NX Machining:
A complete solution for machine tool programming

NX™, the digital product development solution from UGS, delivers a complete and proven system for machine tool programming. NX Machining applies leading-edge technology and advanced machining methods to maximize efficiency of manufacturing engineers and NC programmers.
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Maximizing productivity and efficiency

With NX Machining, companies can transform their NC programming, manufacturing engineering and machining processes to dramatically reduce waste and significantly boost productivity of resources – both manpower and machinery.

Total design-to-manufacture connectivity

NX Machining is totally integrated with the NX product development solution. NC programmers can directly access comprehensive design, assembly and drafting tools in the same unified system. Design through manufacturing associativity means that design changes are automatically propagated to machining operations. With this complete development solution, programmers and manufacturing engineers can work with part models, create and assemble fixtures, develop tool paths and even model entire machines for 3D machining simulation.

An all-inclusive solution for machining:

Broad support of machine tools and operations

Milling
• 2- and 3-axis machining
• 5-axis milling
• Drilling
• Feature-based machining
• High-speed machining
• Engraving

Turning
• Turning
• Merging lathes
• Milling and turning combination

Other
• Electrical discharge machining (EDM)

A full set of applications

Design/assembly
• Fixture design
• Part and assembly modeling and editing
• Geometry translators

Automation tools
• Process templates
• Tool libraries
• Feeds and speeds data

Verification and simulation
• Tool path verification
• Machine tool modeling and kinematics
• Machine tool simulation

Output
• Postprocessor building and editing
• Shop documentation output
• Data management
The NX Machining advantage

NX offers an extensive array of tools for the NC programmer. Driven by the real-world requirements of manufacturing companies worldwide, NX Machining offers great flexibility in methods and a wide range of practical machine tool programming capabilities.

First-time quality through simulation
Companies using NX Machining can take advantage of integrated simulation tools to ensure that programs hit the shop floor with right-first-time quality, without requiring tryouts at the machine tool. Full material removal and machine tool motion simulation are immediately available in the NX programming environment - no separate system and no data translation steps are required.

Efficiency through leading technology
NX Machining improves efficiency with high-performance capabilities that help companies reap the benefits of the latest machine tool and machining technologies. It easily handles programming of multiple-function machines that eliminate multiple machines, setups and transit time. NX supports high-speed machining that maximizes cutting performance, material removal rates and surface finish. For advanced multiple-axis machining, NX enables faster programming with total tool control for the most complex parts.

Productivity through automation
NX Machining reduces programming time and required skill levels through advanced automation of the programming tasks. With feature-based programming, NX automatically creates optimized machine programs directly from part design models. Process templates and wizards ensure the use of preferred and proven machining methods. The result is high levels of quality in both the finished product and the process.

Experience and leadership
UGS is the world’s leading vendor of CAM software and services, according to the CIMdata research firm.*

All in one system
NX covers complete NC programming, building and executing postprocessors, tool path and machine motion simulation. In addition, its market-leading design and assembly software can be used to model the product, tooling and fixtures and to create 3D models of the machine tool for the simulation.

"The breadth and depth of functionality, data integration, and knowledge-based orientation of the NX CAM offering is impressive. NX includes robust capabilities across the entire CAM spectrum."
Alan Christman
CIMdata

NX Machining applications are fully integrated components of the NX product development solution, leveraging synchronized product and process data from design through manufacturing.
High-speed machining

Faster to finish
Delivery yesterday may be impossible – but with NX you have the tools to get there faster, more efficiently and at lower cost, while maintaining the target product quality.

Maximum productivity
With process automation, the latest tool path technology and unified solutions spanning tool design and manufacture, NX can help you achieve maximum productivity in mold and die work.

Extensive capabilities for efficient die/mold machining include Z-level roughing, semifinishing, steep and nonsteep area milling, uncut material removal, finishing and profiling. Feature-based machining and process-based automation can greatly reduce mold and die structure programming times.

High-speed machining: hard milling made easy
High-speed machining (HSM) techniques can provide significant savings in machining hard mold and die metals.

Uniform metal removal
Successful high-speed roughing maintains metal removal rates while managing tool loads. NX tracks remaining material at each cut and adjusts subsequent tool paths for best finish with least machining time.

PROVEN VALUE

"With UGS, we found software and support of the highest quality and performance. Results show us that our decision to introduce high-speed machining was right and we are now collecting the fruits of our investment: excellent accuracy and surface finishing with reduced manufacturing time."

