- synchronized virtual and physical systems

Virtual

CAD
Fixture Design
CAM - NC programming
Post Processing

Engineering Data Management

Tool Design
Process Planning
Resource Management
Quality
Work Instructions

Physical

Shop Floor Data Management

NC Program Checking & Editing
DNC
Quality

Tool Management
Tool Setup
CNC Controller
Machine Tool

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From Plan to Production
- synchronized virtual and physical systems

Virtual

- CAD
- Fixture Design
- CAM - NC programming
- Post Processing

Synchronized virtual & physical environments

ERP & MES

Engineering Data Management
- Right the first time manufacturing
- Improved utilization of equipment
- Shortened time to production
- Standardization of manufacturing resources
- Optimization of manufacturing methods
- Meeting product quality targets

Shop Floor Data Management

Physical

- NC Program Checking & Editing
- DNC
- Quality

- Tool Management
- Tool Setup
- CNC Controller
- Machine Tool

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Single Source of Information
- maximum availability of critical data

Virtual
- CAD
- Fixture Design
- CAM - NC programming
- Post Processing

Product
- Tool Design
- Process Planning
- Resource Management
- Quality
- Work Instructions

Process
- Data
- Data
- Data

Physical
- NC Program Checking & Editing
- DNC
- Quality

Resources
- Tool Management
- Tool Setup

Plant
- CNC Controller
- Machine Tool

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Shop Floor Connection
- Integrated CAM Data & Resource Management

CAD

CAM - NC programming

Product
Process
Resources
Plant

Resource Management

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Shop Floor Connection
- Integrated Resource Manager

- Full classification system
- Supplied cutting tool library
- > 30,000 tools in catalog
Shop Floor Connection
- Resource Manager and tool inventory
Shop Floor Connection - tool inventory management

Tool Data Management
- Tool planning functions & Statistics
- Tool inventory (location, remaining tool life)

Connection to shop floor devices
- Barcode reader
- Chip reader (Balluf)
- Tool Setting Station
Shop Floor Connection
- DNC connection with closed loop
Shop Floor Connection
- DNC & NC program management & transfer

**DNC - NC Program Management**
- Central NC program management and archiving
- NC program transfer via
  - SINUMERIK operator panel or
  - DNC computer
- NC Program comparison
- Connection of different CNC controllers
- Configurable user profiles and functions

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From Plan to Production
- connecting virtual and physical worlds

Virtual

Physical

- CNC optimized CAM

- Planning and shop system synchronized

- Common data backbone

- Optimized CAM to CNC connection

- Maximized machine tool utilization

- Right the first time manufacturing
- Improved utilization of equipment
- Shortened time to production
- Standardization of manufacturing resources
- Optimization of manufacturing methods
- Meeting product quality targets

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CAM-CNC Integration

Maximizing Part Manufacturing Efficiency

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