



NX Machining Summary

Bob Sammut
May 8, 2006



NX Machining Goals & Strategy



NX Machining goal

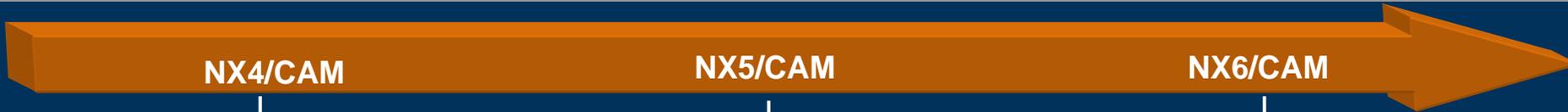
- ▶ Expand our leadership position

NX Machining product strategy

- ▶ Continue to invest in the major industry segments
- ▶ Expand the User base by entering into the Mid-Market
 - ▶ Machinery
 - ▶ Multi-functions machines
 - ▶ High production machining
 - ▶ Die/Mold (automotive & high tech)
 - ▶ Plastic injection mold tooling
 - ▶ Automotive die tooling
 - ▶ Progressive die tooling
 - ▶ Aerospace & Defense
 - ▶ Airframe manufacture
 - ▶ Turbo machinery



NX Machining Roadmap



NX4/CAM		NX5/CAM		NX6/CAM	
Q4/2005		Q1/2007		Q1/2008	
<i>Usability</i>	<ul style="list-style-type: none"> ✓ Support for Wizard Builder ✓ Dialog Enhancements 	<i>Velocity</i>	<i>Usability</i>	<i>Usability</i>	<ul style="list-style-type: none"> ✓ Noncutting Moves Engine
<i>Feature Base Milling</i>	<ul style="list-style-type: none"> ✓ Feature Enhancements ✓ Solid Edge Feature 	<ul style="list-style-type: none"> ✓ Integration with SE ✓ Design of User Interface ✓ Noncutting Moves ✓ Post Processors Library 	<i>Velocity</i>	<ul style="list-style-type: none"> ✓ Design of UI for VAX ✓ Post Processors Library Cont'd 	<i>Velocity</i>
<i>3x Milling</i>	<ul style="list-style-type: none"> ✓ Plunge Milling ✓ Form Tools ✓ Trochoidal Milling 	<i>3x Milling</i>	<ul style="list-style-type: none"> ✓ Simple Milling ✓ Contact Contour ✓ Interpolath ToolPath ✓ Z level Enhancements ✓ GM Enhancement 	<i>FBM</i>	<ul style="list-style-type: none"> ✓ Contour Feature Support
<i>Turning</i>	<ul style="list-style-type: none"> ✓ Solid Silhouette 	<i>5x Milling</i>	<ul style="list-style-type: none"> ✓ Interpolated Tool Path ✓ Z-level 5 axis ✓ VAP Ph 2 	<i>Milling</i>	<ul style="list-style-type: none"> ✓ Simple Milling ✓ Variable Axis Cavity Milling ✓ Variable Axis Surface Contouring
<i>5x Milling</i>	<ul style="list-style-type: none"> ✓ VAP –No Floor ✓ Tool Axis Optimized 	<i>Feature Based Machining</i>	<ul style="list-style-type: none"> ✓ Feature Teacher ✓ Process Teacher ✓ eM Machining Shared Components 	<i>Probing</i>	<ul style="list-style-type: none"> ✓ Closed Loop Machining ✓ Adaptive Machining ✓ CMM Support
<i>ISV</i>	<ul style="list-style-type: none"> ✓ Mill/Turn IPW 	<i>On Machine Probing</i>	<ul style="list-style-type: none"> ✓ On Machine Probing 	<i>Application Integration</i>	<ul style="list-style-type: none"> ✓ Application Integration
<i>Multi-Function Machines</i>	<ul style="list-style-type: none"> ✓ Mori NT 2000 	<i>Machine Kits</i>	<ul style="list-style-type: none"> ✓ Machine Kits 	<i>Machine Kits</i>	<ul style="list-style-type: none"> ✓ Additional Multi-function machines

Legend

- ✓ Project completed or delivered
- ✓ Project under development
- ✓ Proposed project



- ▶ Usability
- ▶ Milling
- ▶ Turning
- ▶ Multi-Axis Milling
- ▶ Integrated Visualization & Simulation

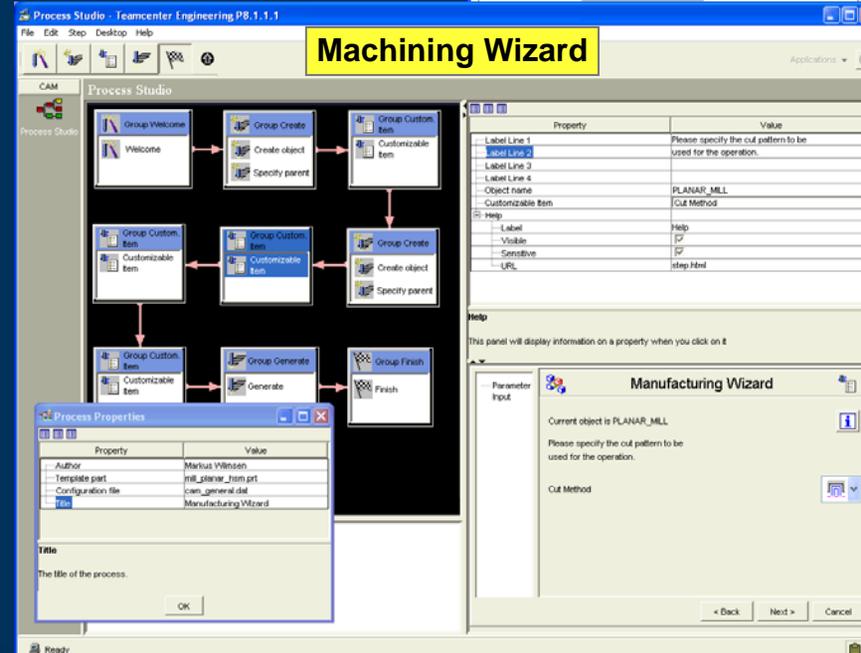
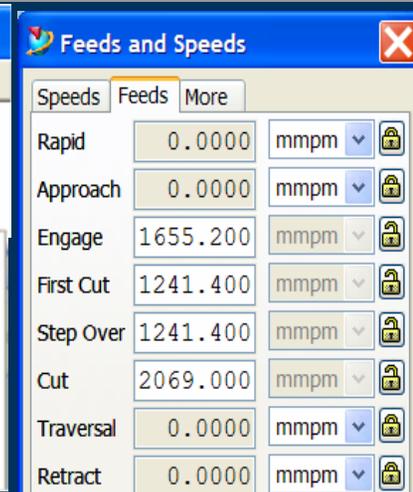
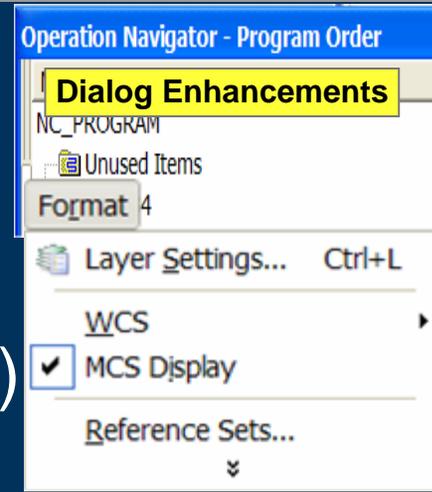