CM Sole, Spain

With high-speed machining, the rate of metal removal should remain as constant as possible. Poor tool paths can cause sudden severe tool loading (as shown in the upper chart), resulting in broken tools. Simply reducing spindle RPM or depth of cut, as depicted by the yellow area on the chart, wastes the value of the machine tool and reduces productivity. NX tool path technology and HSM methods offer results depicted by the lower chart, with the highest metal removal rate consistent with good tool life, maximizing productivity and optimizing machine and tool utilization.
Faster and finer

**Consistent finish in steep and shallow regions**
The automatic addition of intermediate tool paths in Z-level in shallow regions leaves a constant depth of stock in semifinishing, ensuring uniform cutting in finishing operations.

**Smooth continuous cutting**
Various options for noncutting moves enable tangential connections between adjacent cuts. Smooth helical cutting can be achieved even on irregular shapes.

**Chatter-free machining for longer tool life**
Extensive research at UGS delivers recommendations for stable, chatter-free high-speed machining, critical for maximizing metal removal while extending tool life.

**Proven, integrated machining data**
NX includes a customizable machining database allowing the user to manage and apply proven data to associative tool path operations. A data set is included for P20, a typical steel for molds and dies.

**Fast tool path generation**
The latest software for Z-level rest-milling enables super-fast tool path computation. This allows tolerances to be tightened for highly accurate and robust rest-milling.

**Fine-tuned output for high-speed machining**
NX tool paths are fine-tuned for high-speed machine controllers. Uniformly distributed point-point, tangential circular records and NURBS output options enable users to match the method to the parameters of each task.
Proven multi-axis machining

Multiple-axis machining enables companies to produce precision complex parts efficiently with fewer operations and setups – reducing cost, waste and delivery times. Efficient and accurate multi-axis machining requires extreme flexibility in both parameter setting and cutting sequences. NX supports these requirements with sophisticated NC processors, multiple levels of control and user-defined drive methods.

Comprehensive

NX is the most comprehensive multi-axis NC programming system available. With proven capability developed from years of experience in aerospace and related industries, NX offers efficient and accurate multi-axis machining. It supports a range of methods for defining precisely controlled tool paths on complex surfaces, with effective collision and gouge checking.

Flexible

NX includes many flexible methods for defining precisely controlled tool paths on complex surfaces. Variable-axis milling includes multiple drive methods with a wide range of tool axis control options. These are coupled with the effective collision and gouge checking that is essential on many jobs.

PROVEN VALUE

“People say that you have to use a programming language such as APT to get total control over machine function. But we have total control with NX CAM and it’s much faster than hand coding. With NX, we can get the tool to do anything we want, even for something complex like 5-axis finishing.”

Brian Carlson
NC Programming Manager
Aerospace Dynamics International
Variable-axis surface contouring and a set of tool axis interpolation options allow 5-axis machining on the most demanding of parts.

NX enables fast, accurate roughing and finishing of typical aerospace parts. Geometry selection in highly automated for easier, faster programming.

NX Simulation provides 5-axis programmers with the essential tools for proving out their machine motion.

PROVEN VALUE

“With NX, we get consistent and error-free tool paths, and we haven’t run across anything we couldn’t program with this software. By supporting state-of-the-art machine tools, NX is a key element of how we’re speeding time-to-market.”

Bob Curwood
NC Programming Supervisor
Smiths Aerospace Mechanical Systems
Landing Gear and Hydraulic Systems
NX offers a complete range of machining capabilities enabling support for the latest multi-function machines.

Not all systems can offer both high caliber turning and milling. In addition, the programming often requires more complex positioning, work coordinate and tool-axis control. NX has a highly flexible machining configuration to accommodate these demands.

**Synchronization manager controls multiple functions**
NX provides a dynamic display of each machining function as a channel on the display. Start and wait code control the flow of each phase of the machining process. Integrated machine tool simulation provides visual validation of the entire process.

**Postprocessing for multi-function machines**
Each machine function requires a specific postprocessor stream which is combined into one synchronized output set. Not limited by CL file content, the NX postprocessor connects directly to the internal tool path definition. It can access any information in the NX machining database, enabling automated software decisions at the postprocessing stage.

