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MAY 14-16, 2019

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Simulation Advancements in “Industry 4.0”

Serge Viau / Sales Representative / CGTech

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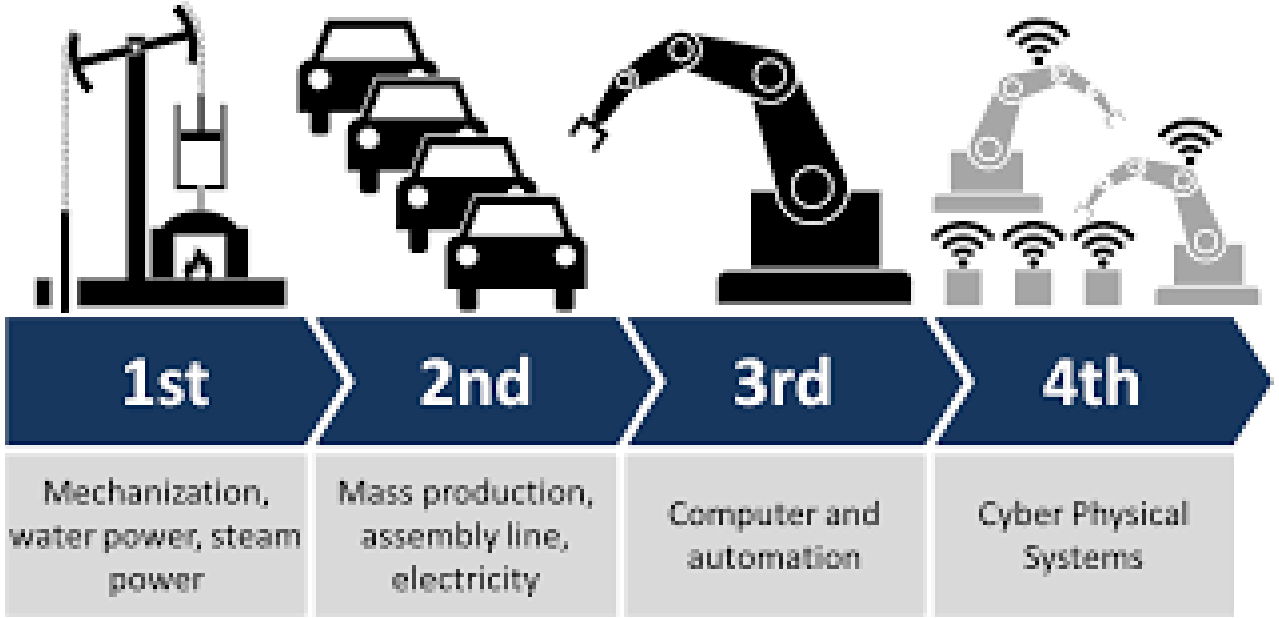
Who is doing simulation that includes the machine tool in their manufacturing process?

If you are, you are implementing (knowingly or not) a form of ‘Digital Twin’ that relates to Industry 4.0

(Image from Logical Advantage)

Industry 4.0

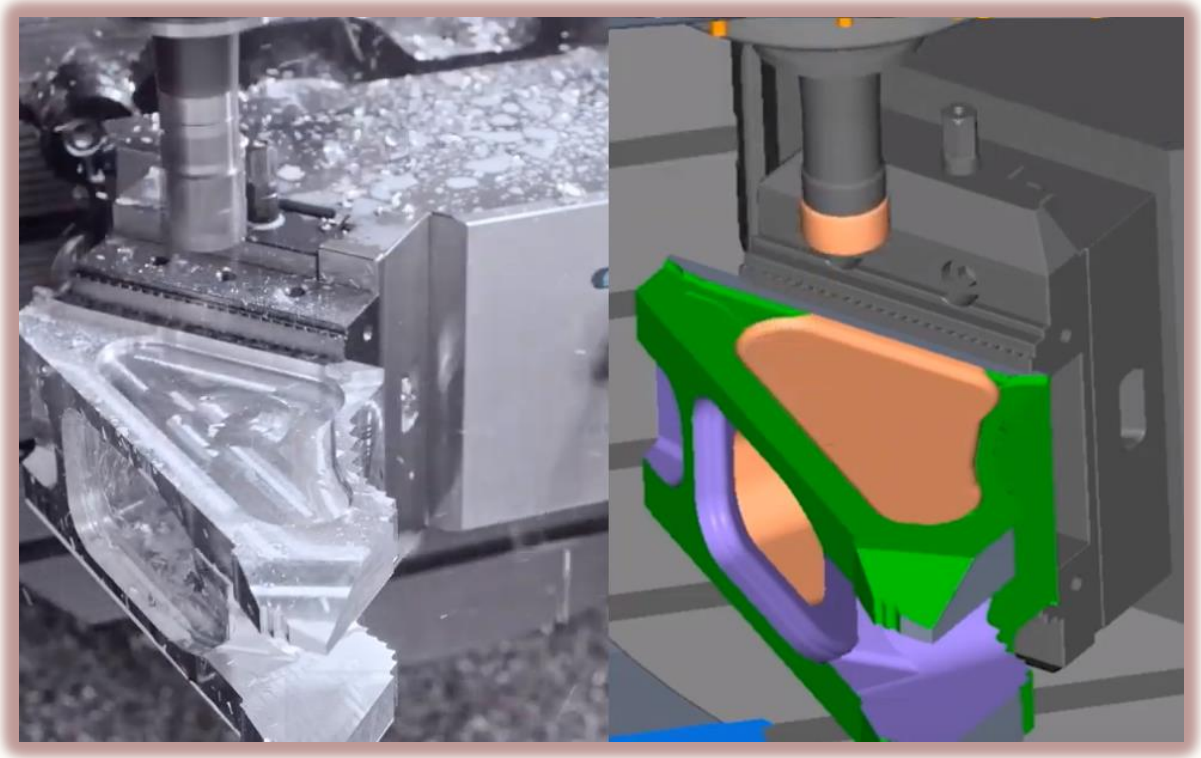
- Current trend of automation and data exchange in mfg technologies
- Referred to as 4th industrial revolution
- 4 design principles:
  - Interconnection
  - Information transparency
  - Technical assistance
  - Decentralized decisions



https://en.wikipedia.org/wiki/Industry_4.0

Digital Twin

- Digital replica of a physical asset
- Bridges the physical and virtual world
- Connection established generating real time data using sensors on physical device