Directions

- ▶ Efficient and consistent user interface and interaction (measured by user work-flows)
- ▶ Discoverable -- easy to learn

NX 4 Projects

- ▶ Journaling
- ▶ Dialogs Enhancements
- ▶ Machining Wizard



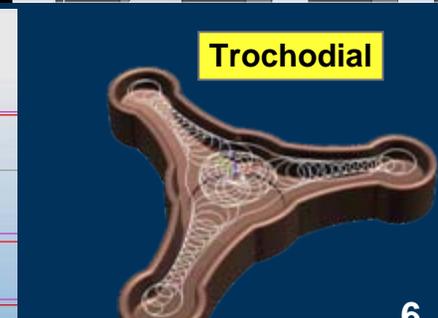
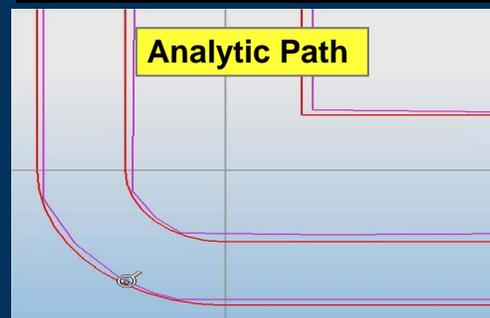
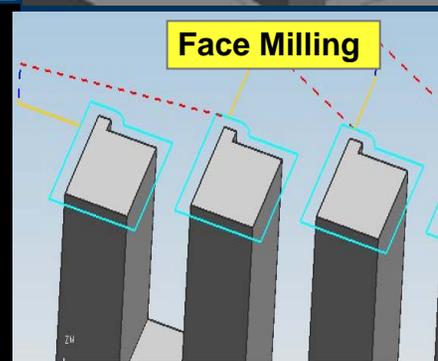
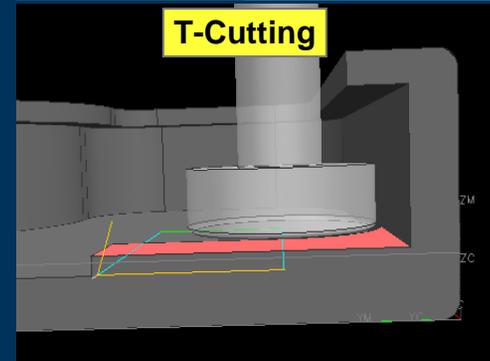
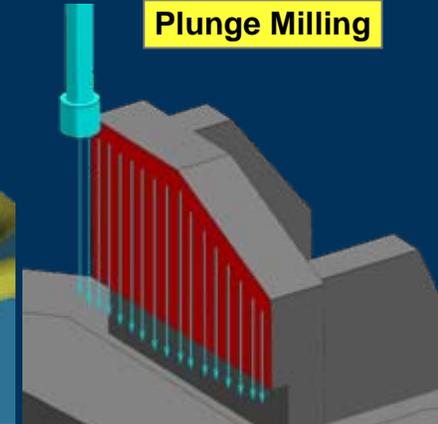
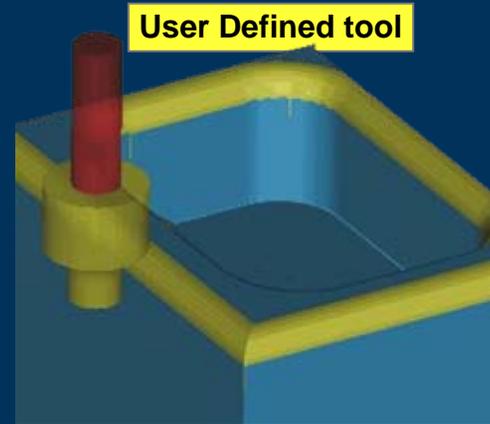


Directions

- ▶ Provide efficient tool paths for Fixed Axis Milling
- ▶ Continuous Improvement in High Speed Milling

NX 4 Projects

- ▶ User Defined Tool
- ▶ Plunge Milling
- ▶ T-Cutting
- ▶ Face Milling
- ▶ Analytic Path
- ▶ Trochoidal Cutting



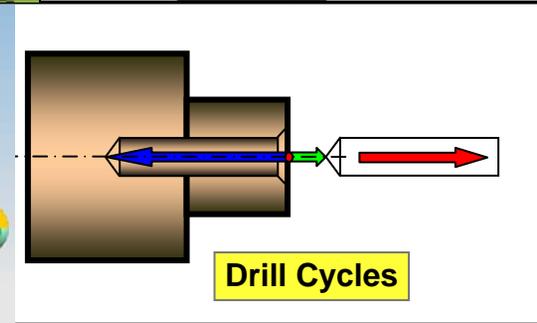
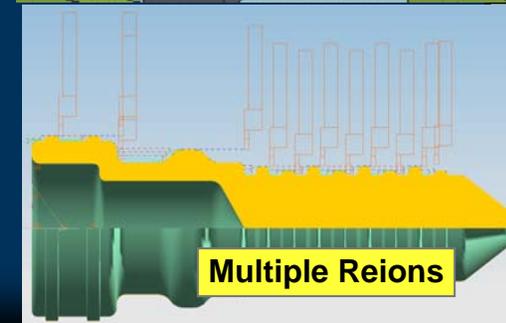
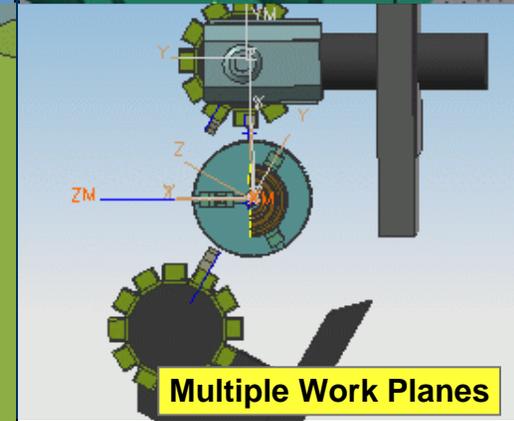
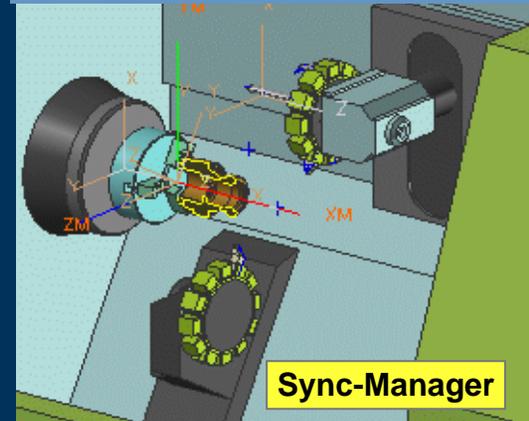
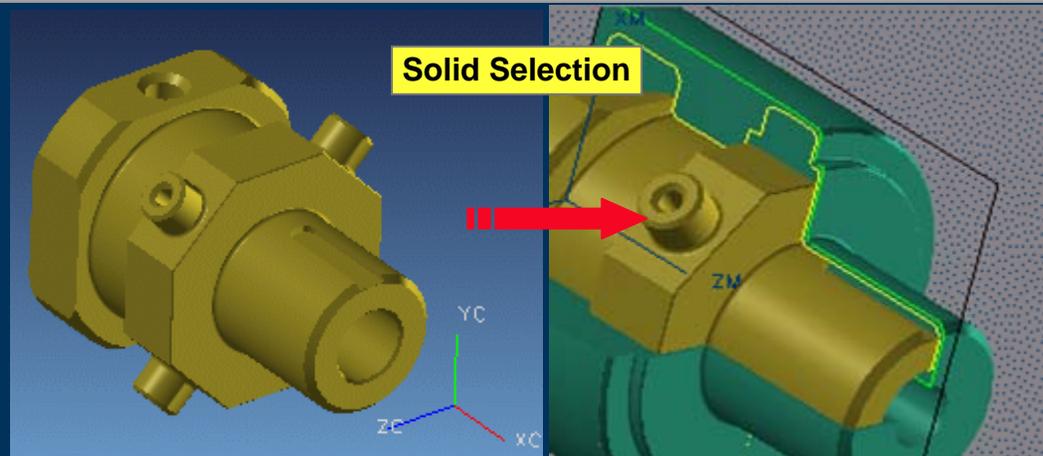


