RE4DY

MANUFACTURING DATA NETWORKS

RE4DY TOOLKIT

Name of the Tool	NX Part Manufacturing
Tool Owner	Industry Commons Foundation
Version	1.0
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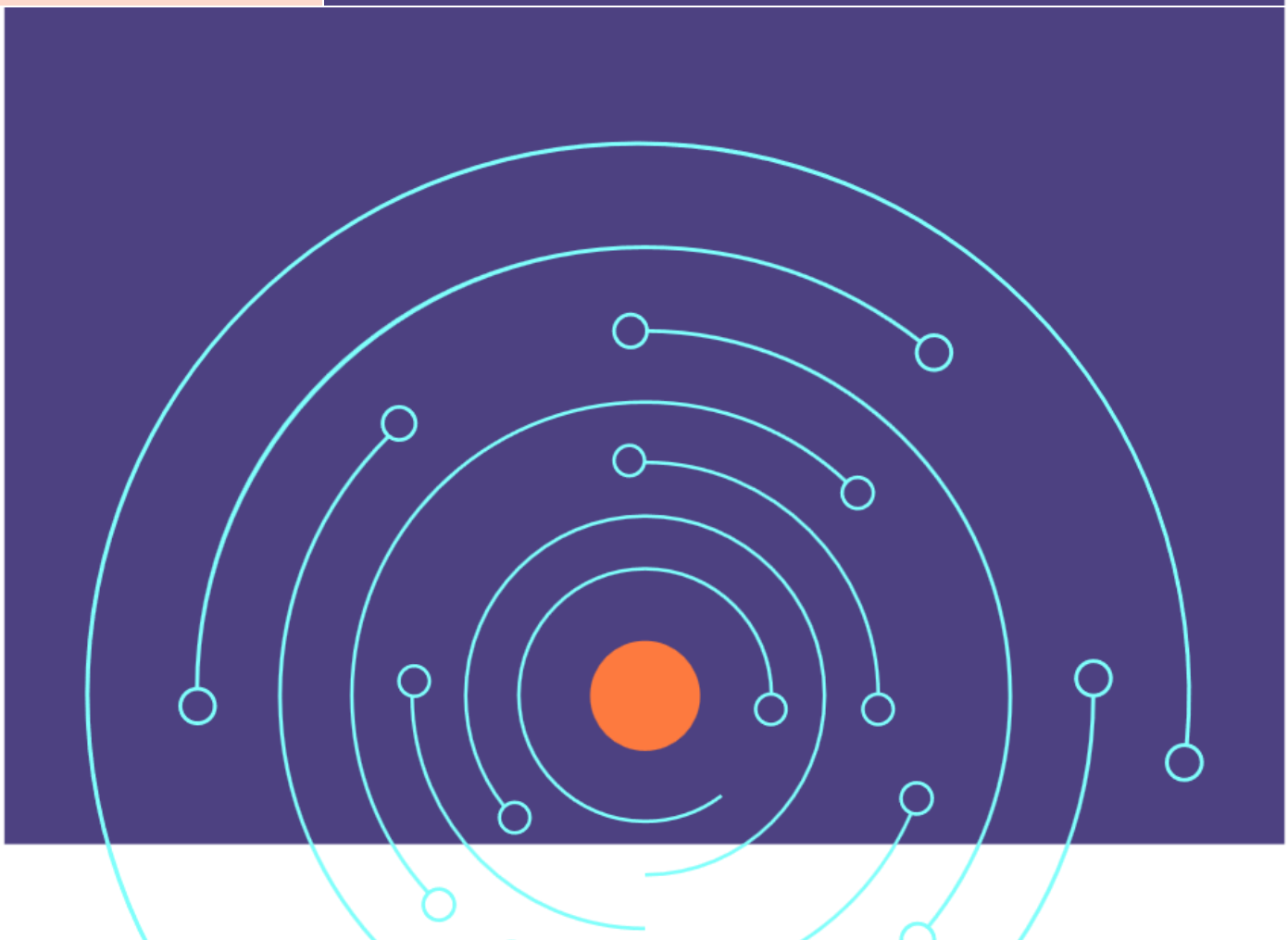