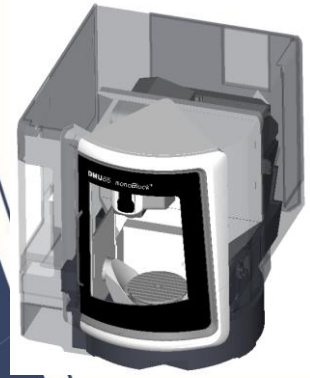


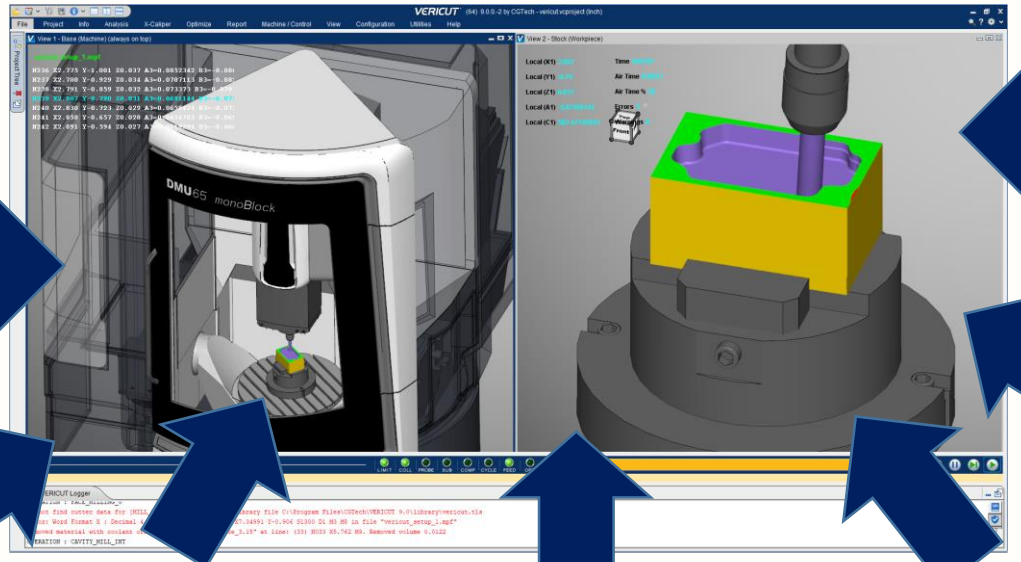
https://en.wikipedia.org/wiki/Digital_twin

How does this relate to simulation?

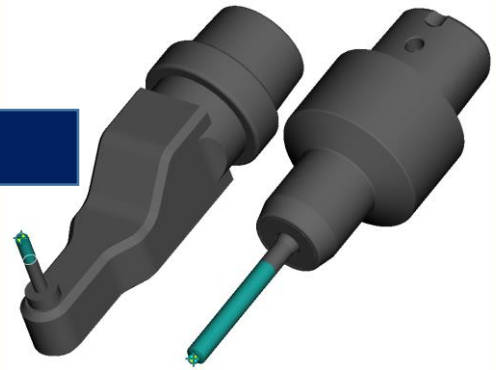
- Culmination of all necessary data needed to machine a part

