

NX CAM : Utilizing CNC Machine Simulation Software to Improve Process Efficiency

Philip D. Ramirez

Hughes Christensen

philip.ramirez@hugheschris.com

(281) 363-6950

Jim Huddy

CGTech

Jim.Huddy@cgtech.com

(949) 753-1050

Company Background

- Hughes Christensen is a leading provider of drill bits and services to the oil, gas and geothermal drilling markets.
- A Baker Hughes company
- Headquartered in The Woodlands, Texas, with operations world-wide.
- 2004 gross revenues \$500M+



Worldwide Operations



World-wide Manufacturing

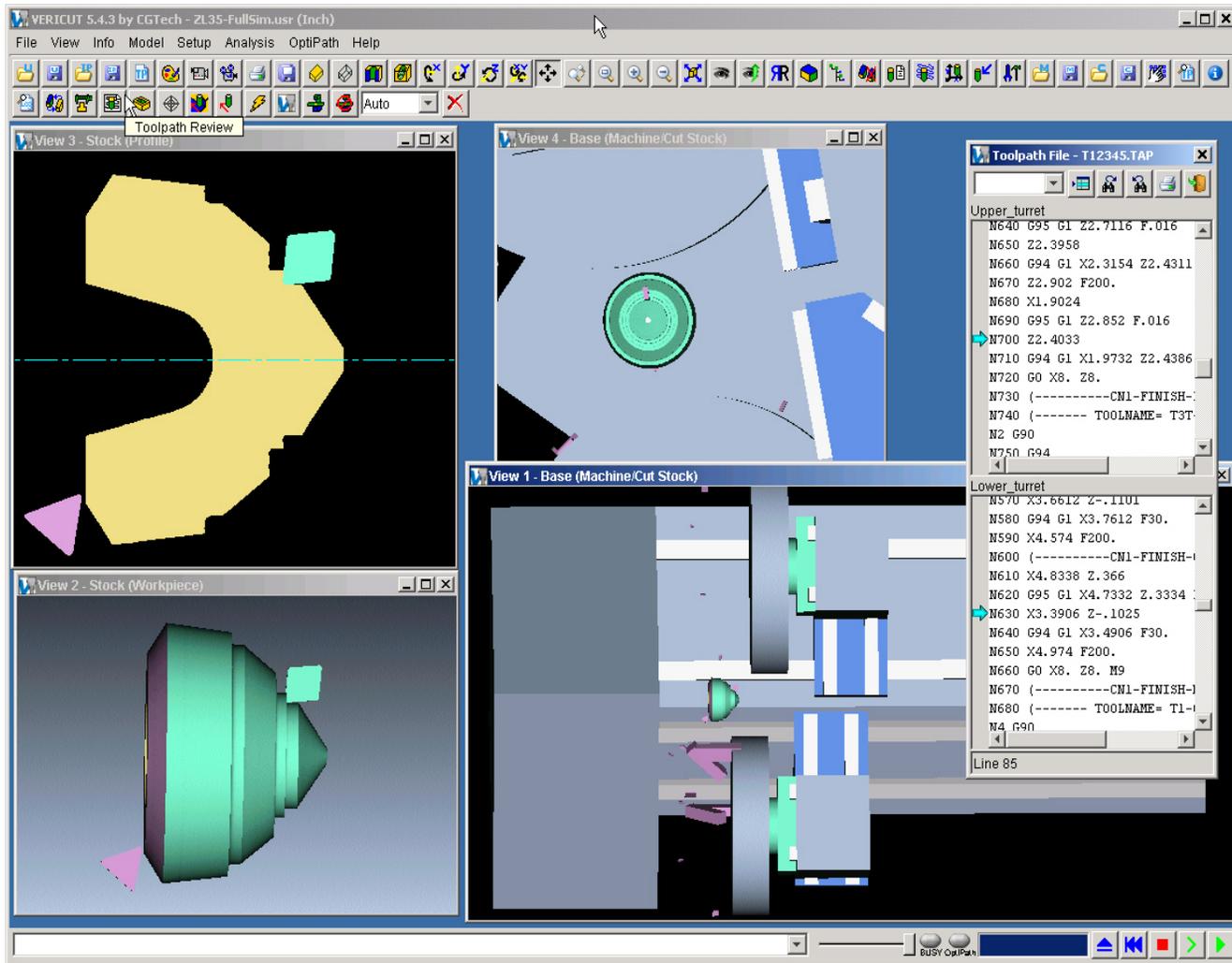
Problem Statement

- Very Complex parts are being machined.



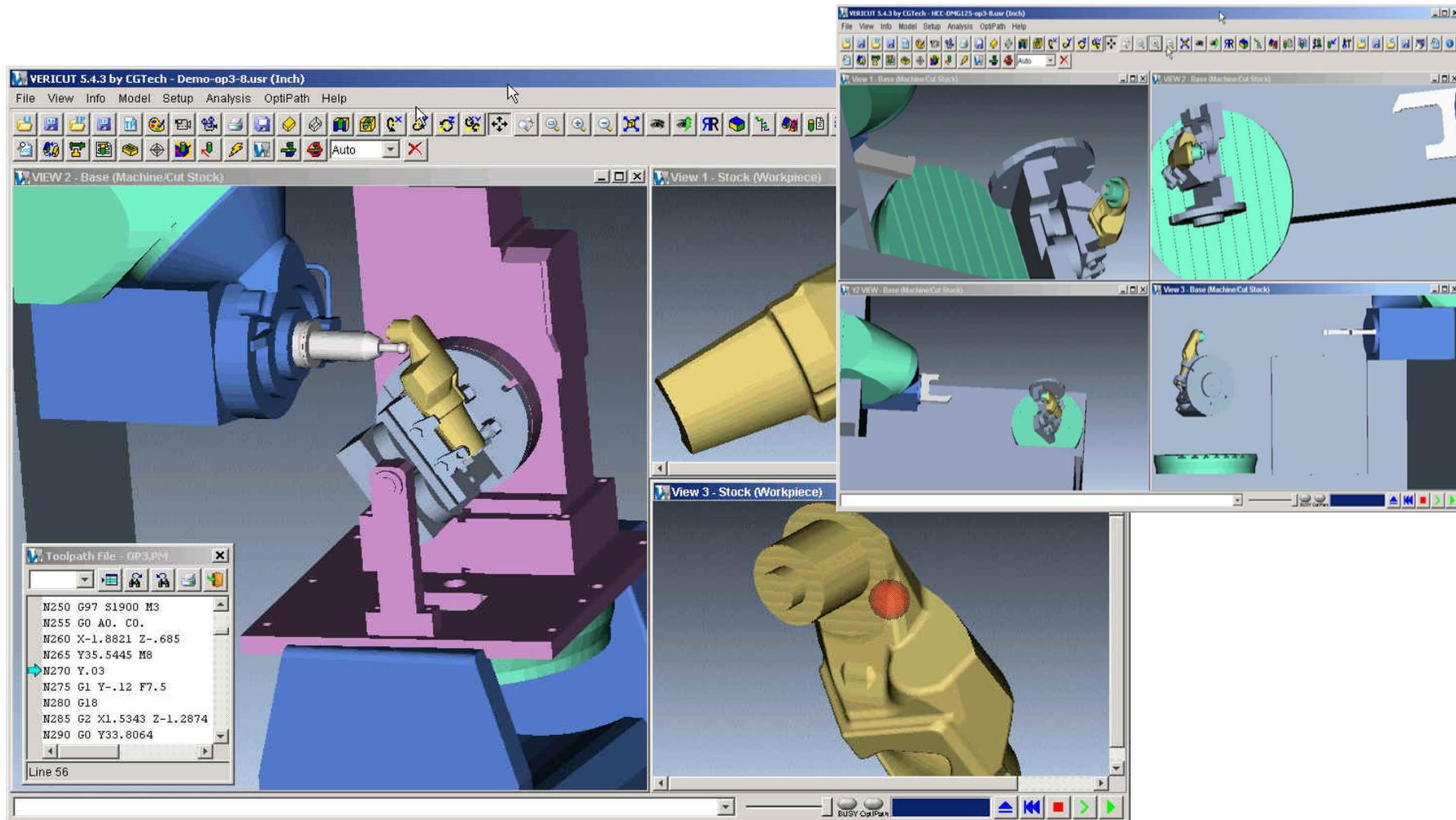
Problem Statement continued

- **Complex** 3, 4 axis lathes used to machine parts.



