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UGS NX 4 Tooling

A CIMdata Product Review

NX 4 Tooling from UGS

A Product Review

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Prepared by
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CIMdata®

Foreword

CIMdata, Inc. prepared this product review as an independent and unbiased assessment of the functional capabilities of NX 4 Tooling, a CAD/CAM software product developed by UGS. UGS is a registered trademark and NX is a trademark of UGS Corp. This evaluation is one in a series of software product reviews produced by CIMdata, a worldwide consulting and marketing firm. CIMdata has authorized UGS to reproduce and distribute this document, without constraints from CIMdata.

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CIMdata is an industry-leading consultant on CAM software systems. It produces the NC Software Market Assessment Reports and the Compendium of NC Product Reviews. Market research has been conducted by CIMdata on a variety of CAM related topics. CIMdata provides consulting services to CAM software users and vendors and to the investment community.

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UGS NX 4 Tooling

Mold, Progressive Die and Stamping Die Design

CIMdata is favorably impressed by the structure, operations, and execution of the UGS NX 4 Tooling program. The combination of the NX modeling software provided, mold and die design capabilities, process planning software, digital manufacturing software acquired with the Tecnomatix acquisition, machining functionality, and the information management capability contained in Teamcenter Manufacturing (TCM) provides an advanced tooling solution set. It is a comprehensive, distinctive, and industry leading offering. The breadth of applications, depth of functionality, data integration, and consulting resources provided within the UGS NX 4 tooling program are impressive.

UGS has adopted the theme of "Relentless Innovation" for the NX 4 software release. This recognizes that the world's leading companies relentlessly search for ways to better satisfy their customers. In NX 4, UGS emphasizes digital simulation, knowledge capture, usability, and systems engineering to help individuals pursue innovations through product development. The NX 4 knowledge-driven automation features include standards, data management, tool design software, NC programming and open collaboration. The capabilities provided in NX 4 Tooling are consistent with the relentless innovation theme being promoted by UGS.

UGS continues to display a strong management commitment to manufacturing. Their strategy and direction in tool design and manufacture is sound, adequate resources are being employed, and a viable marketing program is being implemented. The overall strengths of UGS in tooling include market presence, industry reputation, breadth of offering, integration from design through manufacturing, consulting resources available, and being among the industry leaders in process planning, mold base design, progressive die design, automotive sheet metal stamping, and information management.

The quality of an end product depends directly upon the quality of the tooling. The design and manufacture of tooling is typically on the critical path of any new product introduction cycle. This is especially true for industries where time-to-market is critical. The overall set of functions or roles involved in the creation of tooling has many elements, and the interactions can be complex. In many cases each step is performed by separate people that could be experts in aspects of tooling such as core and cavity design, mold structure design, die design, detailing, and NC programming. In some environments the tasks are carried out in one multipurpose office; in others the functions are distributed across multiple contractors in multiple locations up and down a supply chain. Not only are individual applications critical but management of data throughout the process is essential.

Toolmakers are no longer stand-alone entities. They are now faced with new and increasing demands from product OEMs and other customers. There is a growing trend for OEMs to participate in supply chain management strategies and early involvement programs. This necessitates effective communication and collaboration across a range of functions to exchange data, perform design reviews, manage schedules, and track and resolve issues. Toolmakers must also increase standardization and re-use of tools to minimize cost, increase quality, and respond to the time consequences related to tool design and repetition.

Defining, capturing, managing, versioning and sharing standard designs, knowledge and components are some of the challenges faced by toolmakers. These issues are beyond the basic requirements for tool design and manufacture, but they form the basis for an advanced tooling solution.

Instead of selecting individual, best-in-class applications as point solutions, the greatest gains can often be achieved by selecting applications that are designed to be connected. Applications that share the same technology platform can enable a higher degree of interoperability than that obtained from use of individual application products. This permits companies to integrate and manage tool design and manufacture, the BOM, drawings, related manufacturing information, processes, resources and reports.

NX Mold Design is the core product in the NX Tooling solution and it has been highly successful since it was originally released as NX Mold Wizard. This was followed in time by products for progressive die design and automated stamping die design. UGS is currently one of only a few vendors to offer such products. The broad range of applications, including those for tool design, tool validation, NC programming, customization, data healing, DFM analysis, costing, and shop floor management is impressive. Users speak highly of the level of service provided by UGS. The Director of R & D at a prestigious U.S. consumer products firm stated, "What we like about UGS is their excellent service. We often push their software to the limits and the UGS team has always responded in a timely manner to help us with our needs."