Machine Geometry



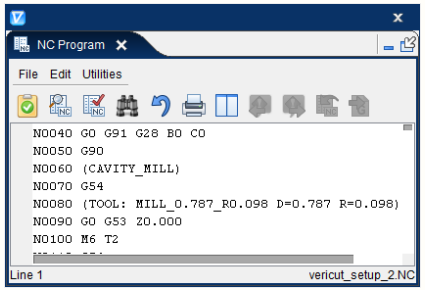


Cutting Tools

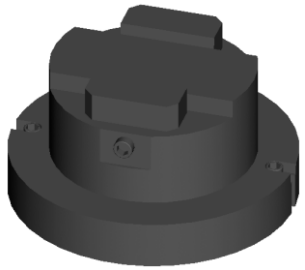


CNC Control: Subroutines, Variables

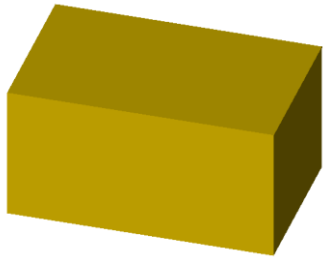
NC Program



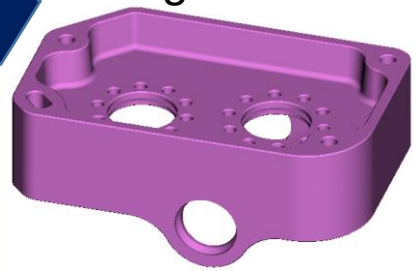
Fixture Model



Stock Model

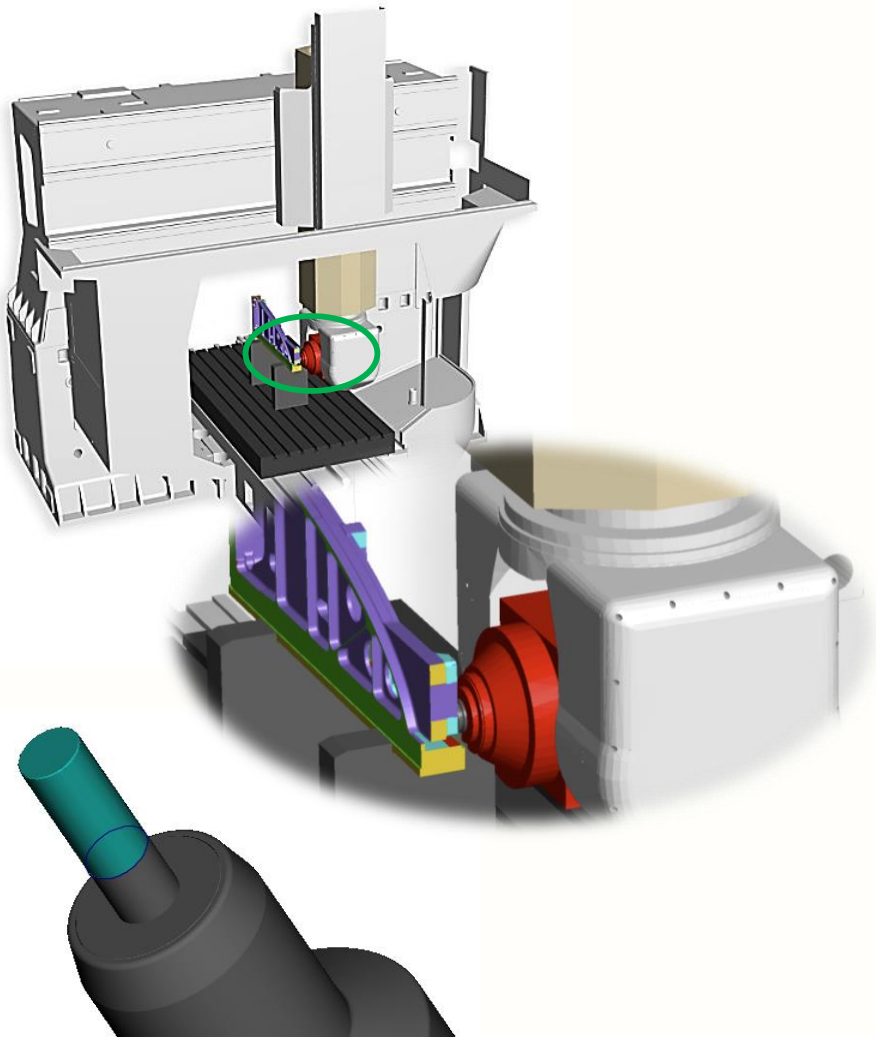


Design Model



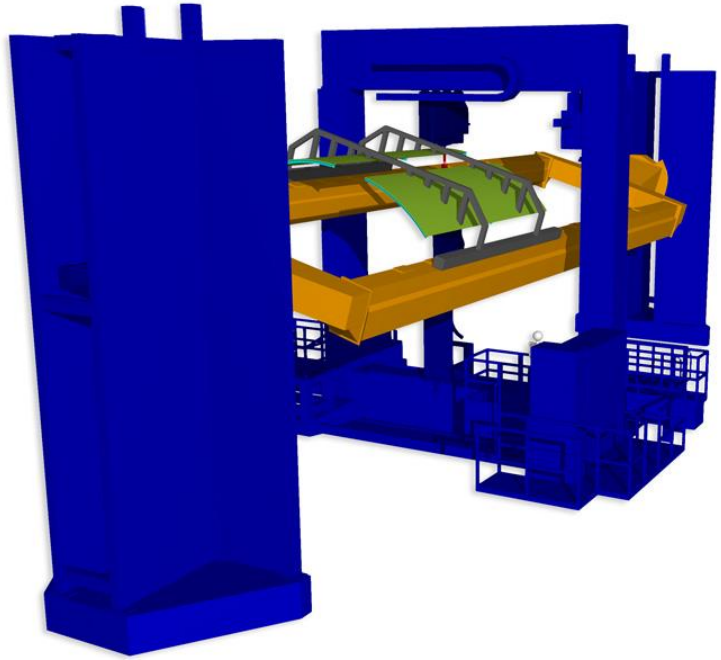
Digital Twin for NC Simulation

- Mission critical – models that exactly match part(s) on the shop floor
  - As realistic geometry as we can get
- Examples:
  - Machine geometry is accurate, but does not need every nut, bolt, screw…
  - Design, stock, fixture need details/accuracy
  - Cutting tools, need accuracy but not fluting on cutter



Not just for CNC Machining…

- Simulation can apply to:
  - EDM Die Sinking
  - Additive
  - Grinder Dressing
  - Drilling & Fastening
  - Composite Programming
  - Composite Simulation
  - Robot Simulation



Data Availability/Accessibility

- Part of Industry 4.0 – (Principle 1) – Interconnection (Interoperability)
- Data available throughout enterprise/suppliers
- Challenges
  - Data/models not available
  - Vendor will not supply
  - Data is inaccurate

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CNC Machine Data

- Requires knowing the machine
- Building a machine that works like the real machine can be challenging
- Technology Partners

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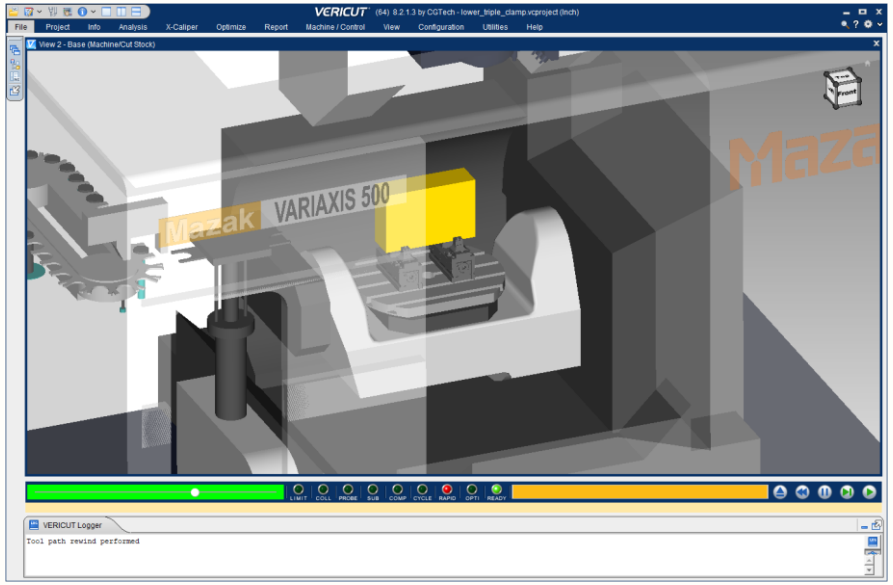
Connectivity to CAD/CAM Systems

- Reuse available data and information via interfaces
- Already setup from previous applications
- Removes human error