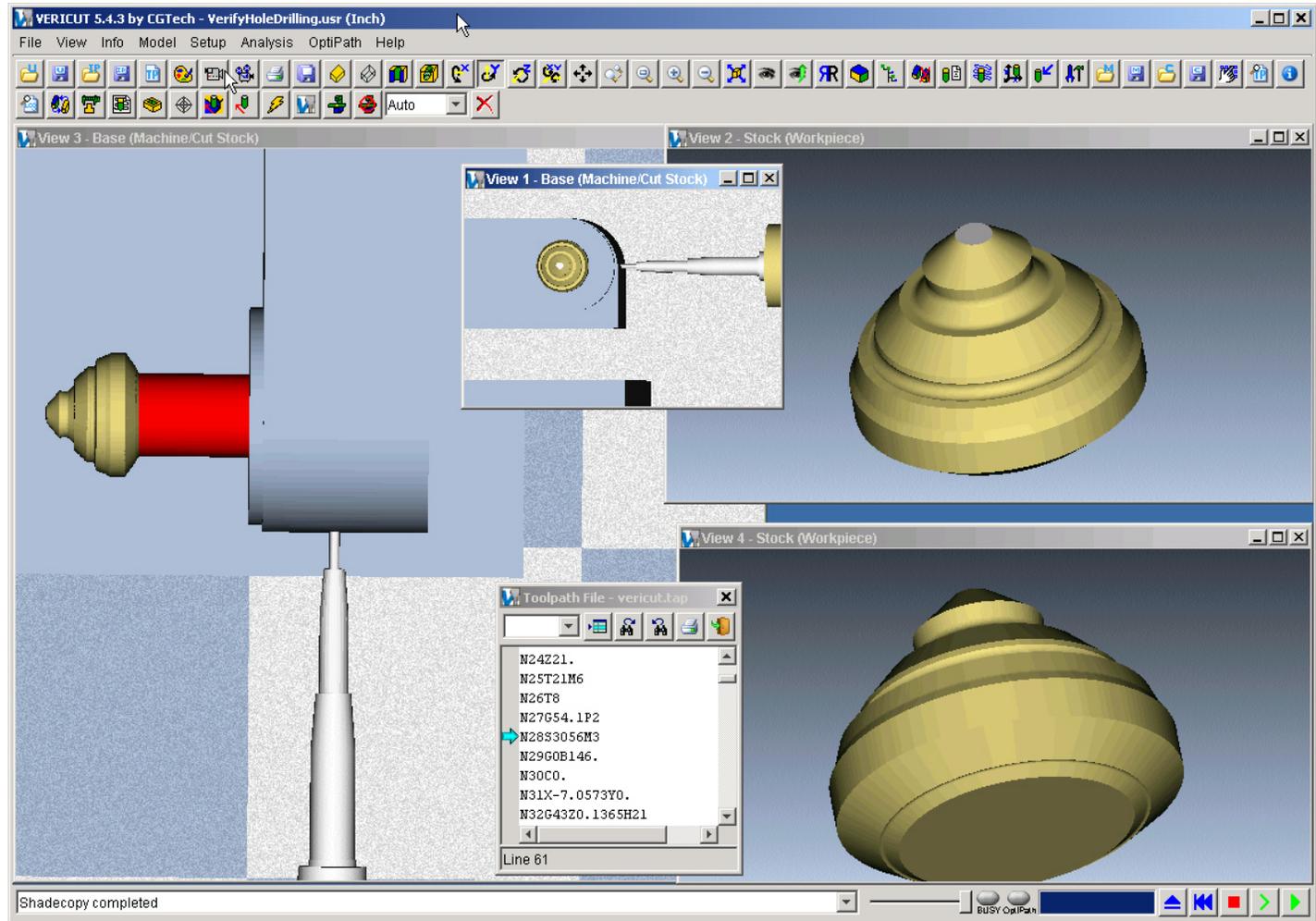
Problem Statement Continued

- **Complex** 4,5,6-Axis milling machines and fixtures are being used.



Problem Statement continued:

- Machine crashes are possible with **unproven** tapes.



Problem Statement Continued

- **Large quantities** of **new** parts must be programmed quickly to keep up with increasing demand.



Problem Statement Continued

- Scrapping parts due to NC programming errors is expensive because it wastes expensive parts and shop time.
- Dry running NC programs is time consuming and expensive because of lost productivity.

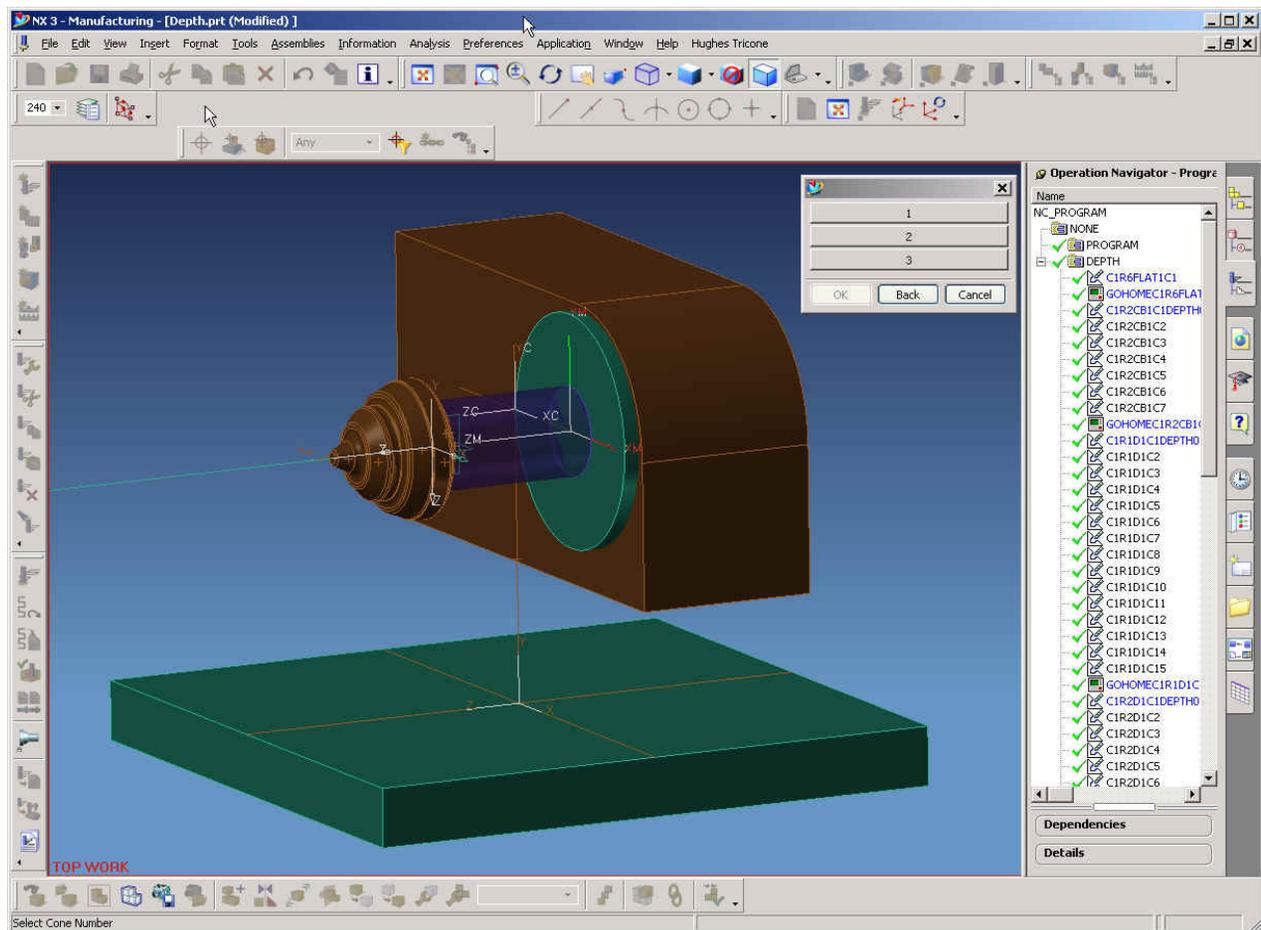


Solution:

- Automate NC toolpath creation using Unigraphics CAD/CAM system and Unigraphics **GRIP/NC**.
- Automate NC toolpath creation using Unigraphics **template models** and **assemblies**.
- Verify NC toolpath.
- Automate verification process as much as possible.
- Verify NC tapes **BEFORE** they get to the shop. This helps to prevent scrap.
- Verify NC Toolpath using **post-processed output** instead of using generic CAM operation simulation.

Benefits of Automating Using Unigraphics NX CAD/CAM

- Allows NC programmer to **quickly** and **easily** create **error free** toolpaths.
- Reduce NC program creation time from 2 days to **30 seconds**.