The strength of the UGS tooling offering is in the comprehensive solution that is provided. UGS provides an integrated mold design, die design, product design and CAM environment within NX. The tooling applications are built on the base of NX design software which provides the core modeling, assembly modeling, and drafting technology.

With the additional support of Teamcenter, design changes and manufacturing process plans can also be managed and integrated among tool design, machining, manufacturing process planning and the shop floor while controlling versions and configurations of tools. Effective collaboration and communication on a global basis can be provided by Teamcenter. The integration of applications within a single product and process data management environment forms the technology cornerstone of the UGS Advanced Tooling Solution. This broader solution provides an advanced tooling solution that is likely to be unmatched in the industry and is being deployed by a number of key companies in the high tech consumer products industry.

Over the years, UGS has established a strong and positive market presence in CAM. In 2004, UGS was again positioned by CIMdata as the worldwide largest CAM software vendor on the basis of revenue received. Moreover, for the first time UGS was also ranked by CIMdata as the largest vendor on the basis of CAM seats shipped in 2004. CIMdata considers tool design to be a component of CAM.

1. Mold Design

NX Mold Design provides software products for automatic separation of cores and cavities, electrode extraction, mold base design and creation of full documentation. In NX 4, mold designers can share the same software environment as product and part designers and NC programmers to minimize data re-entry and translation and to provide for a more efficient process. CIMdata views NX Mold Design to be competitive with products from other leading PLM and CAM-centric vendors in the mold making market that offer similar capabilities.

The basic UGS mold design process is to:

- Receive the product model from NX Design, Parasolid based systems, or other design systems in native format or through translation
- Evaluate the part design for moldability
- Automatically establish the parting surfaces
- Automatically create the mold cores and cavities

- Extract and create electrodes for EDM
- Create the mold base utilizing standard mold bases and components
- Document the mold base with automated drawings and bill of material creation

NX Mold Design provides for automated solid-based design and intelligent assembly of molds including cores, cavities, and mold bases. Associativity is maintained throughout the process. This permits changes to a part model to be propagated to the core and cavity. A user is guided through the mold design process. NX Mold Design includes capabilities for data import, part creation, shrinkage manipulation, automatic cavity layout, parting of the core and cavity, electrode design extraction, model comparison and model swap capability, knowledge-based building of a mold base, assembly drawing automation, and BOM generation.

NX Mold Design provides for splitting the core and cavity, a major and time consuming task in moldmaking. The mold parting function permits the user to step through the parting process without interruption. Parting lines and parting surfaces are produced automatically. To find the parting line for mold separation NX Mold Design utilizes an analysis technique that locates the crossover between positive and negative faces. This is considered to be a more accurate technique than a commonly used approach that mathematically shines a light on the model and looks for the shaded areas.

NX Mold Design includes a capability for electrode extraction. It effectively designs, validates, documents, and manages the process from design through production. To perform this function, the user picks a surface area in which use of an electrode would be appropriate. This area is then projected to a Z-level. An offset parameter is added to allow for the spark gap. The electrode geometry is defined. A user can add features to the solid model of the electrode area.

The electrode system in NX extracts a blank for the electrode, provides blank and holder designs from standard part libraries, does clearance and interference checking, calculates burn areas, creates electrode drawings, provides integration with CAM, and does BOM reporting. Data can be captured within Teamcenter, whereupon a drawing can be generated and data can be forwarded to the shop floor for EDM machining.