AUTODESK® FEATURECAM®

surfcam

AUTODESK® POWERMILL®



TopSolid

CAMWorks®
A Geometric Product

SolidCAM

DASSAULT SYSTEMES

SIEMENS
NX

creo®

edgecam

Mastercam

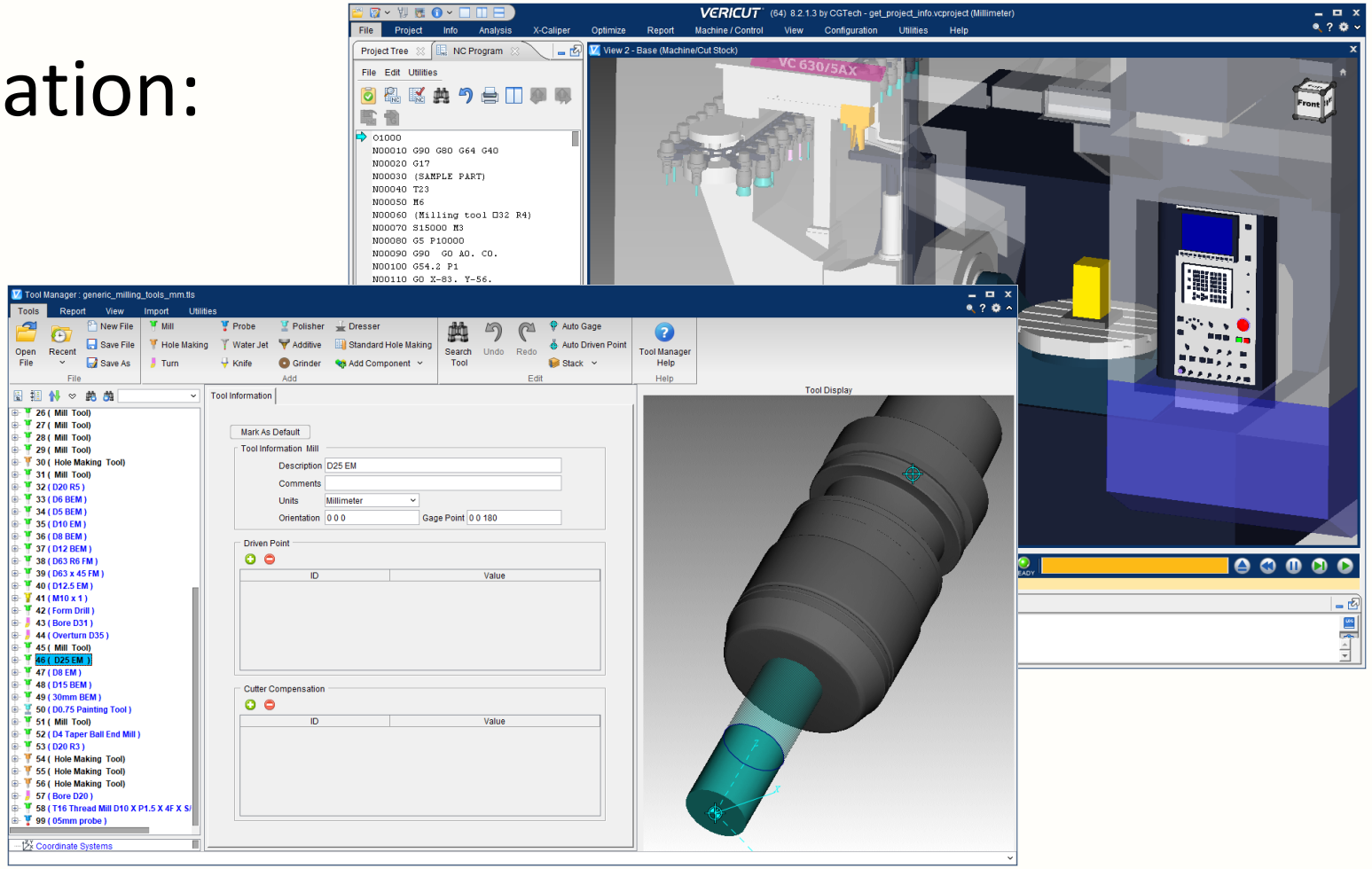
ESPRIT

GibbsCAM®

OPEN MIND
THE CAM FORCE

Advantages with Interfaces

- Sets up a simulation:
  - Fixture
  - Stock
  - Design
  - NC Program
  - Work offsets
  - Tooling



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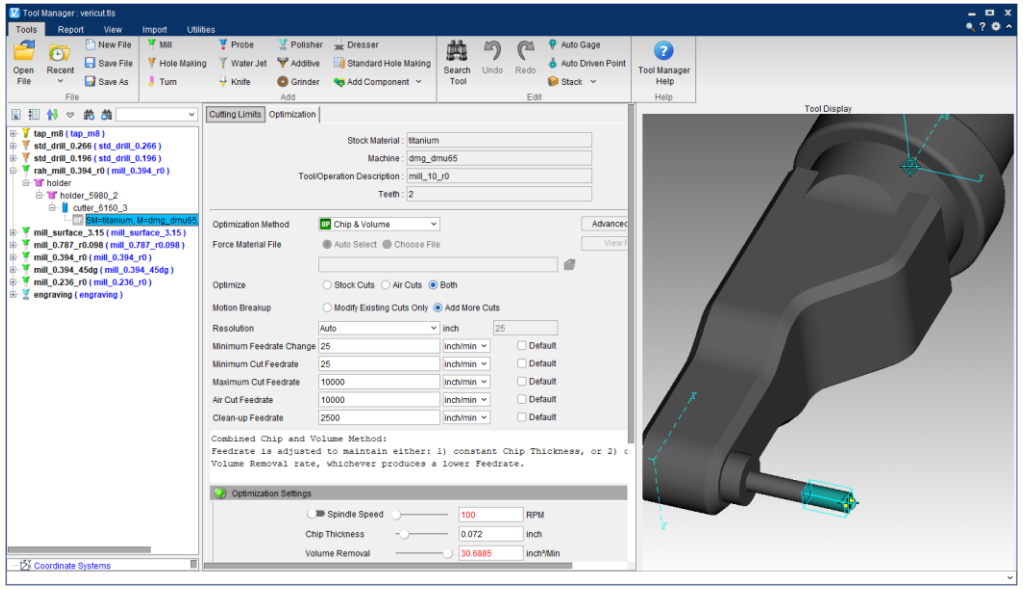
Connecting/Reusing Tooling Data

- Utilizing data from data management systems
- Tooling data and cutting parameters reused from various systems