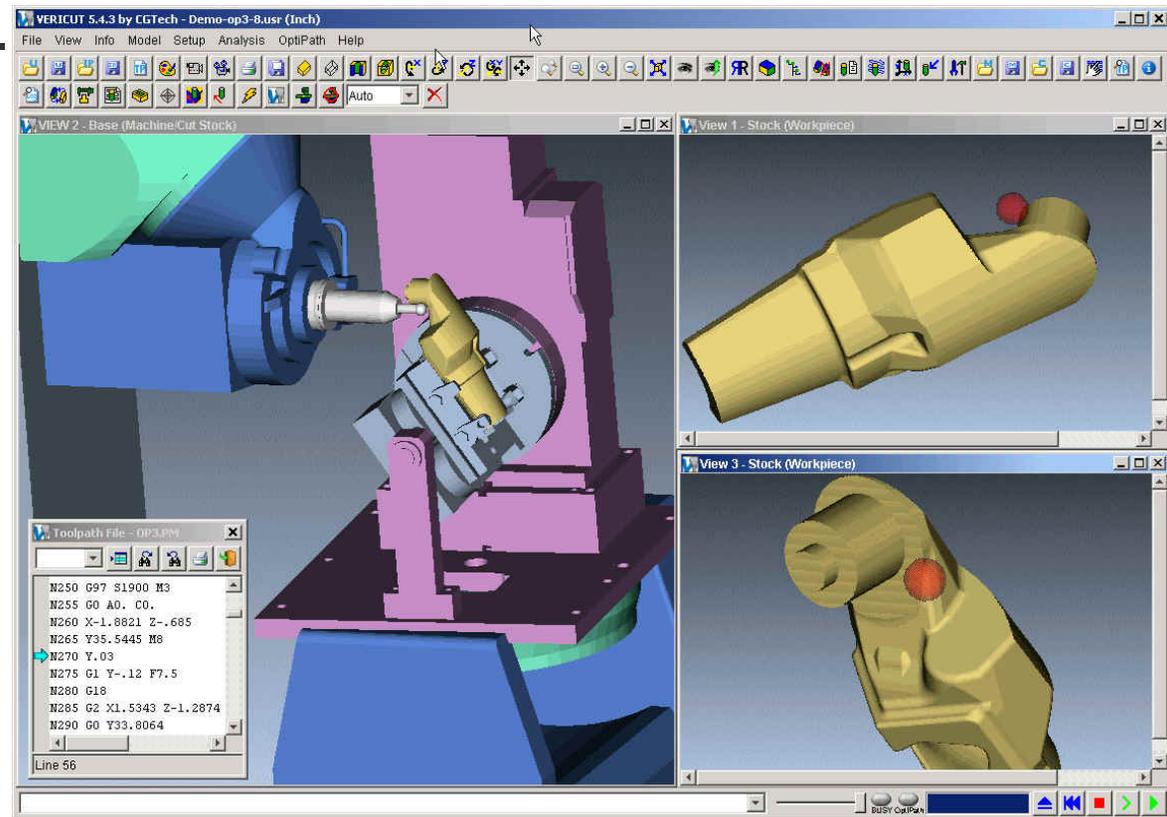


Benefits of Automating Using Unigraphics NX CAD/CAM

- **NC Programmer only has to press 1 button and he is done. Easy! (Shhh! Don't tell the boss that you are done already.)**
- **Eliminates NC programmer stress. (Now you just have to look busy.)**
- **Eliminates NC programmer errors. (But you take the credit.)**
- **All programs are consistent. They run the same. (They are all Perfect!)**
- **Make more programs in less time. (Or more time to surf the net.)**
- **Allows designer's creativity to flow since the NC program is made automatically without regard to the complexity of his design. (Tell the designer that his designs are too simple.)**

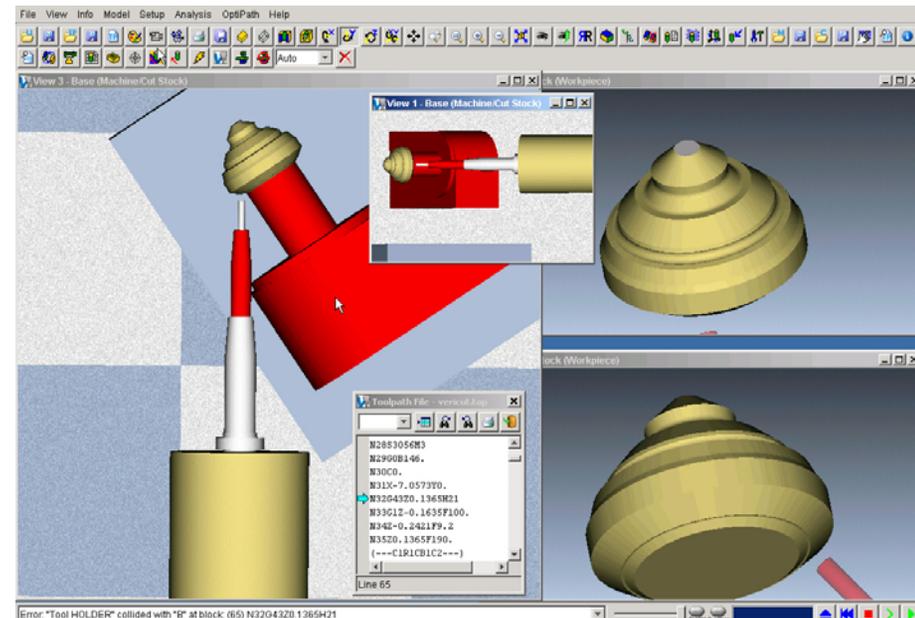
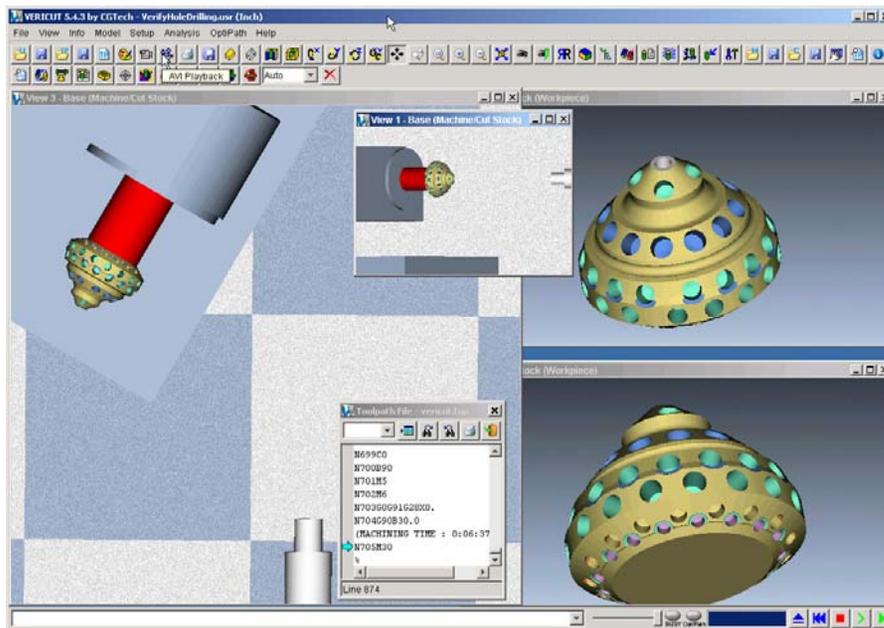
Why Vericut Machine Simulation?

- Ability to add **multiple views** to see the part being cut from several angles all at once.
- Ability to **stop** verification, **rotate** views, **zoom in/out** then continue.