**NX post builder**
Customers and solution implementers can create or edit postprocessors, working from example configurations and their own specifications. Standard postprocessors for typical machine and controller configurations can easily be edited. NX also creates CLS files that can be used as input to third-party postprocessors.

**PROVEN VALUE**

“We have evaluated other CAD/CAM systems, and NX has always provided the best functionality of any system available – and it can support any machine tool we need to support with its robust processing capabilities.”

Bob Curwood
Supervisor of NC programming for landing gear and hydraulic systems
Smiths Aerospace
Maximizing productivity

Automation through process and setup templates
In order to make the task easier for the programmer, process-based machining in NX employs templates embodying typical machining methods for each machine type and configuration. By selecting and applying the templates to new jobs, many of the time-consuming tasks are automatically applied and specific machine control parameters are preset, making the task faster, easier and repeatable.

Machining simulation
Precise simulation is essential to optimizing the complex interactions of multiple parts of the machine. NX offers full tool path and machine tool motion simulation. Motion simulation is driven by the postprocessed output – and it all happens in the NX programming environment.
Programming automation

Automation in NC programming provides a major opportunity for competitive business advantage. Automation makes programming much faster and repeatable and it provides expert results every time.

Maximum productivity
Software that can apply the knowledge and skill of experts, automating the same decision processes, maximizes the productivity of the everyday user.

Maximum resource utilization
Software that applies proven methods, tooling and fixtures automatically ensures that the use of existing and preferred resources are maximized.

Practical automation
While fully automated design-to-machining solutions in NX can provide extraordinary business advantage, practical elements of automation applied to key programming tasks can transform even the most variable work.

Process wizards
For everyday use of common tasks, companies can use NX to build process wizards with easy-to-follow steps. Wizards can make complex software settings based on simple user selections.

Process templates
NX enables programmers to apply predefined process and setup templates that can be driven by rules. This automates and speeds the programming task, ensures the use of preferred methods and tooling and helps the less experienced user. The user can easily create new templates or modify existing ones.

Customization
With NX Machining companies can fine-tune the programming environment for maximum productivity using:
- Tool catalogs
- Machining data tables
- User interface customization
- Wizards and templates

Siemens subsidiary Demag Delaval Industrial Turbomachinery Ltd. uses knowledge-based manufacturing applications created with NX to make NC programming an automatic, repeatable process.

Incorporating proprietary programming know-how within templates and process assistants, the company now begins NC programming while the design is in progress, eliminating delays of up to three months. NC programmers now support 40 additional CNC machines, and tooling costs have been reduced through standardization.

PROVEN VALUE

The NX Machining Wizard Builder provides an easy graphical way to construct custom wizards to support your shop best practices. No programming skills are required.

A familiar wizard interface steps the user along a predefined programming process. Wizards like these can help standardize programming operations and capture knowledge for the future.

> Maximum programmer productivity
Feature-based machining
NX programming automation directly builds on manufacturing features in part models. Feature recognition, even from imported wire frame geometry, together with automatic process selection and tool path generation, can reduce programming time by more than 90 percent compared to standard techniques.

Feature manager
The feature manager allows the programmer to easily see all manufacturing features by type, detail and programming status.

> Users report up to 90 percent reduction in programming times

Feature identification
• Automatic
• By feature type

Method selection
• Templates
• Rules
• Parameters

Automatic tool path generation
• Type
• Method
• Tools

Tool path optimization
• Tool changes
• Tool path length

 Manufacturing output
• NC program
• Shop documentation
• Process information
• Analysis
Machining simulation

NX Machining provides fully integrated tools for simulation and validation of the entire machining process. The solution is scalable from tool path display, through dynamic material removal, to full machine tool motion simulation.

Tool path verification
NX allows immediate replay of the computed tool path with a range of display options, including dynamic material removal from the stock model.

Machine tool simulation
Full machine tool simulation within NX Machining displays motion driven from the G and M code output of the NX internal post-processor. A 3D solid model of the machine, with the part, fixtures and tooling, moves in the way the machine tool will move as the machine code is processed.

Collision detection
NX Machining automatically provides checking for actual or near collisions between the part, the in-process workpiece, tooling and fixtures and the machine tool structure.

Full data display and control panel
The user can see the NC program running in the program window, shown as “goto statements” or as G and M codes from the posted output. Other data such as coolant status is also shown.