Directions

- ▶ Improve usability
 - ▶ Support complex cross-sections
- ▶ Support the functions of Mill/Turns and 4-Axis Lathes

NX 4 Projects

- ▶ Solid selection
- ▶ Sync-Manager Enhancements for multiple spindles
- ▶ Multiple Work Plane for multiple turrets
- ▶ Multiple Cut Regions in one operation
- ▶ Controller Drill Cycles





NX4 Multi-Axis Milling

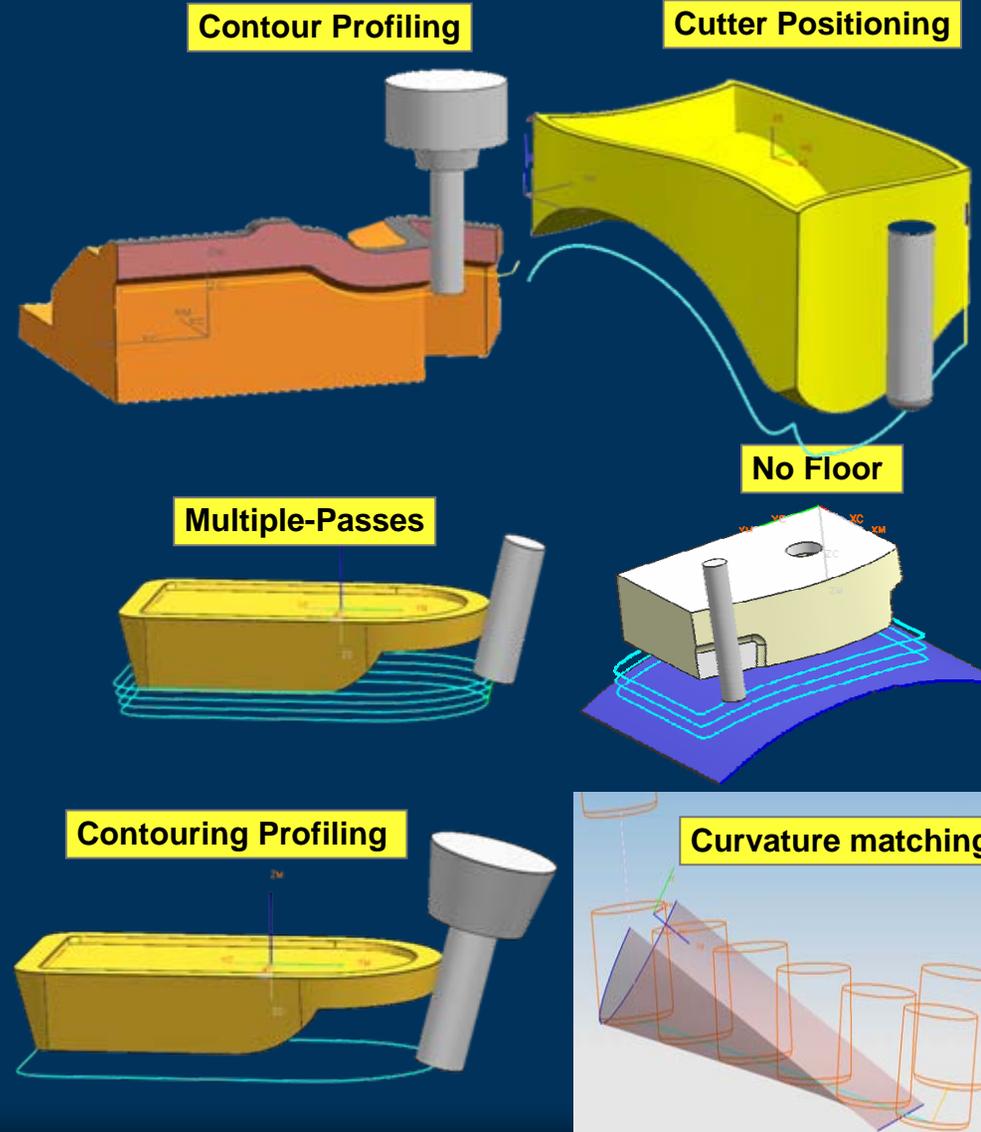


Directions

- ▶ Provide Highly Automated Processors
- ▶ Reduce User interaction

NX 4 Projects

- ▶ Contour Profiling
- ▶ Cutter Positioning
- ▶ Multiple Passes
- ▶ No Floor Machining
- ▶ Contour Profiling
- ▶ Curvature Matching





NX4 Integrated Simulation & Verification



Directions

- ▶ Provide a virtual machining environment
 - ▶ Material Removal
 - ▶ Machine Tool Simulation
 - ▶ Cutter path Verification

NX 4 Projects

- ▶ Integrated IPW for Mill/Turns
- ▶ Gouge Checking Consolidation
- ▶ ISV Enhancements



Operation Navigator - Program Order

Name	Toolchange	Path	Tool	Gouge Check
NC_PROGRAM				
NONE				
ZLEVEL_PROCESS				
ZL_PRE_ROUGH_ZL	█	✓	UGT0202_001	✓
ZL_ROUGH_ZLEVEL_STEEP	█	✓	UGT0203_009	⚠
ZL_ROUGH_FLOWCUT	█	✓	UGT0203_009	✖
ZL_SFIM_FLOWCUT	█	✓	UGT0203_010	⚠
ZL_ROUGH_NON_STEEP...	█	✓	UGT0203_009	✖

Gouge Checking Consolidation

- Checked
- Warnings
- Errors
- Gouges found
- Not checked





▶ Usability

- ▶ Feature Based Machining
- ▶ Complex Machining
- ▶ Integrated Machine Validation
- ▶ Quality
- ▶ Machine Kits



NX 5 Usability Objectives



- ▶ Simplify learning
- ▶ Ease of use
- ▶ Improve discoverability for new users
- ▶ Increase consistency
- ▶ Make it easier to use for all users





Ease of learning & use – Dialog consistency

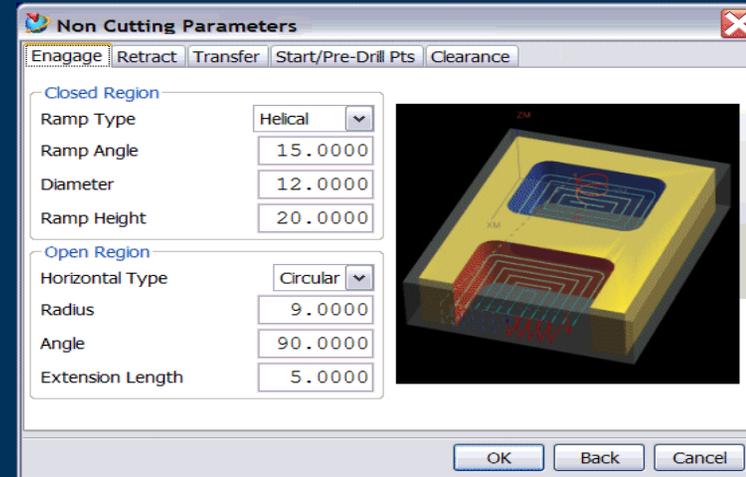


Capabilities

- ▶ Dialog presentation and interaction consistency
- ▶ Improved dialog display and interaction
- ▶ Edit dialogs are equivalent to creation

Why is it important to you?