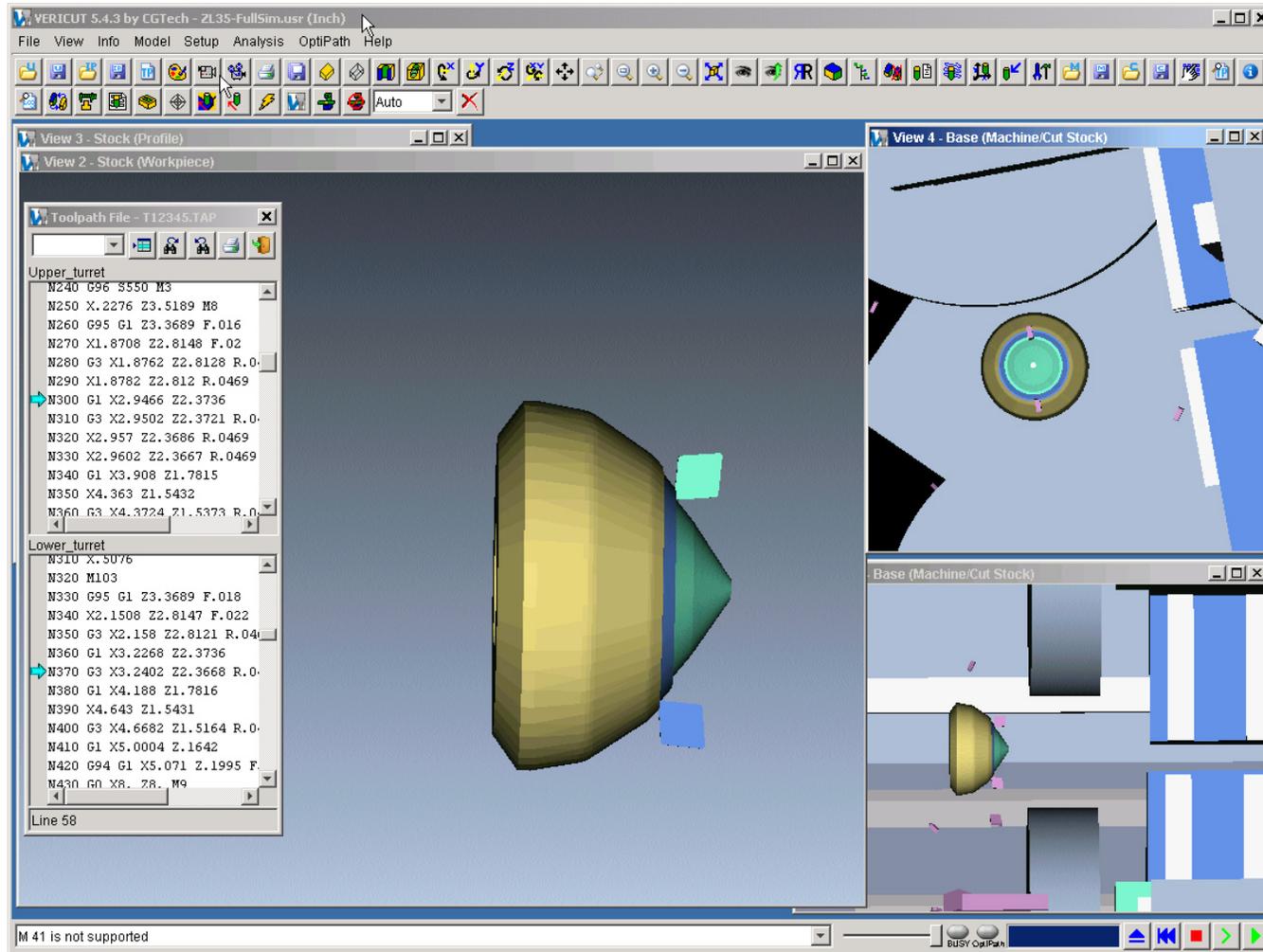
More Why Vericut Machine Simulation

- Ability to use the **actual NC tape** to verify exactly what is going into the machine control. This eliminates possible post-processing errors not being detected in generic CAM operation verification.
- Vericut allows you to open a window with the machine program in it and step through **block by block** to see what code caused which motion. Helps in debugging NC programs.