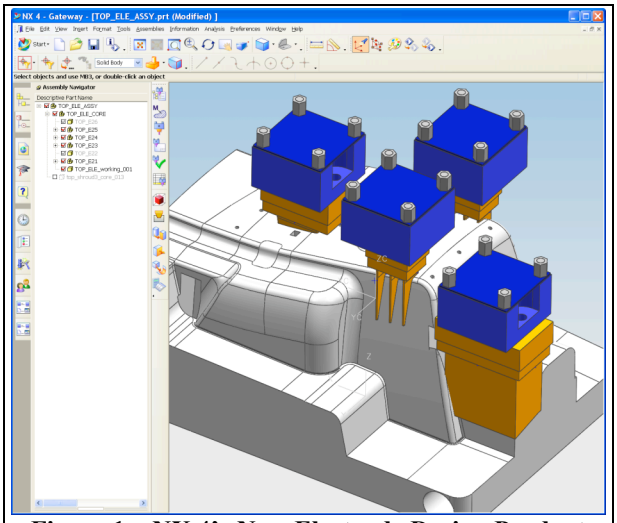

Figure 1—NX 4's New Electrode Design Product Extends Its Mold and Progressive Die Tooling Design Capabilities

A mold base assembly is built by selecting components from a library and inserting them into a design. A standard part library is available for selecting existing parts. Industry standard mold base libraries, such as Hasco and DME, are provided and custom libraries can be embedded in the software. A design is enhanced by the associative and parametric nature of the software, capturing best practices for a shop, and incorporating a rules base for assembly of components. For example, components such as riser plates or ejector pins can be parameterized so that creation of a component to meet a new requirement can be quickly generated. If a pin is created, the software will automatically generate a hole for the pin. If pins are moved, the mold assembly will adjust accordingly. As changes are made to mold base components, the mold base assembly will automatically update. A bill of material for a complete mold base is automatically produced.

In NX the mold designer uses many of the standard assembly functions provided in the underlying NX design product. For example, to check for interference, such as screws going through a

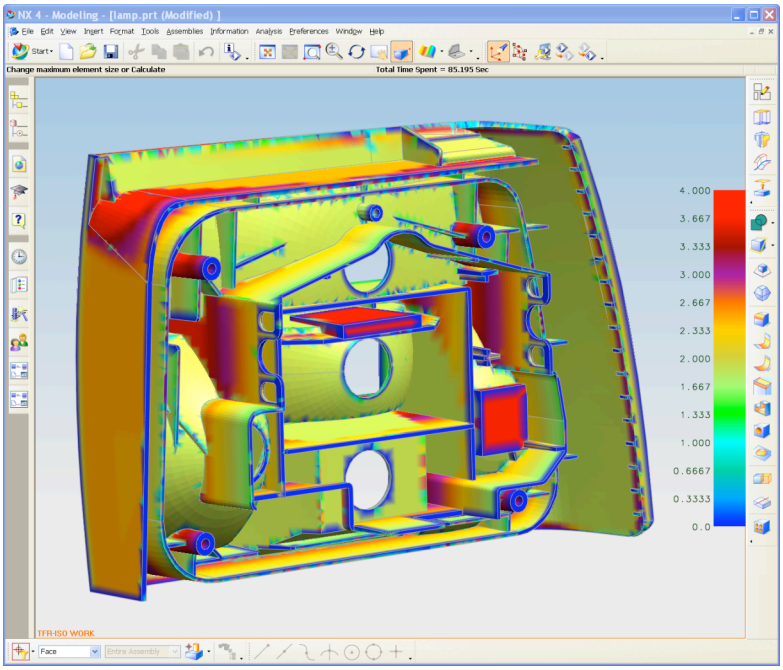

Figure 2—NX 4 has a Mold Wall Thickness Checker with Color Coded Display of Analysis Results

cooling line, a user accesses the standard assembly application in NX. In some competitive mold design packages this function is built into the mold design application itself. Automated interference checking among mold base components is a significant feature that is not yet available in NX, but will be included in an upcoming release.

NX Mold Design includes added integration, improved concurrent design, new patching tools for trimming, extending, and replacing of a solid box, improved parting definition, and a maximum radius rolling ball algorithm for wall thickness validation. A CAD/CAM manager at a New Zealand tool shop commented that, "He particularly liked the ability within NX to customize the tooling environment to better meet their needs."

The manufacturability checking features built into NX Mold Design are a significant enhancement. They extend manufacturing awareness to the front of the design process, which should reduce time to market and improve product quality. NX 4 design validation tools enable a user to analyze the part and automatically obtain information about draft angles, undercut areas, sharp corners or any other consideration that would make a part impossible or difficult to mold.

A wall thickness check computes the thickness throughout the solid model and permits users to view the thickness of any area in a model. Wall thickness is provided at any point in a molded or cast part. It is defined as the diameter of the largest possible ball inside a part model that can be touching at that point. Color-coding of wall thickness is provided by associating a given color with a given range in wall thickness. The user can readily see the material thickness at any location on the casting or part. The wall thickness check and other checks for conditions such as undercuts and sharp corners should be helpful to users.