- ▶ Makes NX consistent and predictable through use of standard “blocks”
- ▶ Learning task is much reduced for all users
- ▶ Amplifies the return from advanced NX capabilities and productivity tools



This is a very large project



NX5 Velocity Projects



- ▶ Role Based Environment
- ▶ Updated UI Dialogs
 - ▶ Streamlined
 - ▶ Consistent
- ▶ Operation Navigator (ONT)
- ▶ Easy to load posts/libraries
- ▶ Teamcenter Express Integration
- ▶ Misc. Projects

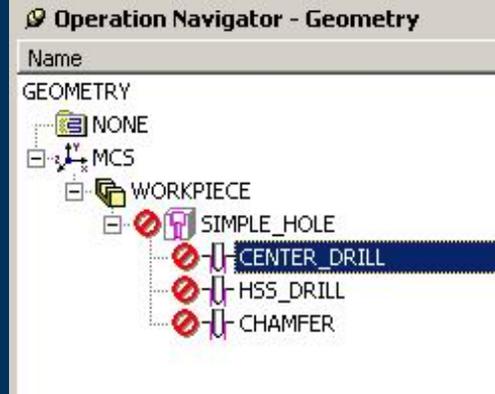
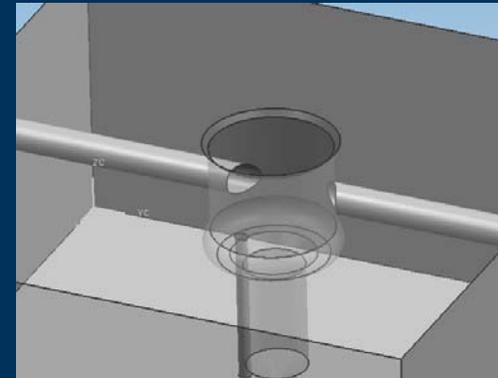




NX 5 Topics



- ▶ Usability
- ▶ **Feature Based Machining**
- ▶ Complex Machining
- ▶ Integrated Machine Validation
- ▶ Quality
- ▶ Machine Kits



	A	B	C	D	E
1	PROCESS	MIN_DIA	MAX_DIA	MACHINE	OPERATIONS
2	1	4	20	HERMLE	CARBIDE_DRILL
3					CHAMFER
4					
5					
6	2			EXCELLO	CENTER_DRILL
7					HSS_DRILL
8					CHAMFER
9					
10					
11	3			DECKEL/M	SPOT_DRILL
12					HSS_DRILL
13					
14					



Feature Based Machining Projects



Feature Recognition

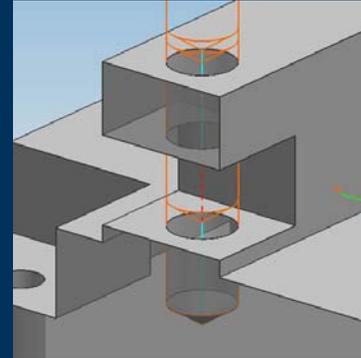
- ▶ Extends recognition to broken hole, interrupted holes, new features.

Feature Manager Enhancements

- ▶ Extends recognition to broken hole, interrupted holes, new features.

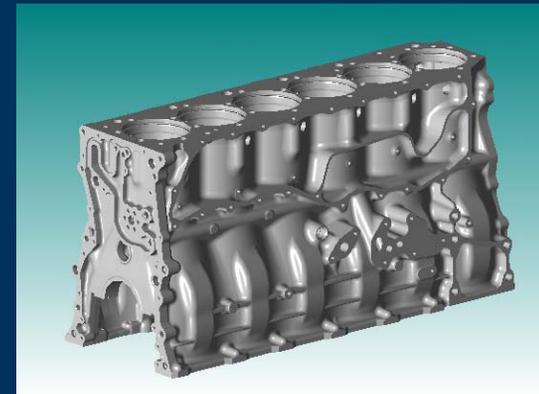
Manual Hole Making

- ▶ Simplified holemaking for Velocity



Why is this important to you?

- ▶ This expands the sets of features available to be processed
- ▶ It should expand usage by 25%
- ▶ Could allow complete automation of prismatic parts giving 10x productivity
- ▶ Heidelberg, W&H, EMF , eM Machining



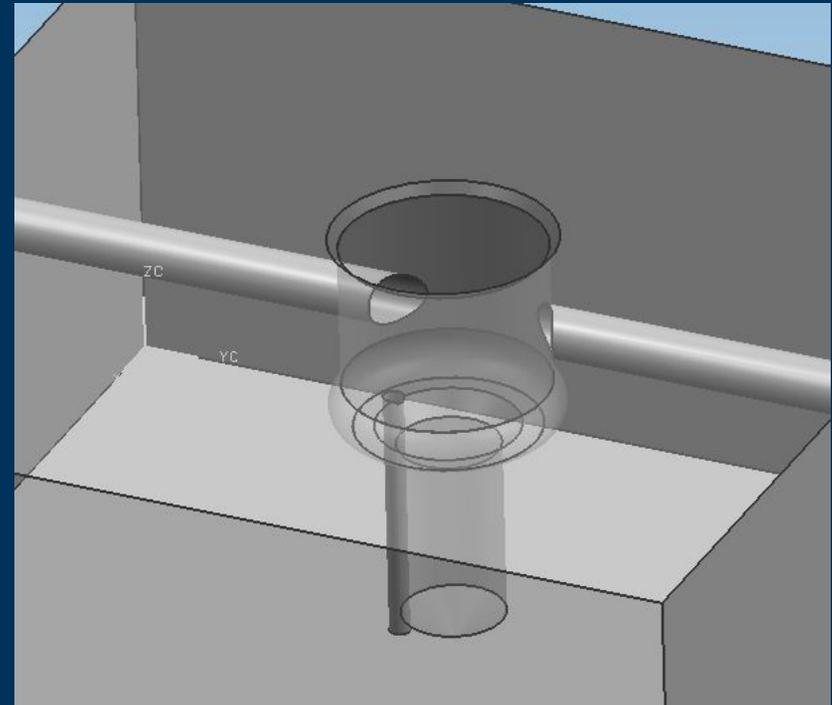


Feature Recognizer Enhancements

- ▶ Implement Feature Recognition components from eM-Machining
 - ▶ Open and interrupted holes
 - ▶ Blend support
 - ▶ Language enhancements (Cone/In, Cone/Out, etc.)