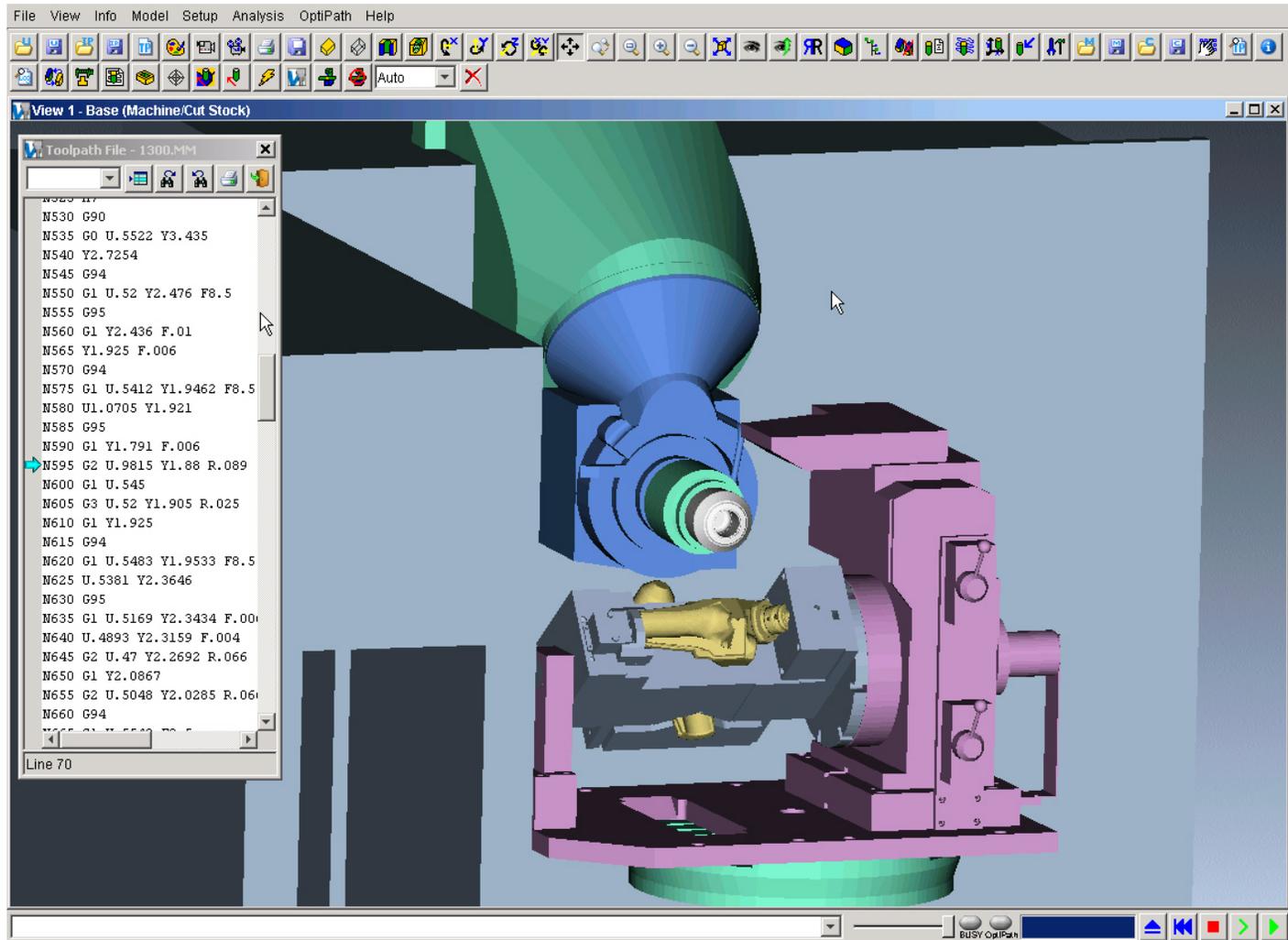
More Why Vericut Machine Simulation

- 4-Axis Turning Verification Capabilities



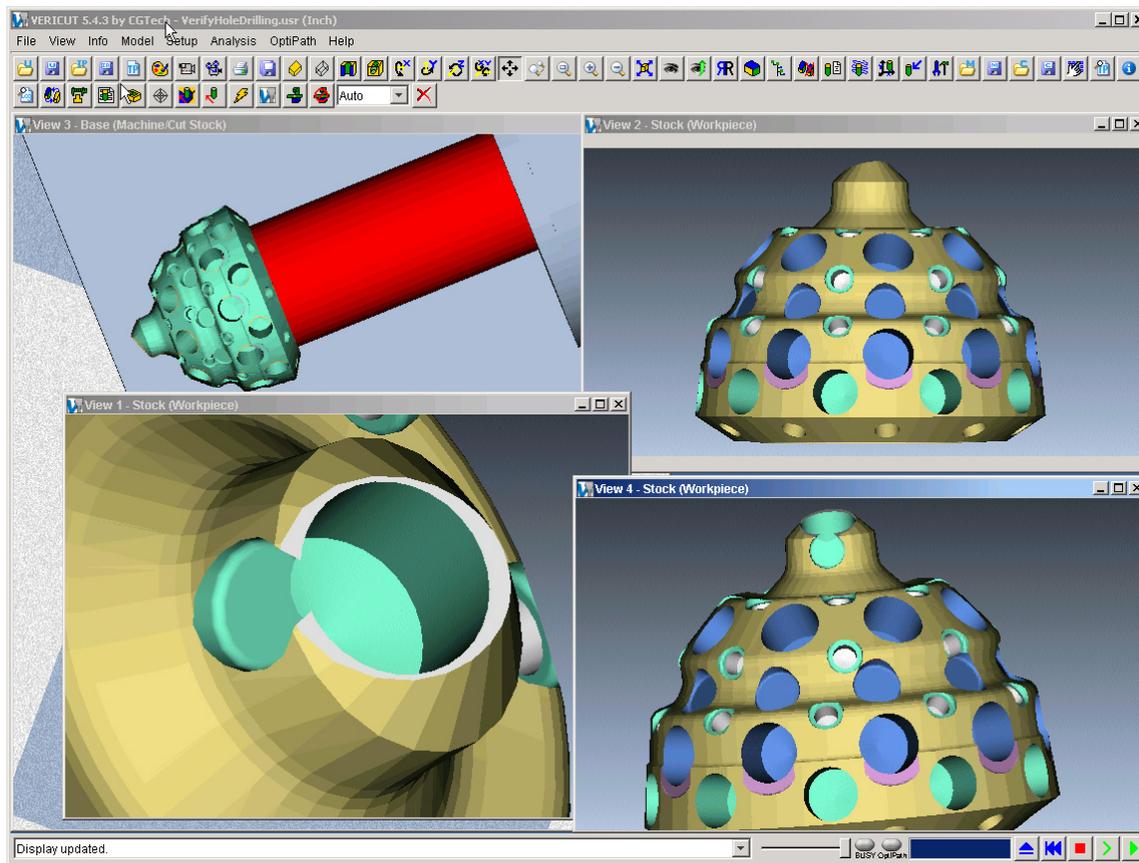
More Why Vericut Machine Simulation

6-Axis Milling Machine Simulation



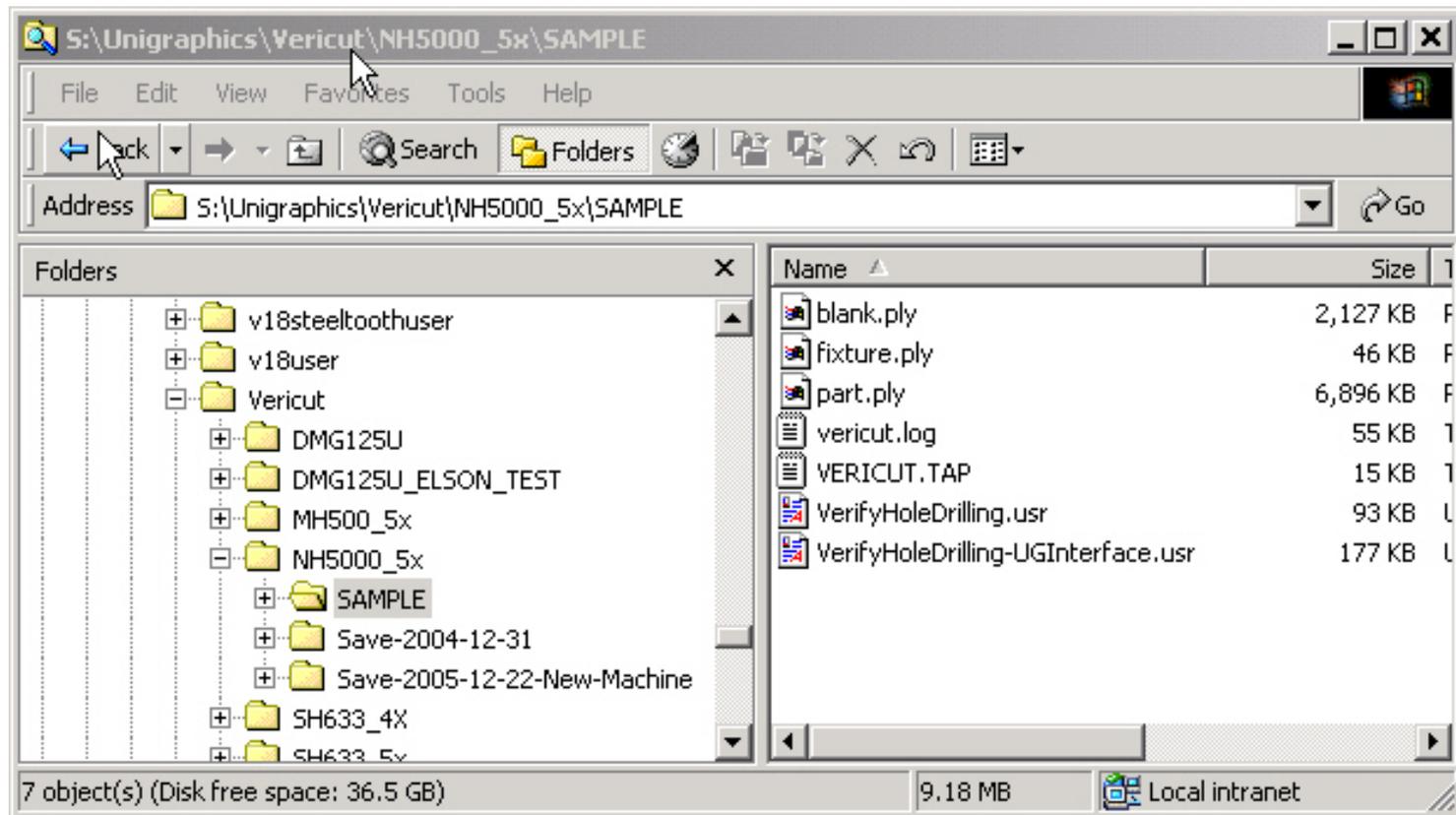
More Why Vericut Machine Simulation

- Ability to **compare** finished machined part against CAD Model.
- This ensures that the finished part is **exactly** what was designed.
- Helps us to determine if we have an NC error or designer error, **before** we cut any parts in the shop. Helps to prevent part scrap! (Saves you Money!)



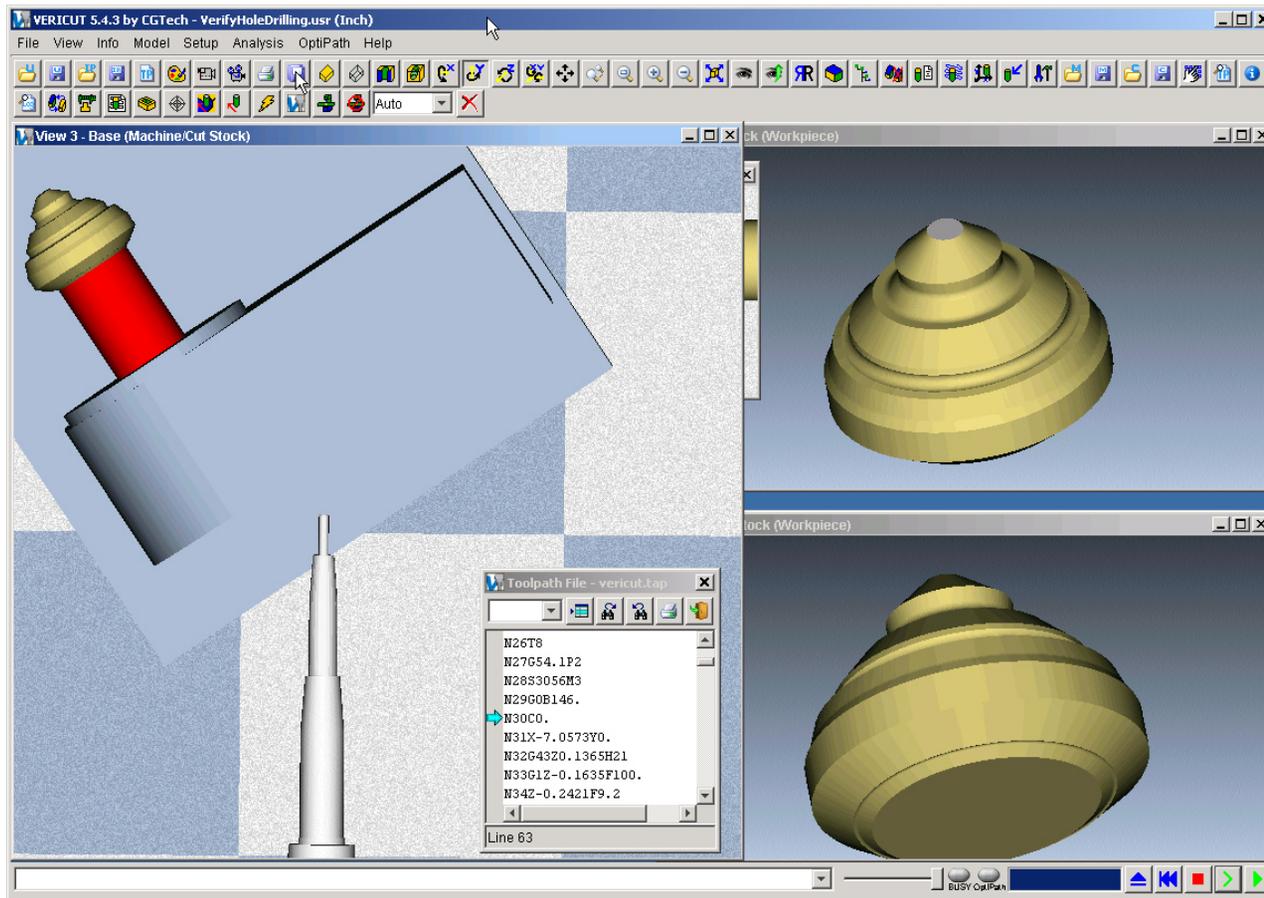
More Why Vericut Machine Simulation

- Automation is simple. .USR file saves all settings.
- .USR file is a simple text file that can be manipulated by an external program for further automation.