NOVO

TEAMCENTER

tdmsystems



MachiningCloud
Smart Manufacturing

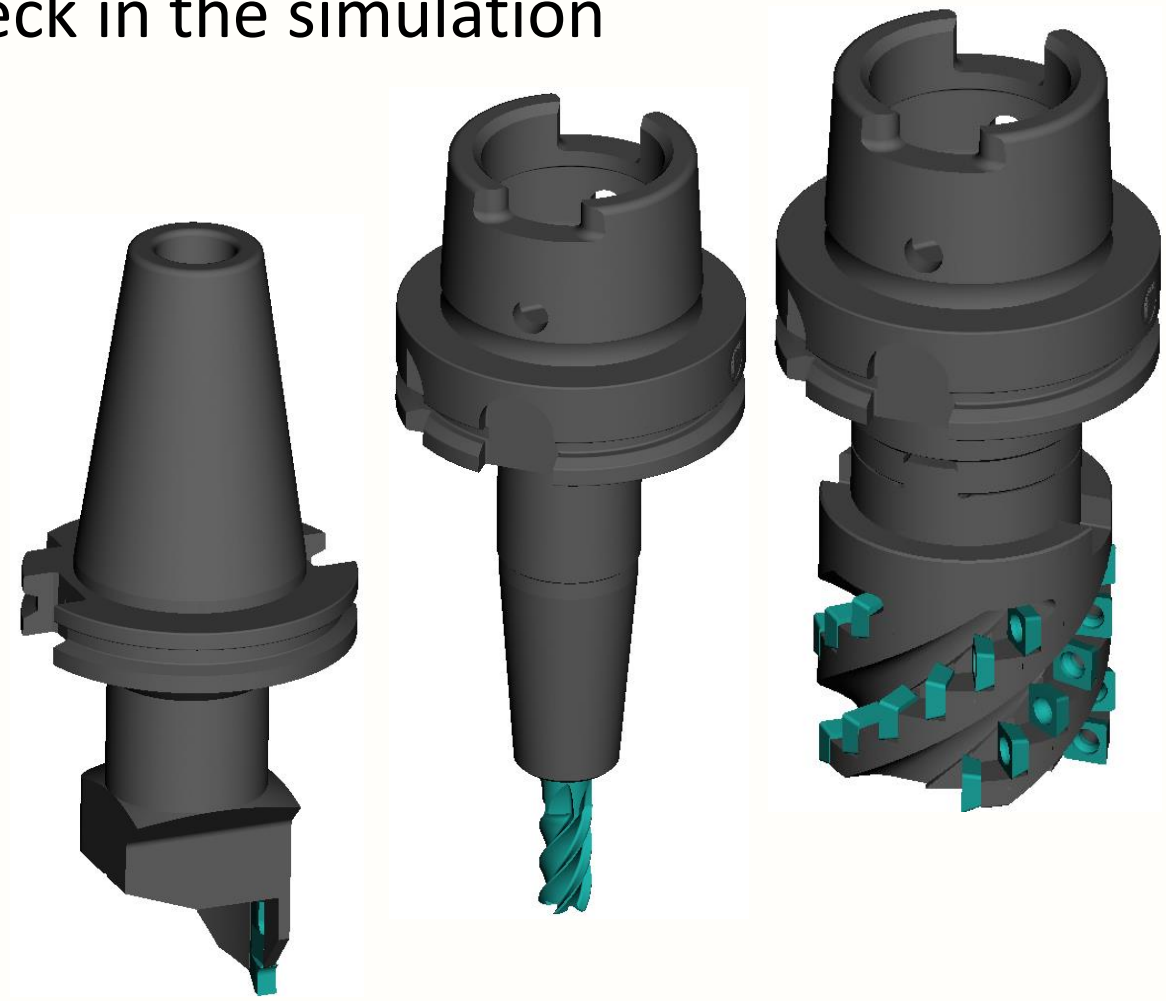
WinTool

CoroPlus®

ZOLLER

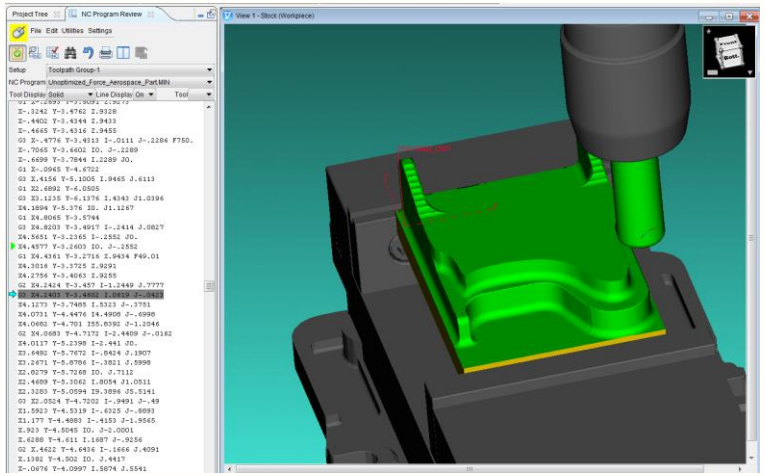
Tooling Data

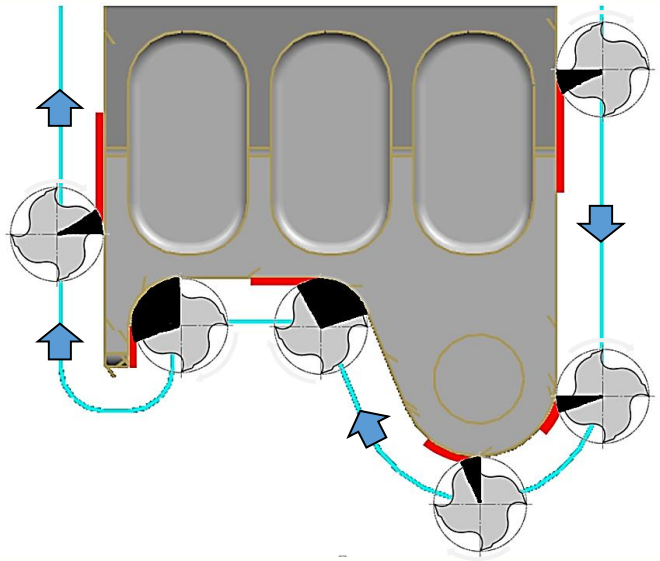
- Tooling data can be read to check in the simulation
  - Tool assembly geometry
  - Gage length/Driven Point
  - Spindle Speed
  - Feed rate
  - Step over/step depth
  - Chip thickness
- Check parameters against simulation results
- Then use tool data to optimize the toolpath