Both uniform and non-uniform scaling can be utilized in shrinkage calculations. Being associative, shrinkage and parting surfaces can be quickly updated when a part model is modified. A core can be subtracted from a block to produce a cavity.

NX Mold Design is available as a standalone product or as a package with the NX CAM software. UGS has defined a NX Mold Design bundle for design and the mold design functions can be added to the NX machining products. Translators, modeling and drafting products are included in the design bundle. Milling, wire EDM, and post-processing modules are included in the NC bundle.

2. Die Design

Software to automate the design of progressive dies and simulate the stamping process is important as a component of the NX 4 Tooling suite. UGS is one of only a few suppliers to provide this type of software. Progressive dies are commonly employed to produce sheet metal components in industries such as consumer products, lighting, computers, and electronics. A progressive die

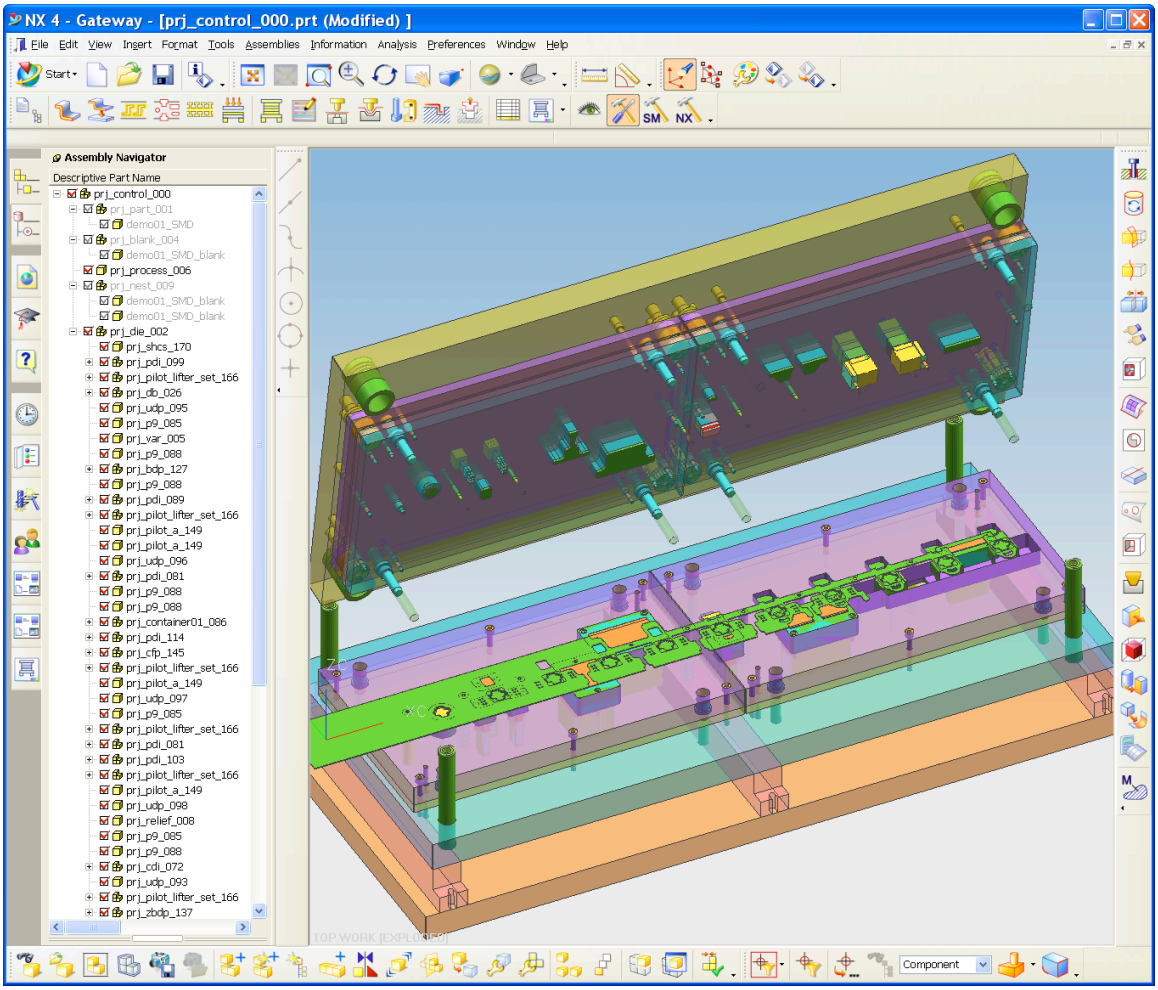

Figure 3— NX Progressive Die Design Offers a High Degree of Automation within a 3D Design Environment