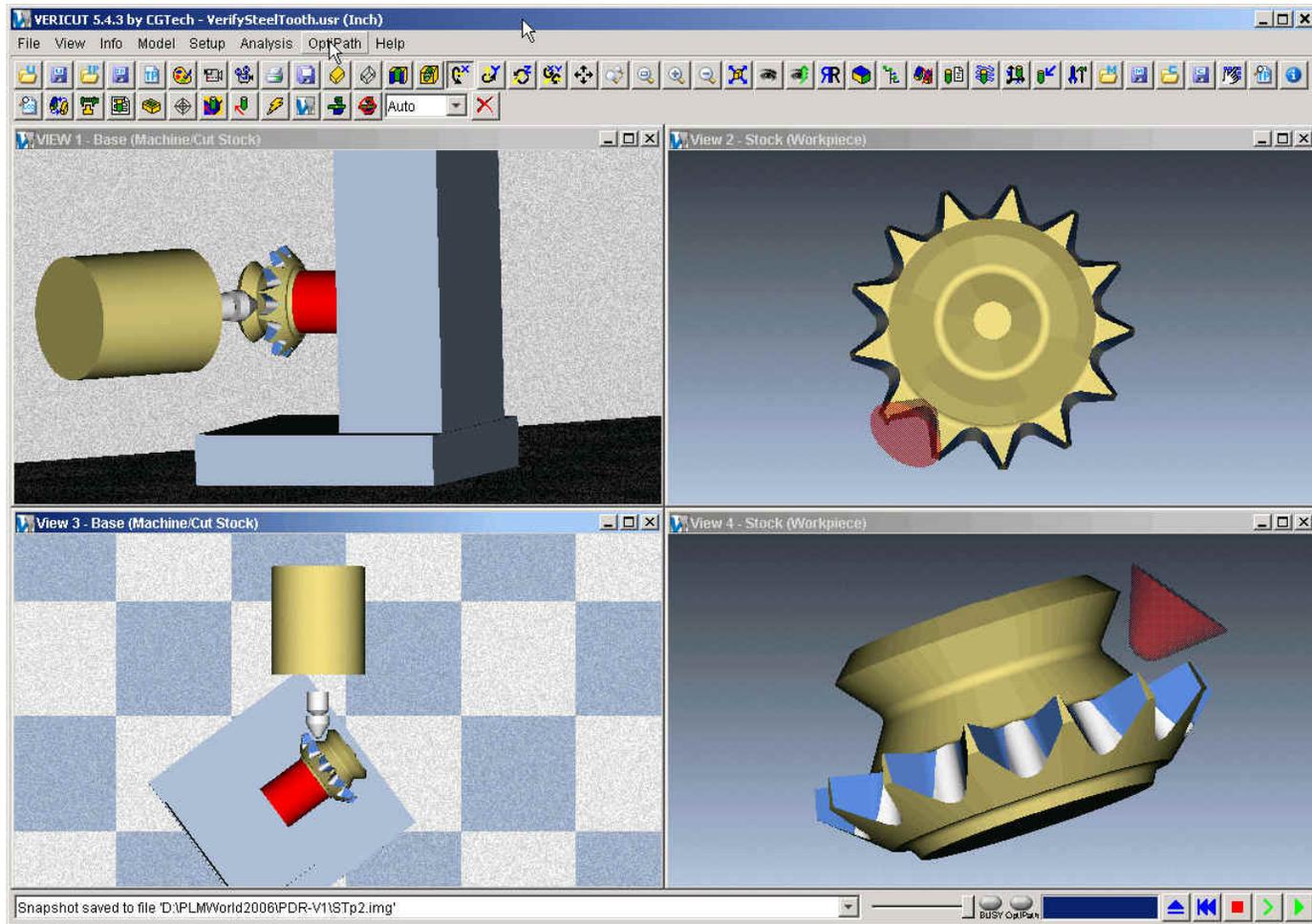
Summarize Benefits of Machine Simulation.

- Ability to view real **PART** motion.
- Ability to view true **MACHINE** and **TOOLING** motion.



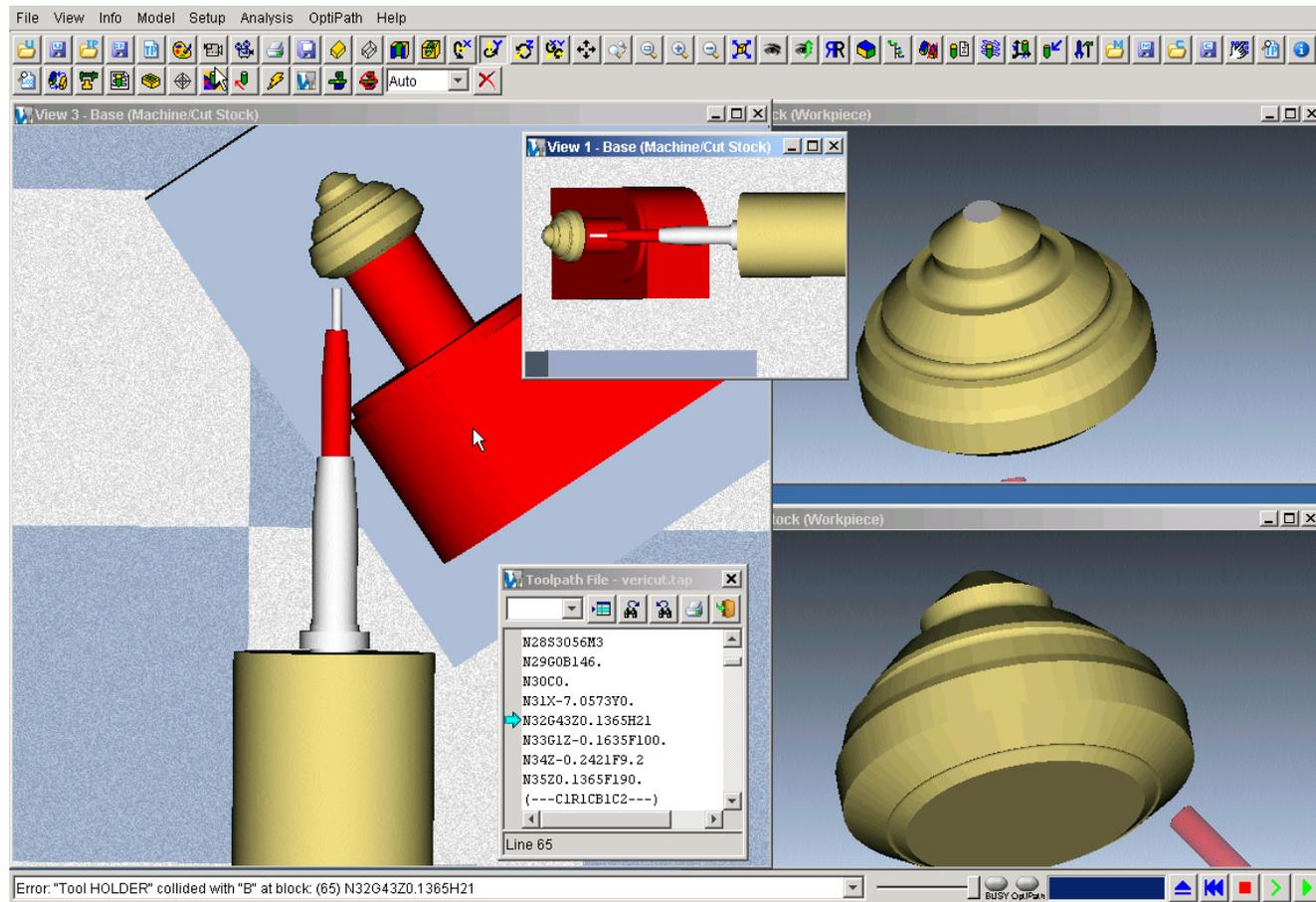
Summarize Benefits of using Machine Simulation

- No **scrapped** parts!



Summarize Benefits of using Machine Simulation

- No machine wrecks!
- No wasted time on shop floor! Saves you money!