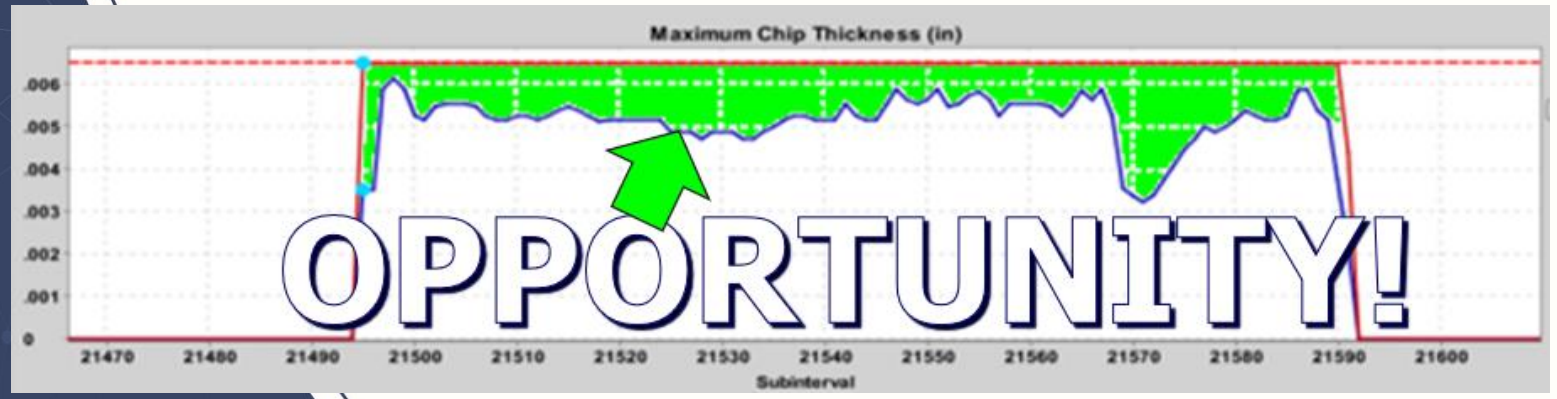


Optimizing Toolpaths

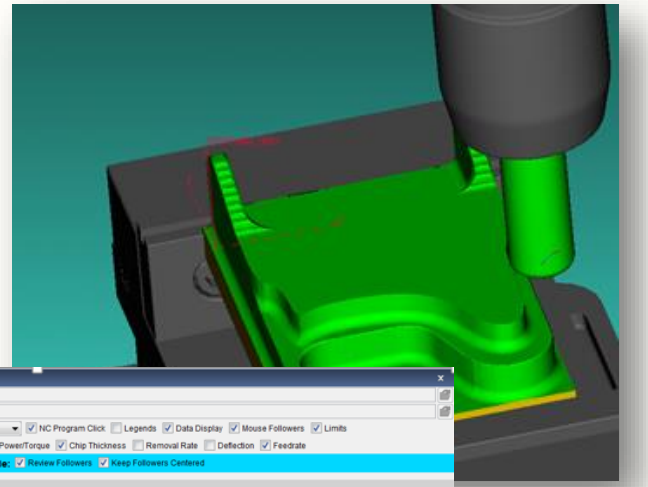
- Part of Industry 4.0 – (Principle 4) – Decentralized decisions
- Non optimal feed rates in NC programs
- Leaves cost savings on the shop floor
- Does not take full advantage of cutting tool capability