sequentially transforms a flat strip of metal into a completed part by employing a series of stations that cut, form and coin the material into the desired shape. In Progressive Die Design a user builds the strip layout, simulates the process, catalogues die bases and documents the process.

The progressive die solution provides a broad tool set to build a complete die from initial part to finish. It is a comprehensive, knowledge-based, associative product that provides considerable automation and continual checking of the die design. This includes a user interface that guides users through the process, creation of assembly and detail drawings, a BOM, and design associativity for downstream functions. Software is provided for product design, tool layout, tool design, tool validation, machining, and support of shop floor operations. Part families as well as solid and sheet bodies are supported in the layout tool set. A corner design tool is available, force computations are made, and a hole report is generated.

Progressive Die Design supports feature recognition as well as rebuild, bending, springback, material utilization computations, 3D strip layout and simulation, nesting, and interference checking functions. A solid model produced in any system can be accepted as input. A database of materials with bending factors is included. A bill of material is automatically generated.

The primary uniqueness of the UGS offering is that it supports free form parts, whereas some other products do not. As such, UGS introduced

the first solution to handle the complete 3D progressive die design process. As in mold design, UGS provides a powerful, comprehensive application solution. It covers the complete environment for progressive die design.

The functions contained in Progressive Die Design include:

- Use of a 3D part model created in NX or by importing a CAD model from other systems in native or translated mode.
- Automatic feature recognition to recognize sheet metal features in a part and a feature build capability to automatically re-build a parametric sheet metal part with features. Features are recognized in NX, IGES and STEP files. Examples of sheet metal features include bend, wall, cutout, flange, etc. A user defined feature is applied to any areas in which a standard feature is not recognized. Feature recognition is one of the initial steps in the die design process. Features are required to unfold a part and do process planning.
- Layout of the blank metal strip by directly unfolding a part and mapping the part features to process features. During this phase the user decides the minimum distance between parts and the number of parts to be produced at a time. Also, the number of bends to be made will be determined. The software includes bending factors by material and the amount of springback to be expected during bending.
- Nesting part blanks on sheet stock to minimize scrap. This is to assure that the material can be punched out properly. The material utilization on the strip is established.
- Automatic strip layout and process design. A skeleton strip is created that rebends the blank models to simulate the forming operation at each die station.
- The die structure, stations and inserts are developed. The number of stations are automatically determined and the features are assigned to stations by using best practice rules that have been previously developed. Since the software is associative, if the number of stations are changed at a later time, the process will automatically update to the new conditions.
- A built-in standard part library is available that includes catalogs from most suppliers.
- Die base design and design of the punch and die inserts. For each feature there is a punch and die in the shape of a feature. The forces being applied are calculated. A 3D simulation is performed to assure that there is no interference between the die and punch.
- Documentation is generated in terms of drawings and a BOM. The drawings are associative to the die design and the die design is associative to the part design.

Use of Progressive Die Design produces a substantial increase in user productivity and the knowledge-based checking features reduce chances for error. It is expected to result in improved visualization, faster and easier die design, a reduction in human errors and increased product quality.

The major market for progressive die is with smaller companies but UGS has been able to sell the system to the some of the largest die design shops. As with the other NX Tooling applications, NX Progressive Die Design is being sold through resellers and by the UGS direct sales force. The UGS intent is to extend the existing product to automatically handle more complex parts, introduce change management, and provide greater process validation.