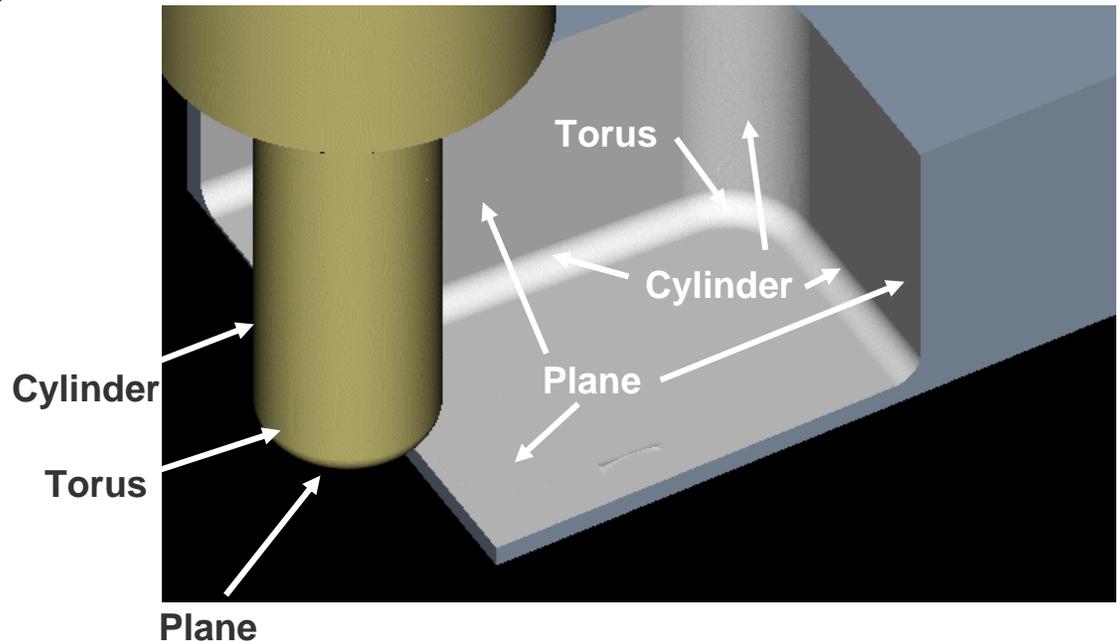
About CGTech

- Original developer of VERICUT®
- Experts in CNC machine simulation and optimization technology
- Established in 1988
- Headquarters in California
 - Subsidiaries in UK, France, Germany, Italy, Japan
- Worldwide diverse customer base
 - Aerospace
 - Automotive
 - Marine
 - Medical
 - Consumer products
 - Utilities, power generation
 - Education
 - Heavy industry & machinery



Verification Technology

- VERICUT “feature model”
 - Accurate cut features
 - Same speed regardless of NC program size
 - Robust reliable results for all material removal
 - One model for all cutting operations
 - 3 axis milling
 - 5 axis milling
 - Turning & Mill/Turn
 - Wire EDM



CNC Machine Simulation

- “The cost of an NC machine has gone up considerably in the last 5 years. Manufacturers need to protect their investment.”

-- *Modern Machine Shop*



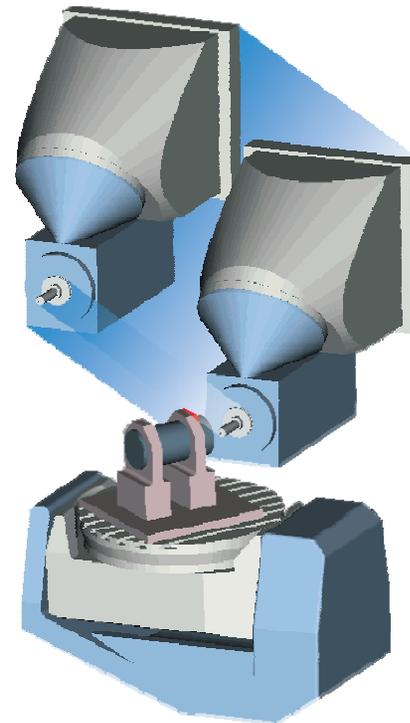
Machine Simulation Technology

- Using software technology to virtually machine a part, before real cutting begins can...
 - Eliminate errors, scrap, rework, broken tools
 - Reduce possibility of machine crash, downtime, delays
 - Detect spindle and table collisions
 - Improve process efficiency
 - Increase safety

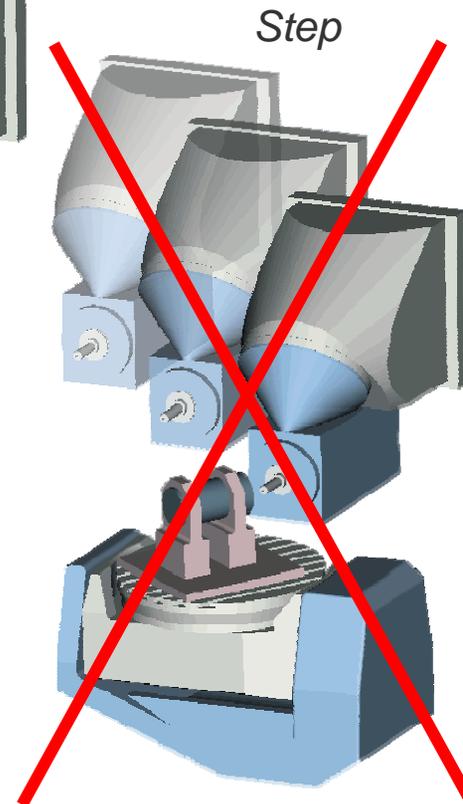


Machine Simulation Technology

- Continuous collision checking
 - All moving components swept through space
- Emulation of complex control features
 - sub-programs, branching, system variables, offsets, cutter compensation, transformations, etc.
- Accurate & configurable machine and control models
- Easy job setup and use
 - Logical separation between machine configuration and job-specific information



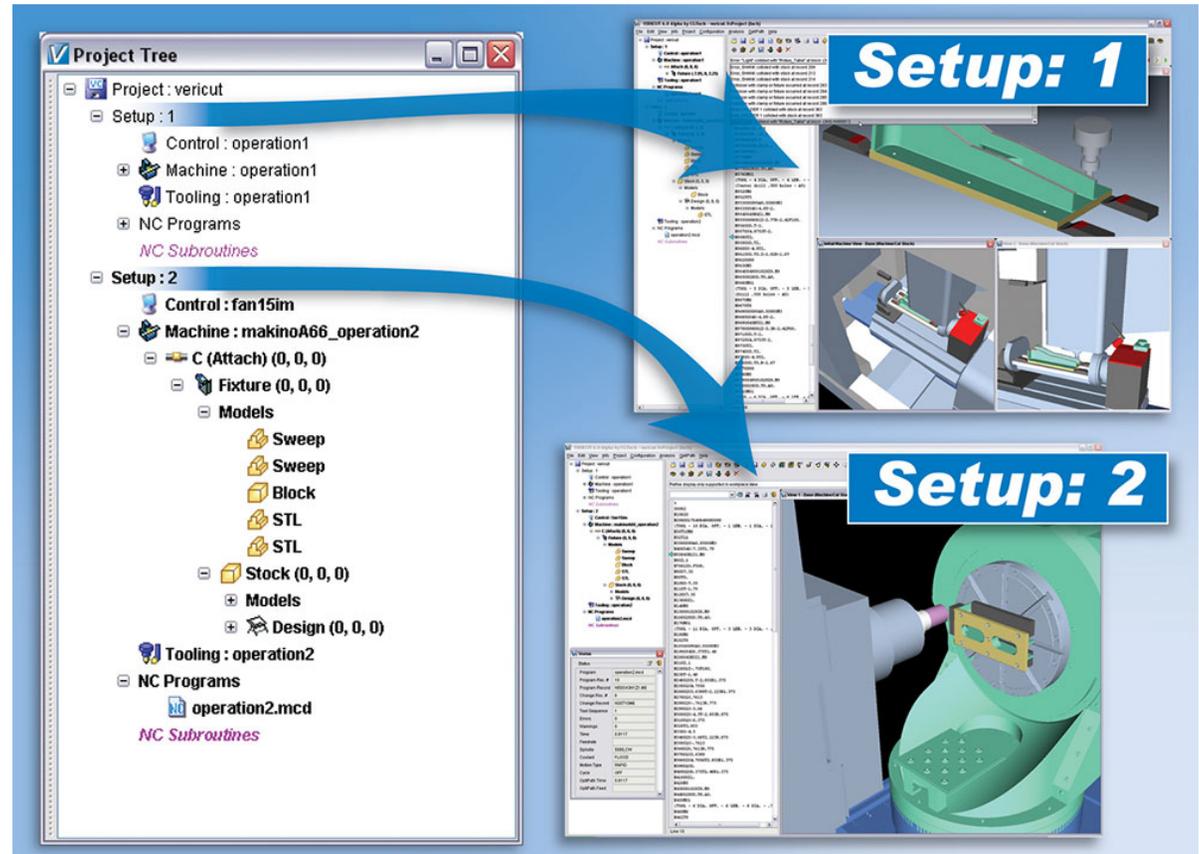
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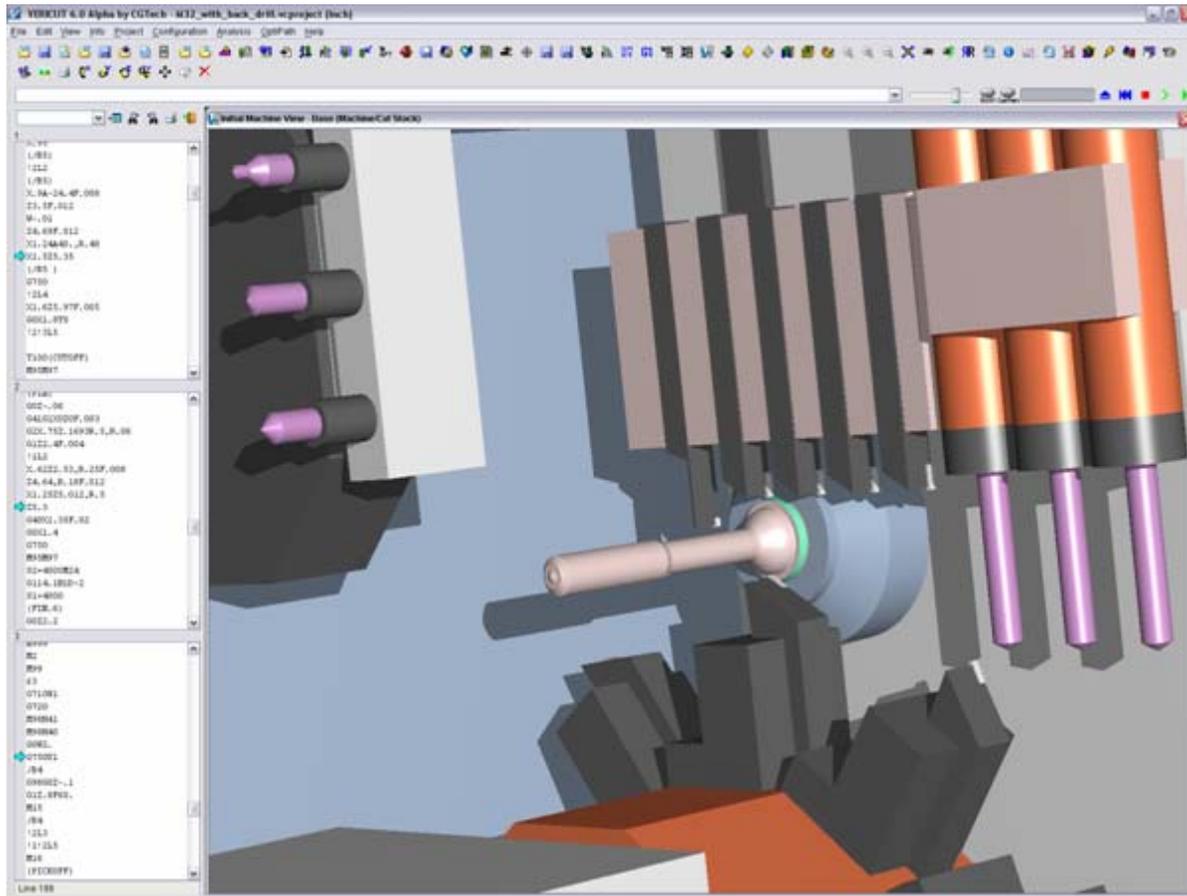
Step