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1. Component Description

A digital map of the production process is also referred to as a “digital twin” – because the real and the digitalized process should be as similar as possible. By combining the NX CAD/CAM system and the SINUMERIK CNC system, Siemens already offers a digital twin for the entire machining process. By taking a closer look at this process, NX CAM uses exactly the same model that was previously created in CAD. With NX CAM, users can speed up machining and achieve high accuracy through advanced toolpath technology. By using Manufacturing Resource Library (MRL), the programmer quickly creates new tool assemblies and quickly finds the appropriate tool through a variety of attributes in Teamcenter or directly in NX CAM. Complex measuring operations are considerably simplified by the use of On Machine Probing (OMP). Users can verify measuring cycles directly in NX CAM, via machine simulation to achieve collision avoidance thanks to true NC code and cycle simulation. For the most accurate machine simulation possible, the manufacturer's exact machine kinematics are stored in the 3D model. When it comes to post-processing, NX CAM Post Hub delivers the modern cloud-based solution. Free for NX CAM users, Post Hub enables a streamlined process for creating production-ready CNC programs for users’ applications. With just a few clicks, Post Hub provides the machine kit (MK) and the corresponding post processor (PP). With Run MyVirtual Machine (RMVM) the hardware components of the control are modeled as software components and represent a complete image of a real CNC control. By combining RMVM and the real NC code from NX CAM, it is possible to achieve a true 1:1 simulation. After verification, the program is released for production in Teamcenter (TC). Afterwards, the NC program can be transferred directly to the machine using Shop Floor Connect (SFC) and all production information is accessible via a device with a browser.

As part of the RE4DY project, NX Part Manufacturing is being used in the GF and Fraisa pilot. With NX Part Manufacturing, a CAD designed workpiece can be prepared for production using elements such as NX CAD/CAM system and post processor. All generated data during this process can be used for optimization, quality improvement and to build a transparent data process.

2. Input

NX CAD/CAM:

- 3D-models of the design part, raw material, machine with machine kinematics, tools and fixtures etc.
- CAM program includes all the information, operation order, tool selection, toolpath movements, feeds and speeds etc.

MRL:

- Import DIN vendor catalog data into Teamcenter and map to MRL component classes
- Import 3D model (and convert to NX parts)
- Create connection rules

OMP:

- A selection of the necessary tool and zero-point adjustments and control structures. Measuring operations and measuring activities are seamlessly integrated into the graphically oriented programming as easy-to-use NX operations. Measurement objects are selected on the 3D model, are associative to the component and measuring cycles are displayed as normal tool paths.

MK / Post Hub:

- A simple selection of the machine, controller, or manufacturing technology and Post Hub will present the applicable postprocessors

RMVM:

- In order to use Run MyVirtual Machine /3D correctly, the machine project must be provided with the 3D model of the machine including kinematics so that the project can be put into operation accordingly.
- The NC program generated from the Post Hub

SFC:

- After a verified simulation, the CAM-object in Teamcenter (including NC-programs, setup sheets, clamping plans, tool lists, drawings or 3D models) receives the status "approved" and is now available on the machine

3. Output

NX CAD/CAM:

- Run tool path verification
- Reusable process and program

MRL:

- Get automatic generated tool assemblies
- Browse for available tools in the library
- Select and use resources in NX CAM session

OMP:

- The 3D simulation simulates and visualizes measuring processes with touch trigger probes. The measuring process is identical to the process on a real machine and has the same prerequisites.
- Continuous quality assurance during production

MK / Post Hub:

- NC-program
- Setup and tool list document for the shop floor

RMVM:

- Full machine simulation with collision check
- Machine simulation with material removal

SFC:

- Secure and professionally managed data and information
- Download and Upload of NC Package (NC pgr, shopdoc and toollist)
- Available on every device via browser.

4. Information Flow

Installation for NX part manufacturing

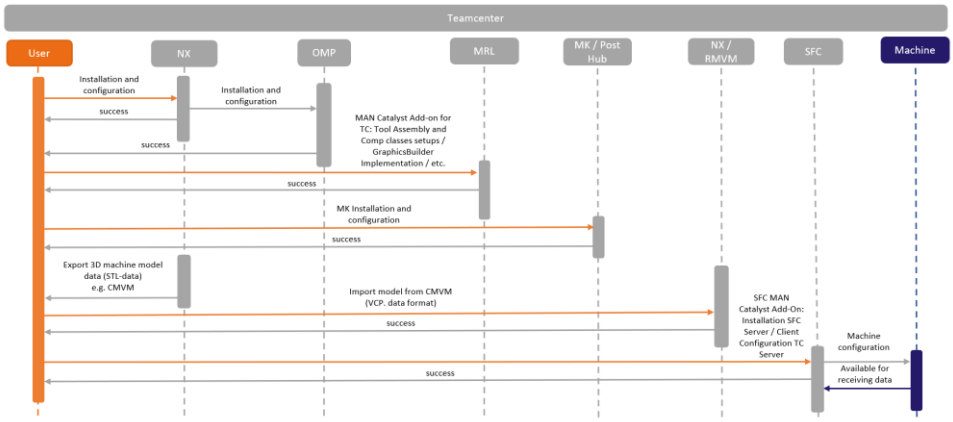

Figure 1 Installation for NX part manufacturing

The user needs to install the NX CAD application. Created NX CAD drawings can be exported as STL data files that can be used by the Create MyVirtual Machine application.