Why is this important to you?

- ▶ This expands the sets of features available to be processed
- ▶ Could allow complete automation of prismatic parts giving 10x productivity





Feature Manager Plans

- ▶ Navigator Implementation
- ▶ Other FBM Enhancements
 - ▶ Feature Update Report
 - ▶ Multiple Setup Support
 - ▶ Compound Feature Support

The screenshot shows the 'Manufacturing Feature Navigator' window. At the top, there is a table with columns: Feature Name, Feature Type, Geometry Gr..., and Status. The first row is highlighted and contains 'COUNTER_S...', 'CAD', and 'CAD'. Below this is a 'Details' section with a table of attributes and values.

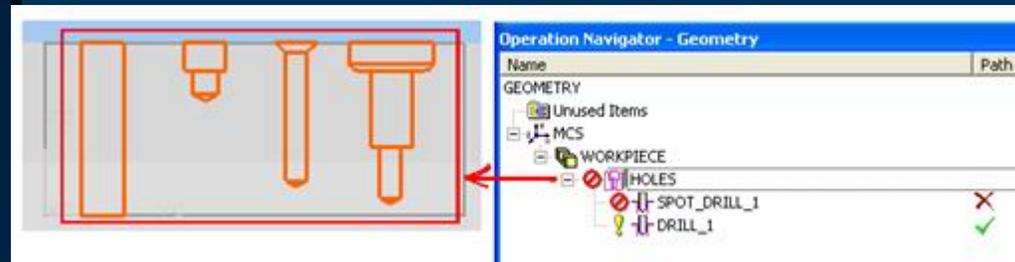
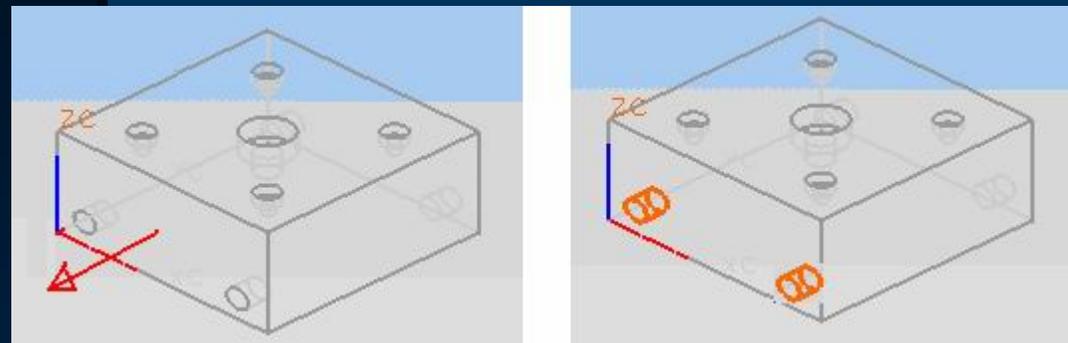
Attribute	Value
Hole Diameter	25.0000000000
C-Sink Diameter	50.0000000000
Hole Depth	50.0000000000
C-Sink Angle	82.0000000000
Tip Angle	118.0000000000

Below the details table is a 'Preview' section. A context menu is open over the preview area, showing options: 'Export to Browser', 'Export to Spreadsheet', and 'Properties...'. On the right side of the window, there is a vertical toolbar with various icons for navigation and actions.



Manual Hole Making

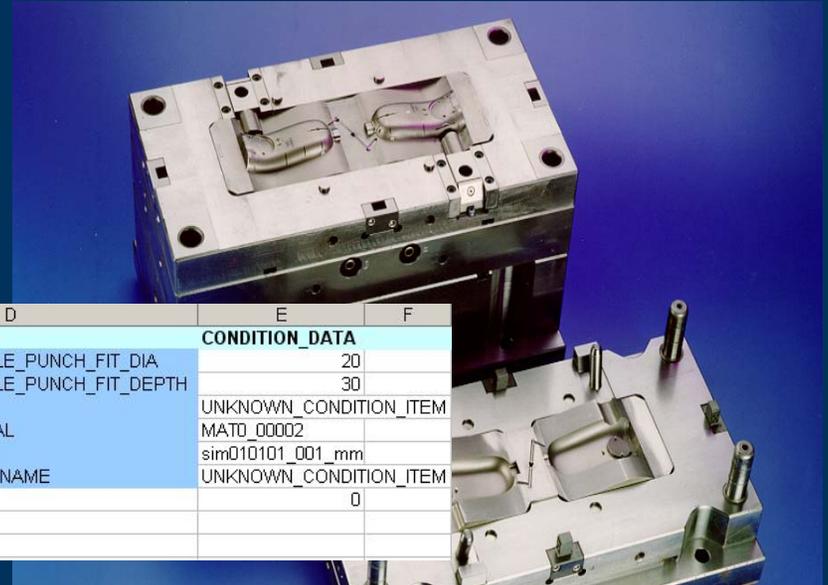
- ▶ Geometry selection similar to Point-to-Point
- ▶ More user control over point order and geometry selection
 - Faces, Edges, Arcs and Points
 - All Holes on Face / Solid
 - By Vector
 - By Min Max Diameter/Depth
 - By Blind / Through
 - Recognizer powered hole detection





New Mold/Progressive Die Wizard Support

- ▶ FBM Process and data per Excel
- ▶ Generic Template
- ▶ Can also be used for non MW/PDW

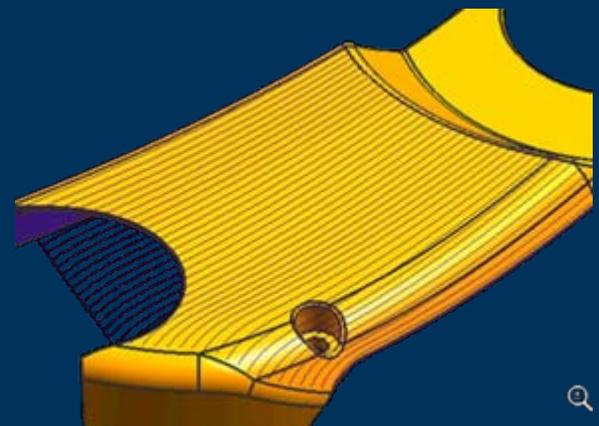
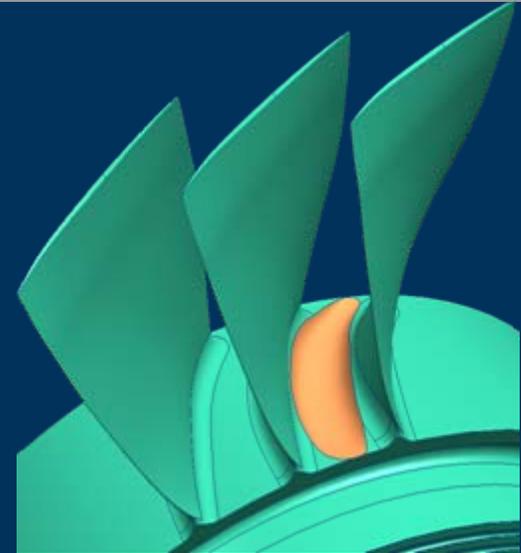