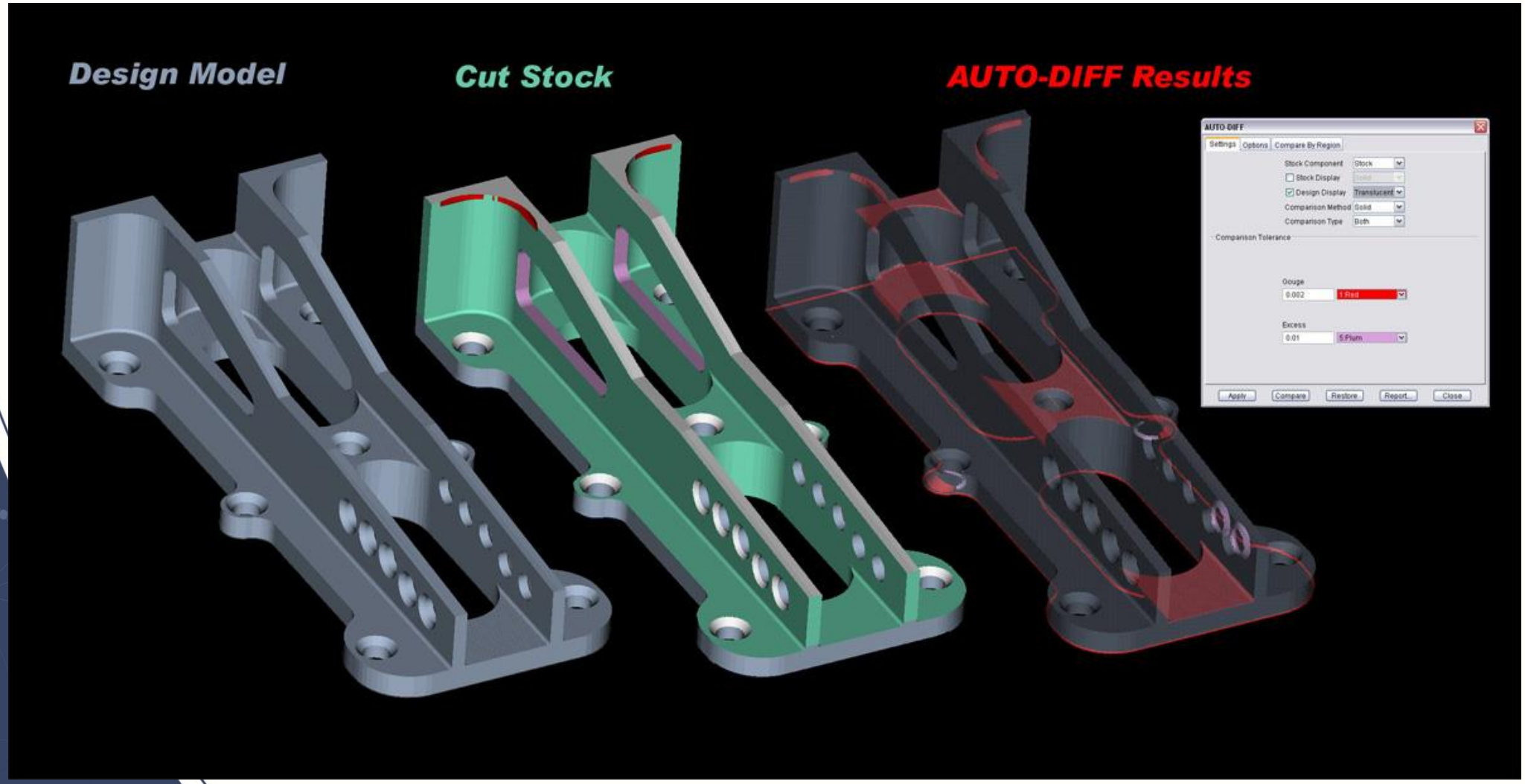




Original vs. Optimized NC Program



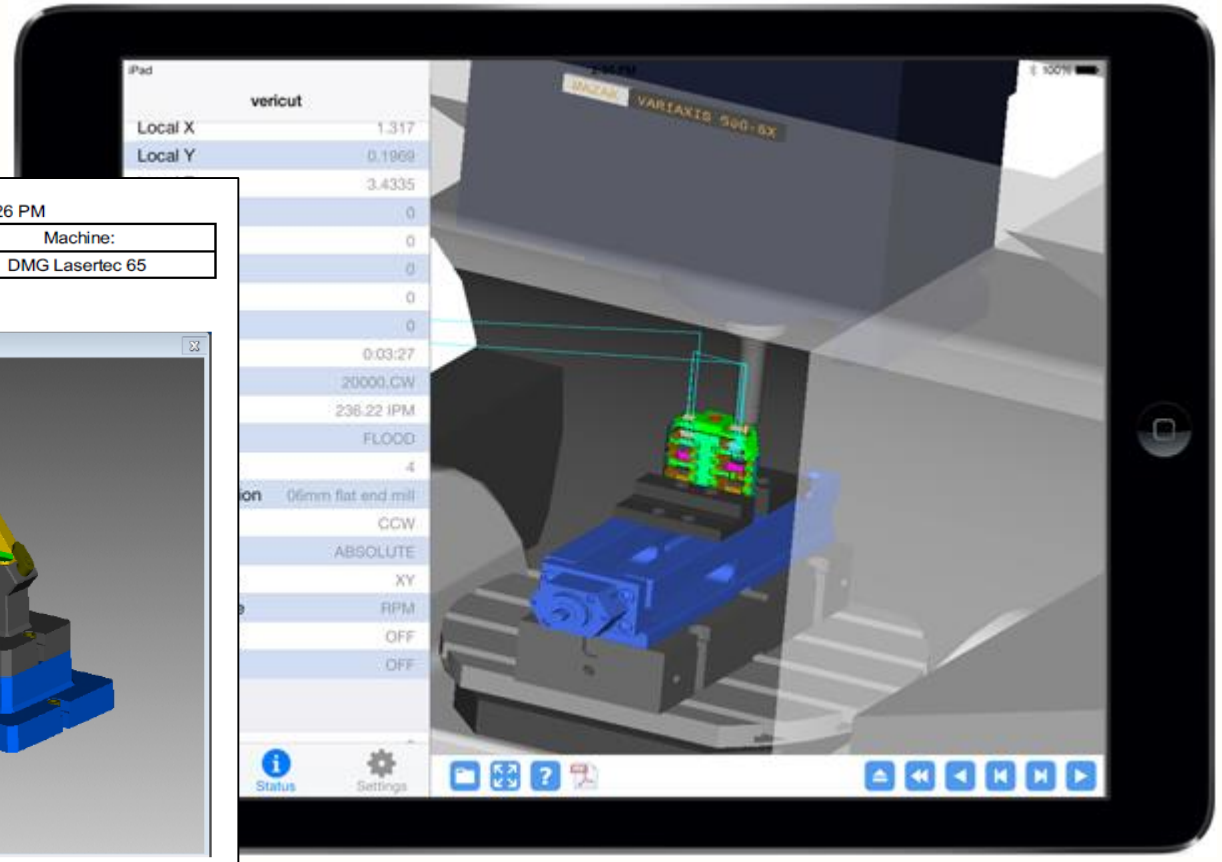
Design Model vs. Cut Stock



Sharing Data

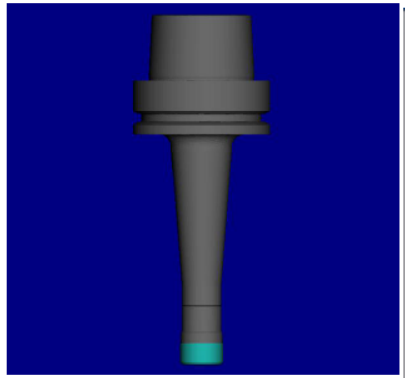
- Part of Industry 4.0 – (Principle 3) – Technical assistance
- Simulation results used many ways
- Generate reports
- Show simulation to shop floor

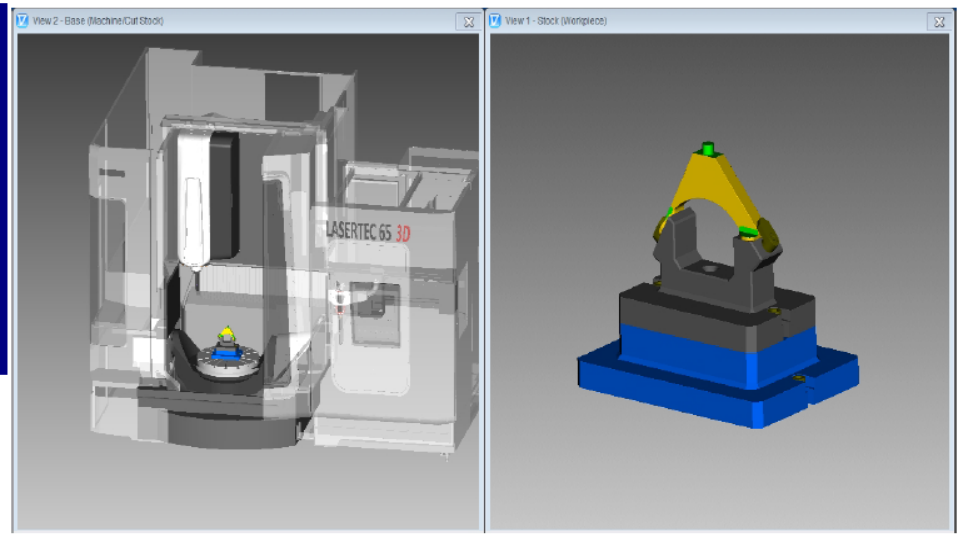
Reports and Reviewer



Programmer: Jeff Voegele January 2, 2018 3:30:26 PM

Part #:	Material:	Setup/Operation:	Machine:
ABC123	Titanium	SETUP_1	DMG Lasertec 65