Easy-to-use replay controls
Programmers have easy-to-use onscreen control buttons that work like a standard video player. The user can vary the program run speed, stop, back up or move to a specific part of the NC program.

Simultaneous display
With NX, programmers can review simultaneous metal removal with a live tool path in the context of a full machine tool simulation, with dynamic pan and zoom of the view.
Multiple levels of simulation

Generic simulation
Similar to many systems that utilize an internal tool path, a CL file or another prepost output to drive the simulation, NX offers a means to drive its machining simulation from the prepost processor data. For many machines this provides adequate accuracy.

Postprocessor-driven simulation
For more advanced simulation and higher levels of accuracy for advanced machines, NX Machining uses the output of the production postprocessor as G and M codes. This provides a more complete representation of the machine tool motion and reduces the possibility of errors. For users of advanced machines such as mill-turns or merging lathes, this is the preferred solution.

Controller-driven simulation
By adding software within based on the real controller, UGS can offer the most accurate representation of the machine tool motion. Accelerations, speeds and timings as well as controller-specific machining cycles can be simulated.

NX Machining – built in 3D modeling and assemblies
For users who wish to create or edit their own simulation models, there is access to full geometry modeling and assembly capabilities, all in NX. This means that not only can the programmer edit part or stock shapes, but also tools, complex fixtures and even the entire machine tool can be modeled. NX assemblies modeling allows all elements to be correctly positioned ready for interactive programming and simulation.

Simulation, sample machines included
NX Machining is offered in packages that include machining simulation as a standard capability. Also included is a set of typical 3D machine examples. These can be modified by the user with the graphical tools provided.

Machine tool support kits
For advanced machine tools, support kits provide an out-of-the-box solution that includes:
• Proven postprocessor
• 3D simulation model (NX solids assembly)
• G and M code simulation driver
• Example parts, templates and documentation

No need for duplication
With tool path verification and machine tool simulation included in NX Machining, there is no need to duplicate data and effort or introduce errors by moving to third-party software solutions. The same models and assembly of the parts, stock, fixtures, tooling and the machine tool are employed in both programming and simulation, all within NX.
NX Machining has a wide range of milling capabilities. Fixed-axis milling delivers comprehensive tools for producing 3-axis motion tool paths. Automatic operations like cavity milling and flow cutting reduce the number of steps required to cut the part. Optimization techniques for operations such as planar milling help reduce cutting time for parts with multiple pockets.

**Turning**
Turning in NX can use either 2D part profiles or full solid models. It includes routines for roughing, multiple-pass finishing, grooving, thread cutting and centerline drilling. Programmers specify parameters such as feedrate, spindle speed and part clearance. NX turning enables A- and B-axis tool control. In addition to rich functionality for common tasks, a special “teach mode” capability provides extra user control for fine finishing and special cutting situations. NX is very flexible and allows programming in XY or ZX environments for horizontal, vertical or inverted vertical orientations.

**Wire EDM**
Facilitating the cutting of parts in 2-axis and 4-axis modes, the NX wire EDM programming works from wireframe or solid models. A wide range of wire operations are available, including multi-pass profiling, wire reversing and area removal. The package also supports paths that accommodate glue stops, various wire sizes and power settings. Broad support of wire EDM packages, includes AGIE Charmilles and many others.
Postprocessing and shop documentation

**Integrated postprocessing**

NX includes a post builder capability that graphically creates postprocessors for 2-axis through 5-axis motion. With the postprocessor builder, users specify parameters for the required NC codes and machine tool kinematics required to interpret the internal NX tool path.

The NX postprocessor builder can create the driver for the 3D machine tool simulation to match the postprocessor.

**Shop documentation**

Process documentation — including setup sheets, operations sequence information and tool lists — is often a significant time drain and process bottleneck. NX automatically generates shop documentation and outputs it in various formats, including ASCII text or html format for shop floor intranet access.

The NX machine tool builder allows the user to add the kinematics to a 3D assembly model of a the machine – all in NX.
NX managed development environment
NX provides a seamless capability to manage and synchronize product and process information across each phase of the lifecycle, utilizing Teamcenter® technology.

Design to manufacture
With manufacturing extensions the managed environment supports collaboration between product designers, tool engineers and all manufacturing disciplines.

The value of the managed environment for manufacturing specialists
Typically manufacturing staff spend up to 60 percent of their time just looking for information. Using the wrong data is often the cause of delay or material waste. Everyone with access to the managed development environment can find and apply the correct data needed for their task, saving time and ensuring right-first-time process and product quality.