A	B	C	D	E	F
1	PROCESS	CONDITION_RULE	CONDITION RULE DESCRIPTION AND COMMENTS	CONDITION_ITEMS	CONDITION_DATA
2	1	FALSE	DIAMETER <= 12	FTR_NUM_PDW_HOLE_PUNCH_FIT_DIA	20
3		TRUE	DIAMETER >= 5	FTR_NUM_PDW_HOLE_PUNCH_FIT_DEPTH	30
4		TRUE	PART_MATERIAL = MAT0_00002 (Carbon Steel)	FEATURE_HEIGHT	UNKNOWN_CONDITION_ITEM
5			TOOL AVAILABILITY CHECK = YES	SYS_PART_MATERIAL	MAT0_00002
6				SYS_MACHINE	sim010101_001_mm
7	2	TRUE	DIAMETER <= 25	PDW_COMPONENT_NAME	UNKNOWN_CONDITION_ITEM
8		TRUE	DIAMETER >= 12.001		0
9		TRUE	PART_MATERIAL = MAT0_00002 (Carbon Steel)		
10			TOOL AVAILABILITY CHECK = NO		

A	B	C	D	E	F	G		
1	PROCESS	OPERATIONS	OPERATION_TYPE	OPERATION_DATA	TOOL_DATA	CYCLE_DATA	TOOL_AXIS	DEPTH
2	1	SPOT_DRILL	HOLE_MAKING	OP_SPOT_DRILL	TOOL_DATA_SPOT_DRILL	DRILL	SYS_DEF	ug_cam_spot_drill_standard()
3		HSS_DRILL	HOLE_MAKING	OP_HSS_DRILL	TOOL_QUERY_HSS_DRILL	CD_HSS_DRILL		MODEL
4								
5	2	SPOT_DRILL	HOLE_MAKING	OP_CENTER_DRILL	TOOL_DATA_SPOT_DRILL	DRILL		
6		HSS_DRILL	HOLE_MAKING	OP_HSS_DRILL	TOOL_QUERY_HSS_DRILL	CD_HSS_DRILL		MODEL
7		CHAMFER	HOLE_MAKING	OP_CSINK	TOOL_DATA_CSINK	DRILL_CSINK		ug_cam_chamfer_dia_percent
8								
9	3	SPOT_DRILL	HOLE_MAKING	OP_SPOT_DRILL	TOOL_DATA_SPOT_DRILL	DRILL		ug_cam_spot_drill_standard()
10		HSS_DRILL	HOLE_MAKING	OP_HSS_DRILL	TOOL_QUERY_HSS_DRILL	CD_HSS_DRILL		MODEL
11								
12	4	SPOT_DRILL	HOLE_MAKING	OP_CENTER_DRILL	TOOL_DATA_SPOT_DRILL	DRILL		
13		HSS_DRILL	HOLE_MAKING	OP_HSS_DRILL	TOOL_QUERY_HSS_DRILL	CD_HSS_DRILL		MODEL
14		CHAMFER	HOLE_MILL	OP_CHAMFER_MILL	ugt0201_110	-		MODEL



- ▶ Usability
- ▶ Feature Based Machining
- ▶ **Complex Machining**
- ▶ Integrated Machine Validation
- ▶ Quality
- ▶ Machine Kits





Directions

- ▶ Extending Mold & Die to Variable Axis
- ▶ Enhancements in HSM
- ▶ New Milling Pattern

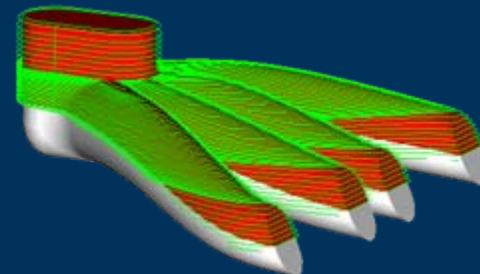
NX Projects

- ▶ Interpolated Tool Path
- ▶ 3+2 machining in Z-Level
- ▶ Expanded On-part
- ▶ Library Enhancements for User defined tools and tracing points
- ▶ Increased support for contact contour

Interpolated Tool path



Z-level

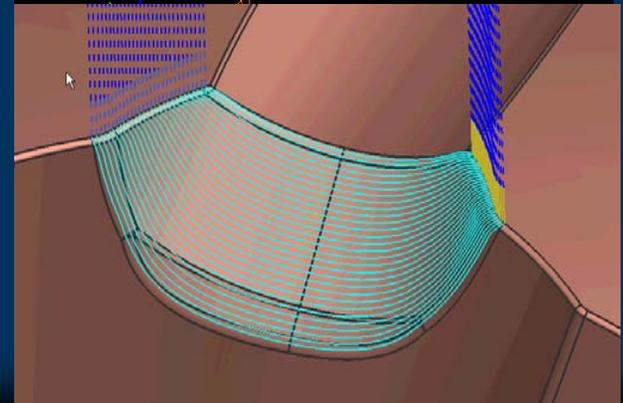
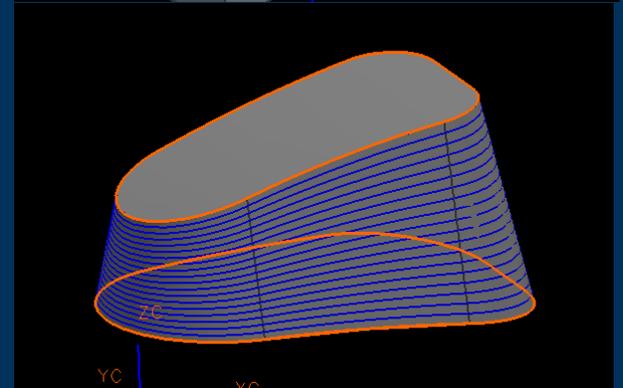
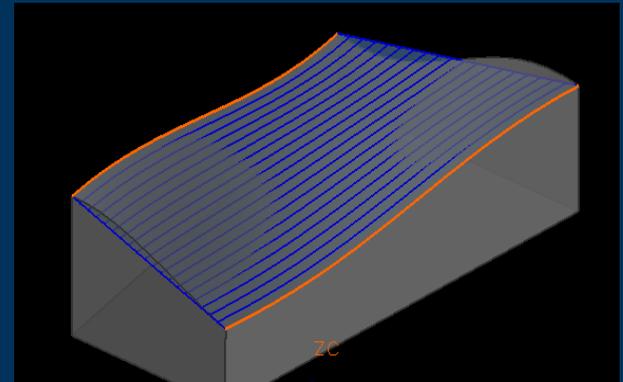




Interpolated Tool Path



- ▶ New Method of Selecting Geometry
- ▶ Cut Pattern will follow selected curves
- ▶ Tool paths will be morphed
- ▶ New cut patterns depending on curves that are selected
- ▶ Available to multiple processors



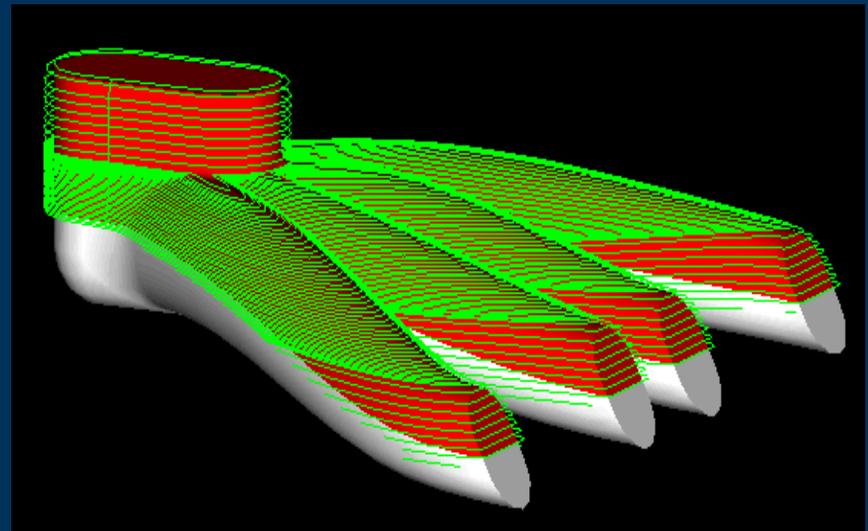


Capability in NX 5

- ▶ Control Z-level cut levels by specifying a maximum cusp height

Why is this important to you?