Tool ID	Tool Description	Cutter Diameter	Cutter Height	Flute Length	Optimized By	Original Time	Optimized Time	Time Diff %	Errors	Warnings
MILL_0.787_R0.078	MILL_0.787_R0.078	0.5079	0.3972	2	No Optimization	0:04:57	0:04:57	0%	6	0
						0:04:57	0:04:57	0%	6	0

Utilizing data from CNC Machines

- CNC machines stream data telling what the physical machine is actually doing
- Part of Industry 4.0 –
  - Principle 2) – Information transparency
  - Principle 3) – Technical assistance
- Streaming data used for:
  - Analytics
  - Calculations
  - Shop ‘health’

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Utilizing data from CNC Machines

- Protocols/Methods to exchange data between shop floor equipment and software applications
  - I.e. Machine Monitoring
- Part of IoT – internet connectivity
- Many possibilities
  - MTConnect
  - OPC UA(Open Platform Communications Unified Architecture)
  - FANUC CNC: FOCAS, FASOPC
  - umati (Universal Machine Tool Interface)

MTConnect®

OPC UA

FANUC FOCAS

umati
universal
machine tool
interface

NC Simulation saves $$$

- Industry 4.0, Digital Twin, Simulation are significant to your mfg processes
- Can simulate real world issues before part is run on shop floor
- Simulation software's connectivity in the NC Manufacturing environment
- What data to seek, what to avoid, and why
- How simulation interoperability and "good" data help
- How physics-based software tools help with optimization and analysis

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CGTech

- Privately held and 100% self financed.
- Established in 1988
- World leader in NC verification
- Largest group of CNC machining experts in the world
- Headquartered in Southern California with offices in 12 countries

CGTECH VERICUT®

The power of CGTech expertise is available to your company

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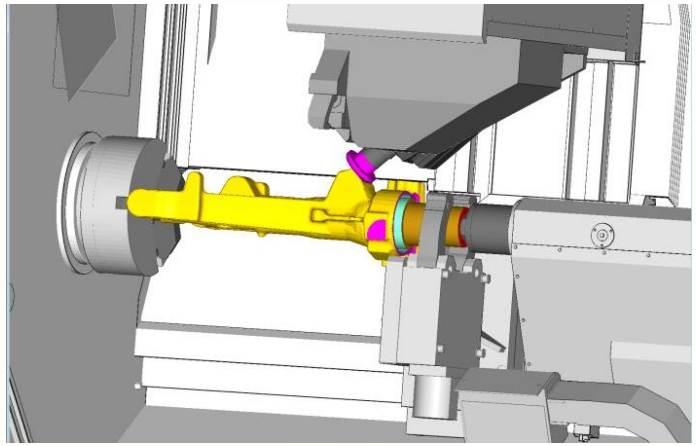
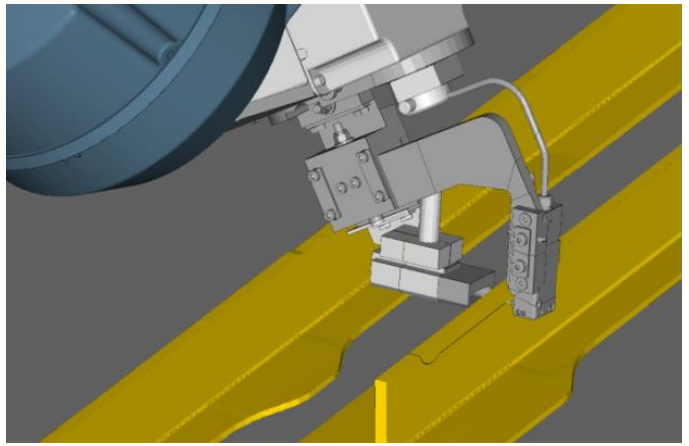
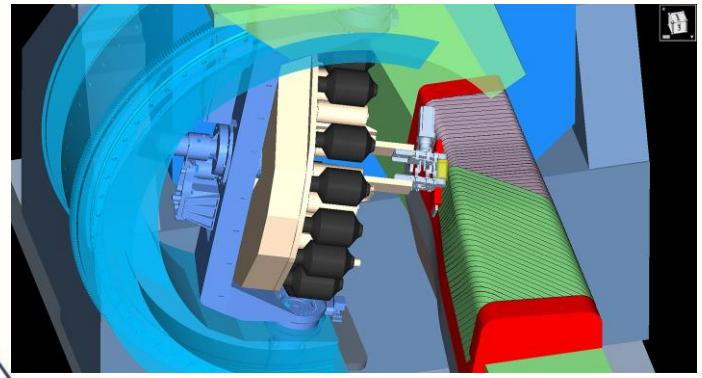
VERICUT software improves automated processes in several domains.



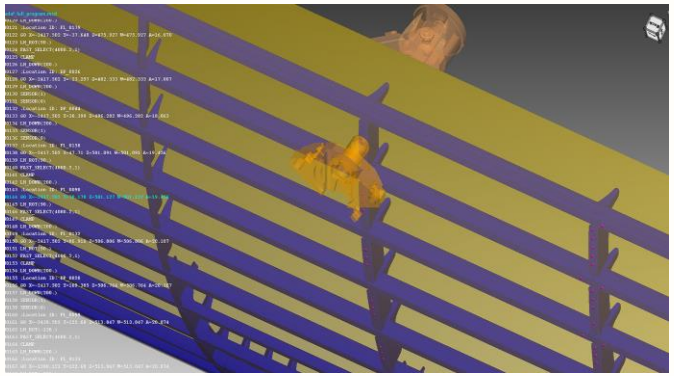
Machining Simulation



Trimming Simulation



Automated Composite Layup



Assembly Drilling & Fastening

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Questions