“Teamcenter Manufacturing is a powerful and unique product. No other product offers such extensive and distinctive information management functionality that is focused on manufacturing. It serves as the information management engine for all NX 3 manufacturing applications. The integrated combination of CAM, digital manufacturing and tool design utilizing Teamcenter Manufacturing as the core component, provides a solution that is unmatched in the industry.”

Alan Christman, CIMdata vice president and noted authority on NC software and market trends.

NC programming
The NX managed environment provides a means to manage NC programming data, including tool paths, output code, shop documentation, tooling and setup data, all linked to the part model.
Fixture design
The managed development environment provides fixture designers with structured access to part models and libraries of standard components that streamline development of workholding fixture assemblies for machining.

Tool, fixture and general resource management
Using Teamcenter technology the managed development environment provides a resource library with full classification capability. The data may be retrieved directly into applications such as NX Machining.

Manufacturing engineer
Process planning
Manufacturing engineers can build process plans using UGS’ Technomatix™ applications that are fully compatible with the managed environment.

Shop floor output
Correctly configured packages of data can be sent from the managed environment to the point of manufacture, including tool and fixture lists, postprocessed data, setup sheets and work instructions.

Synchronized product and process data
The NX portfolio offers a set of highly automated solutions for mold and die design. NX Mold Wizard, NX Progressive Die Wizard and NX Transfer Die Design dramatically reduce the time required to create fully functional tools – and just like an expert.

The shared technology of NX means that NX tool design applications and NX machining are a combination providing unmatched process time reductions, maximum efficiency and highly repeatable product quality.

**Transfer die design**

NX offers a set of process-oriented tools to address die process specification, die layout, die analysis and detail die design. The package automates the more costly and time-consuming processes associated with the production of stamped sheet metal parts, significantly reducing their typical lead times.

**Integration with machining**

The automated tool design applications create mold and die faces, bases and structures that can be machined directly with NX Machining using shared 3D geometry and with associative updating for easy changes, all in one system.

**Progressive die design**

Progressive Die Wizard maximizes progressive die design productivity through intelligent automation of industry-proven processes. It provides a complete environment for progressive die design and encapsulates die making expert knowledge, while allowing flexibility to incorporate customer-specific requirements.

**Mold design**

NX Mold Wizard automates the entire process of designing mold faces and structure components directly from the part model. Key feature data added by Mold Wizard drives automated tool path programming in NX Machining.
The NX advantage

Throughout its broad product application suite, NX leverages key attributes that help companies achieve business objectives of waste reduction, quality improvement, shorter cycle times and greater product innovation. These unique attributes directly support business process initiatives aimed at transforming product development:

- **Managed development environment**
  NX solutions include fully integrated, synchronized management of all product data and process knowledge to transform product development with a structured collaborative environment.

- **Unified product development solution**
  Seamless integration of NX applications rapidly propagates changes of product and process information, replacing point solutions with a unified development system, from concept to manufacturing.

- **Knowledge-driven automation**
  With NX, companies can apply product and process knowledge across all elements of product development to automate processes and maximize re-use.

- **Simulation, validation and optimization**
  Comprehensive simulation and validation tools in NX automatically check performance and manufacturability at every step of the development process for closed-loop, continuous, repeatable validation.

- **System-based modeling**
  NX structured conceptual models standardize design practices and allow rapid creation of variants, transforming development from component-based design to a systems engineering approach.
About UGS
UGS is a leading global provider of product lifecycle management (PLM) software and services with nearly 4 million licensed seats and 46,000 customers worldwide. Headquartered in Plano, Texas, UGS’ vision is to enable a world where organizations and their partners collaborate through Global Innovation Networks to deliver world-class products and services while leveraging UGS’ open enterprise solutions, fulfilling the mission of enabling them to transform their process of innovation. For more information on UGS products and services, visit www.ugs.com.

UGS leads to greater innovation
There is no single road to innovation, but there are signs you’re headed in the right direction. Leading innovators get to market faster, manage compliance, optimize resources and achieve globalization. They’re also four times more likely to use PLM software to plan, define, build and support their products. UGS’ family of PLM solutions helps businesses establish Global Innovation Networks that transform their process of innovation. Drive your business to greater innovation and accelerate your growth.