- ▶ Z-level finishing is an important technique for HSM
- ▶ Cusp control is essential to good semi-finishing and finishing





Interpolated Path

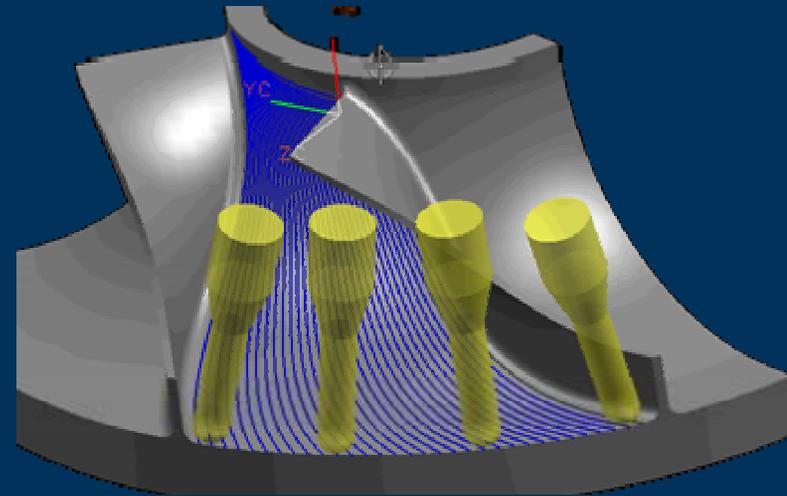
- ▶ Initial start of a new and improve Variable Axis Surface Contouring modules

Enhancement for Multi-Axis

- ▶ Source Contouring will be enhanced to support tilting of the tool
- ▶ Enhance Z-Level Profiling

Quality Enhancements

- ▶ Analytic Tool Path Ph 2



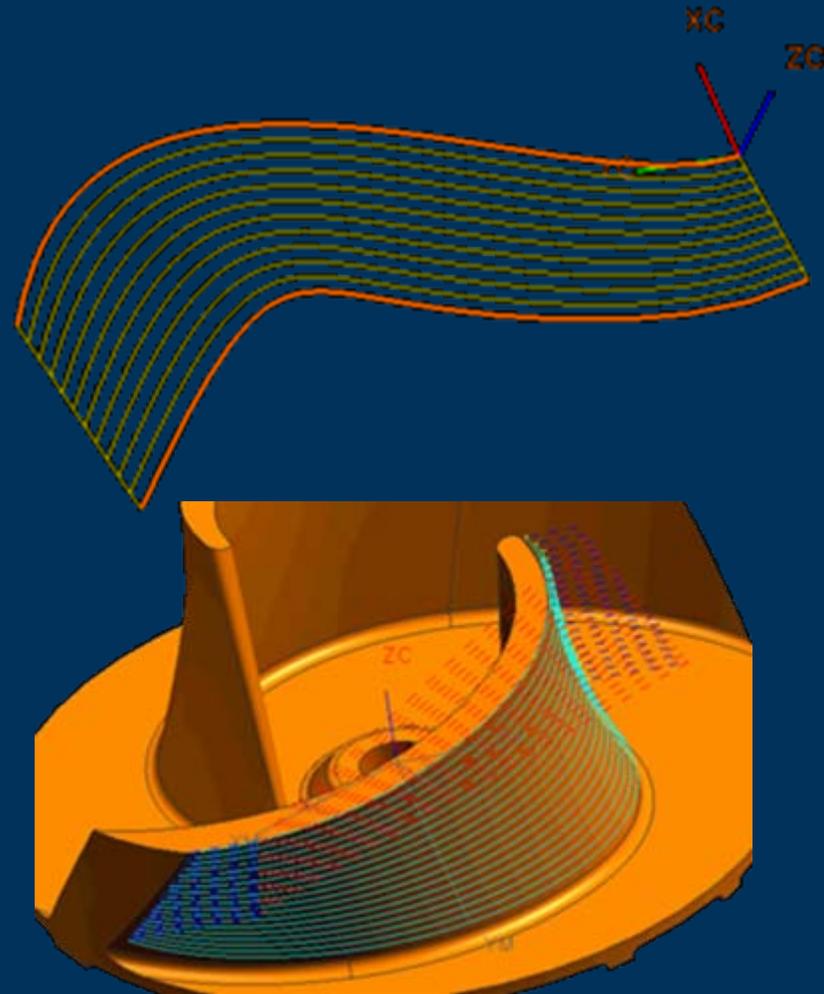


Capability in NX 5

- ▶ New Method of Selecting Geometry
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Why is this important to you?

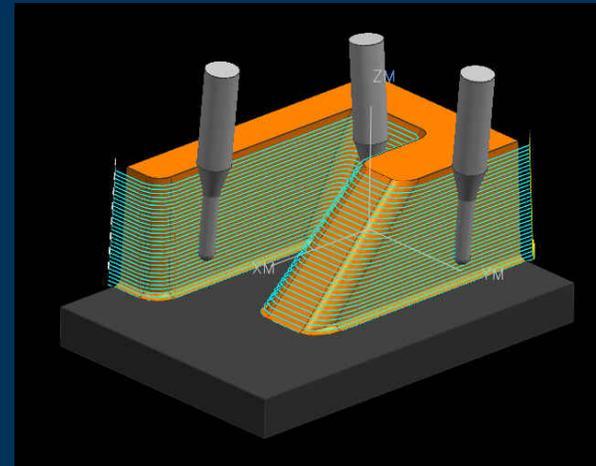
- ▶ It allows the user to define a variety of cut patterns for higher productivity and improved quality





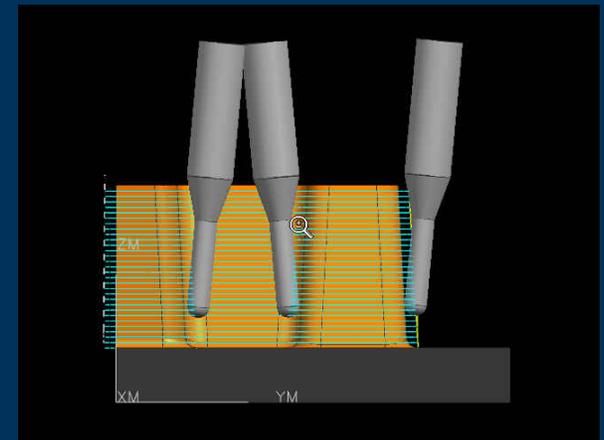
Capability in NX 5

- ▶ Provide 5-axis capabilities in volume roughing operation, Z-Level and eventually Cavity Milling.
- ▶ 5-axis moves appear only when needed



Why is this important to you?