Within the NX CAD application further applications such as On Machine Probing can be installed and configured. Further elements such as Manufacturing Resource Library, Machine Kit and Shop Floor Connect must be prepared and installed to make the part manufacturing available.

5. Internal Architecture

NX CAD/CAM / OMP / MRL / RMVM / SFC:

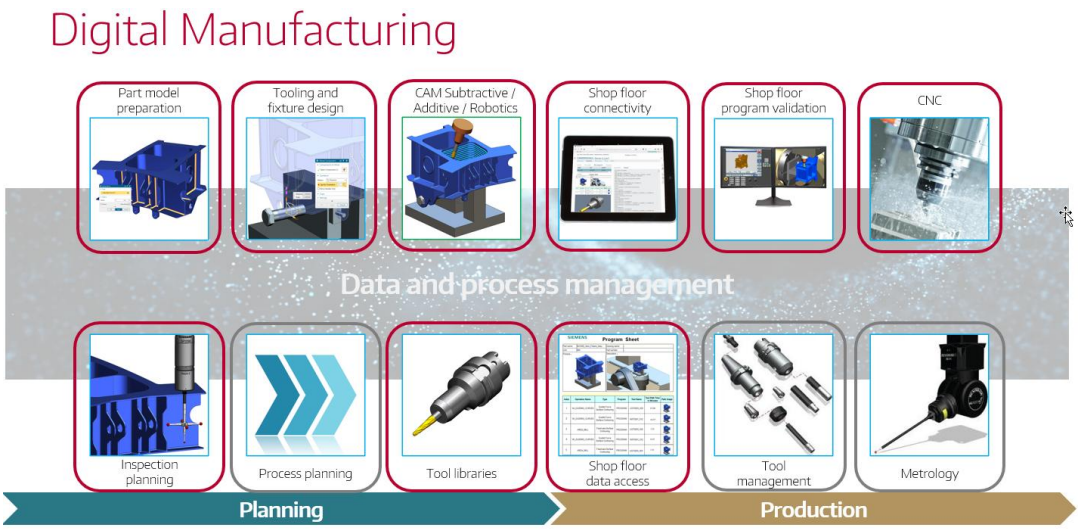

Figure 2 Internal Architecture

In the digital manufacturing process several applications must be installed and configured. The manufactured part is designed in NX. In addition, applications and elements such as tool libraries, shop floor connectivity, inspection planning or tooling and fixture design are needed to complete the digital manufacturing process.

6. API

NX CAD/CAM:

NX software provides an automation architecture that serves as the foundation for all NX APIs as well as for a new journaling utility. Called the Common API, it combines the power of journaling and automation with the freedom of a language-neutral platform. Integrated within the core NX architecture, the Common API is the foundation for all NX solutions and is fully compatible with the existing Open C API.

MRL: N/A

OMP: N/A

MK / Post Hub: N/A

RMVM:

The open interface allows an external application to control the SINUMERIK ONE system and to communicate with SINUMERIK ONE Application during runtime. The task scope of the open interface addresses various use cases (selection):

- Remote control of the SINUMERIK ONE application for example, in automatic inspection and test units
- Cyclic exchange of runtime information, for example, to connect external simulation systems (I/Os, virtual machine applications etc.)

SFC:

The connection of all NC controls works directly via network or serial via Com-Server++.

7. Implementation Technology

NX CAD/CAM:

Provides a native .NET API that supports all .NET languages including Visual Basic .NET and C#. The Java and Open C++ APIs support the full range of Common API capabilities.

MRL: Teamcenter application

OMP: Python based

MK / Post Hub: Directly integrated in NX CAM

RMVM:

License**:** Run MyVirtual Machine /3D Operating system: Microsoft Windows 10 Professional/Enterprise/IoT Enterprise/Home (64 Bit)

SFC:

Shop Floor Connect (SFC) supports Microsoft SQL Server 2017, 2019, 2022 or Oracle 12c as well as Windows 10 and 11. The following browsers are supported, Mozilla Firefox, Google Chrome and Microsoft Edge. The existing standard interface for connection to NX CAM allows the data and information generated there to be stored automatically.

Further information:

NXOpen.CAM Package — NXOpen Python API Reference 10.0.0 documentation (siemens.com).

8. Comments

None.