Multiple Setups in a Single Session

- Each setup has its own...
 - Machine and control
 - Fixtures
 - Tools
 - NC programs
 - Settings
- Cut Stock automatically moves from setup to setup



Synchronize Subsystems



- VERICUT 6.0 can move 32 sub-systems simultaneously
- Synchronization method is saved in the control
- Synchronization occurs within one setup
- Subsystems selected for synchronization are saved in the setup

NC Program Optimization Benefits

- Reduces machining time
 - Faster time-to-market
 - Increased productivity
- Prolongs cutting tool life
- Reduces machine tool wear
- Improves finish quality
- Produces consistent results across machines, shifts, operators, and programmers (even if the “expert” isn’t around)



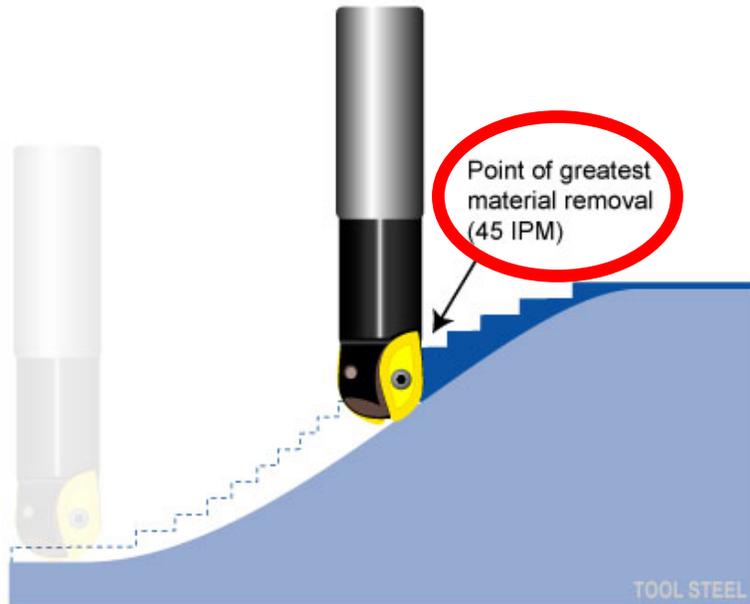
Optimization Methods

- Optimize by hand
 - Very time-consuming & error-prone
 - Not all programmers have proper expertise
 - Difficult to visualize the cutting conditions for each cut
- Use CAM software
 - CAM software doesn't know the in-process material for each cut
- Adaptive controls
 - Reactive vs. pro-active
- VERICUT software



How VERICUT Optimization Works

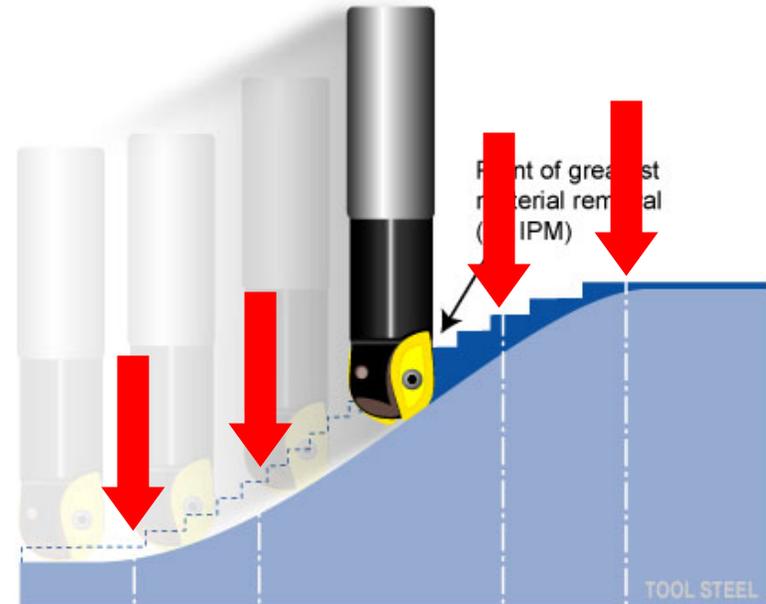
Typical NC Program



Original NC program feed rate does not change

45 IPM

Optimized NC Program



Optimized NC program adjusts feed rates automatically

80 IPM

70 IPM

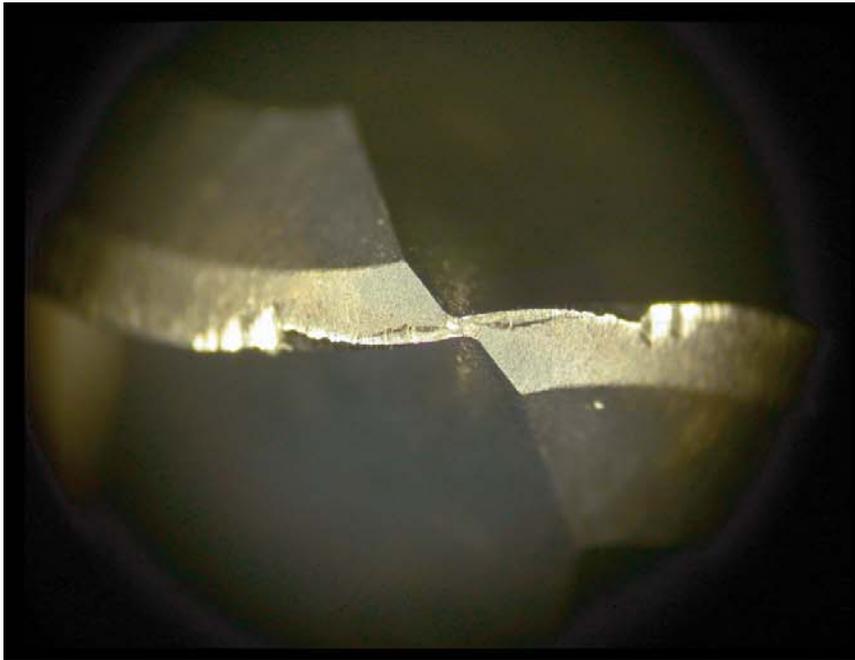
45 IPM

70 IPM

80 IPM

Extra Optimization Benefits

- Decreased Cutter Wear



Summary...

- Machine simulation and optimization software:
 - Ensures programs will not scrap the part, break cutters, crash the machine, etc.
 - Eliminates the need for prove-outs
 - Protects your machines, parts, and processes
 - Lights-out, first run machining
 - Ensures that the part is dimensionally accurate
 - Optimizes for more efficient machining
- Increases your competitive edge!