- ▶ Better roughing leads to faster cycle times on the machine
- ▶ 5-axis roughing is growing industry item
- ▶ Product differentiator



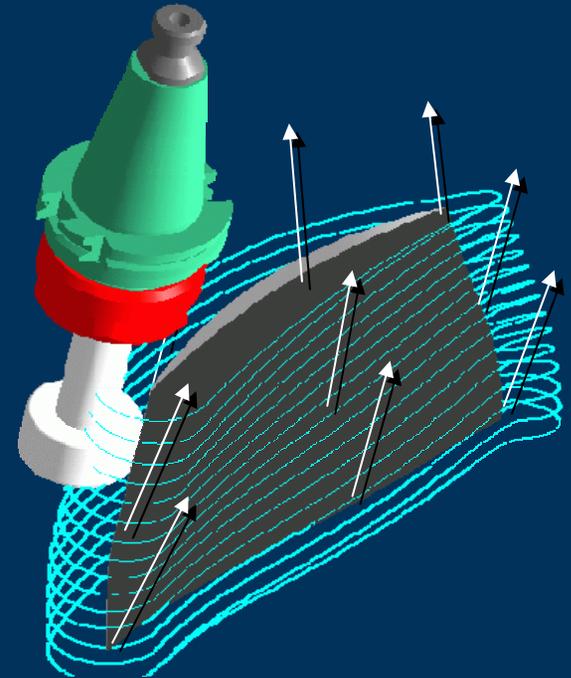


Capability in NX 5

- ▶ Initial start of a new and improve Variable Axis Surface Contouring modules
- ▶ Allows for improved user control over tool axis

Why is this important to you?

- ▶ This project will incorporate some of the new feature implemented in VAP for higher quality machining finishes.





- ▶ Usability
- ▶ Feature Based Machining
- ▶ Complex Machining
- ▶ Integrated Machine Validation
- ▶ **Quality**
- ▶ Machine Kits

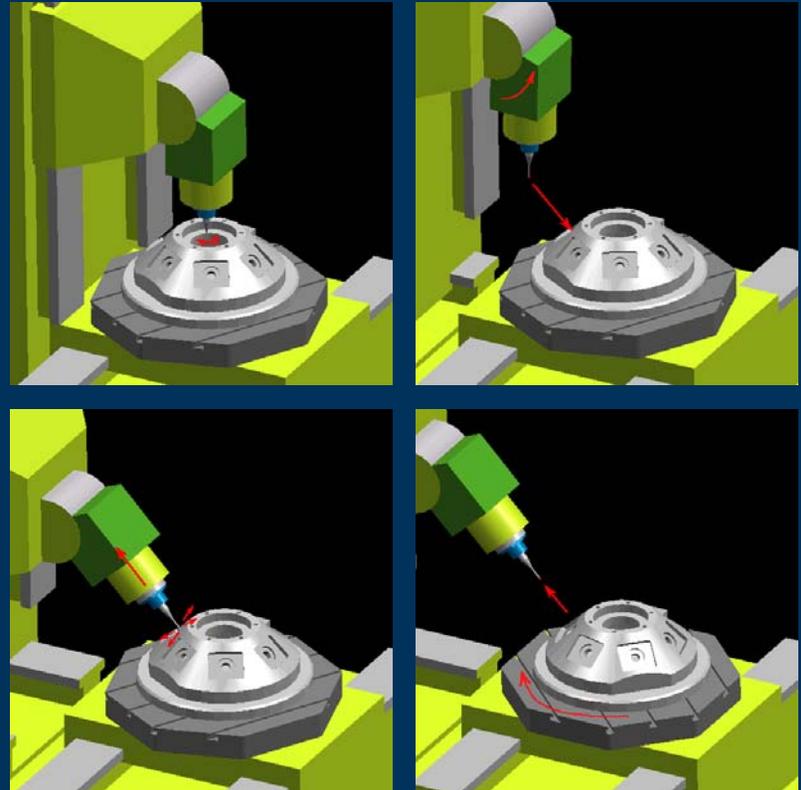


Capability in NX 5

- ▶ Provide operation type to drive probing tool
- ▶ Motion of probe similar to drilling cycles
- ▶ Feedback from probes delivered to Post for adaptive (closed loop) machining

Why is this important to you?

- ▶ Probing techniques and closed loop machining are very important to maintain consistent quality during production, especially with castings and forgings of variable size/volume.





- ▶ Usability
- ▶ Feature Based Machining
- ▶ Complex Machining
- ▶ Integrated Machine Validation
- ▶ Quality
- ▶ **Machine Kits**



Multi-Function Machine Kits

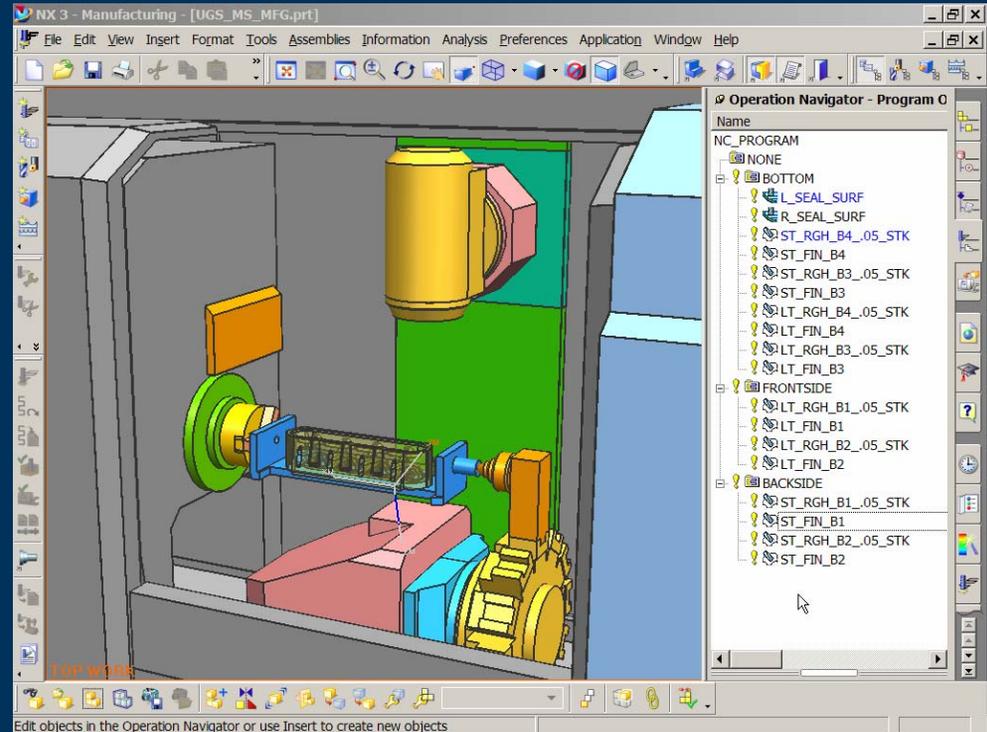


Capability in NX 5

- ▶ Kit will contain
 - ▶ Kinematics Model
 - ▶ Software Controller
 - ▶ Post processor
 - ▶ Templates

Why is this important to you?

- ▶ This will allow high productivity out of the box. Users can program complex machine tools and take advantage of new machine features with investment in machine models and posts.





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