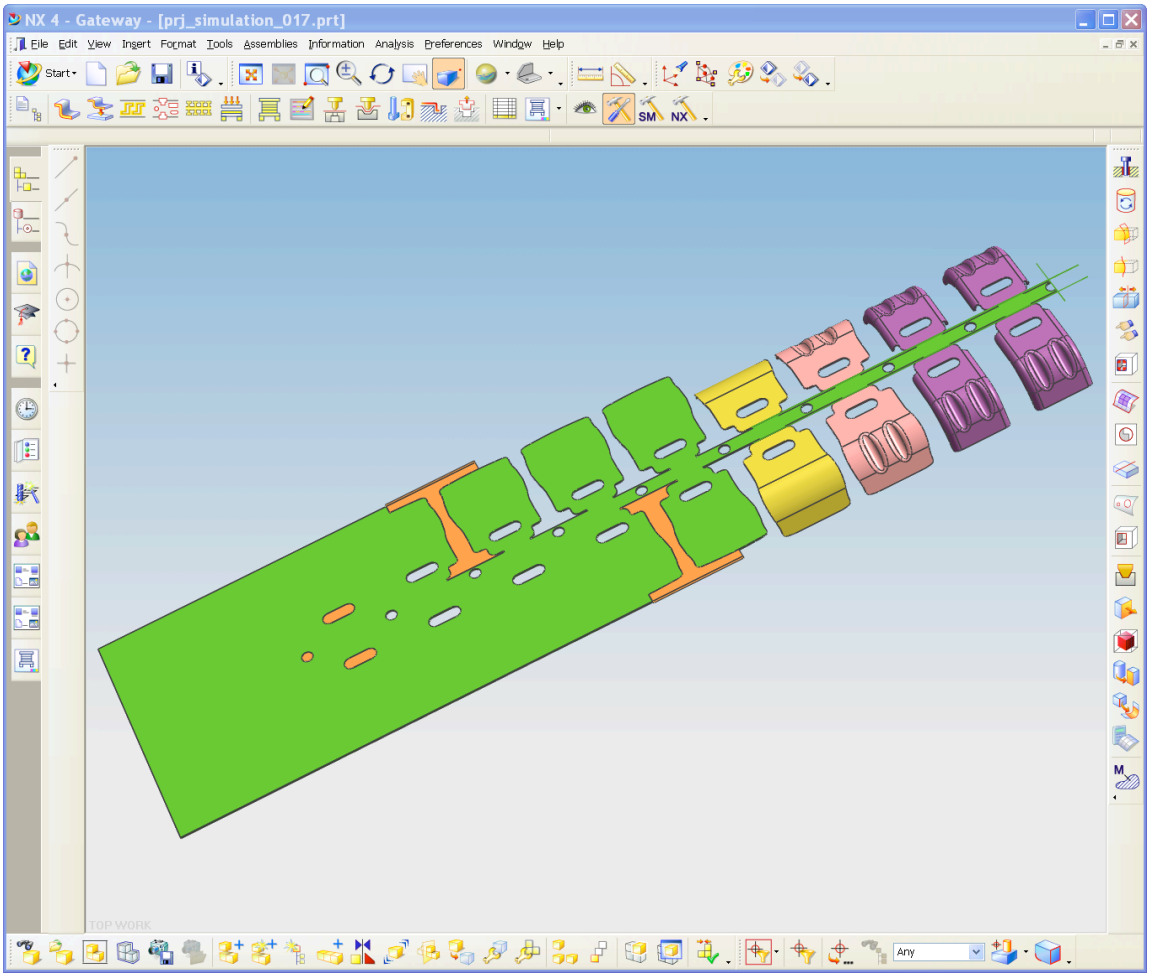

Figure 4—Multi-Stage Forming and Stamping and the Evolving Sheet Metal Shape can be Simulated in NX Progressive Die Design

UGS also provides a comprehensive stamping solution for design and optimization of automotive dies and press lines. It includes capabilities for sheet metal design, stamping process design and optimization, die face design, die structure design and NC programming for die manufacture. It offers tools to determine the die operation across a complete press line.

The capabilities of the UGS sheet metal stamping solution include:

- Producing a representation of the sheet metal for the draw, trim and flange elements of the die process.
- Using analysis application to check formability.
- Simulation of the intended operation of the press-line, individual press elements and inter-press handling equipment.
- Analysis and optimization of the press-line.
- Use of NX Die Design for detailed design of a die structure.
- Use of NX CAM for programming the cutting of a die.
- Teamcenter Manufacturing for process planning, data management, configuration control, and production of shop floor and other documents.

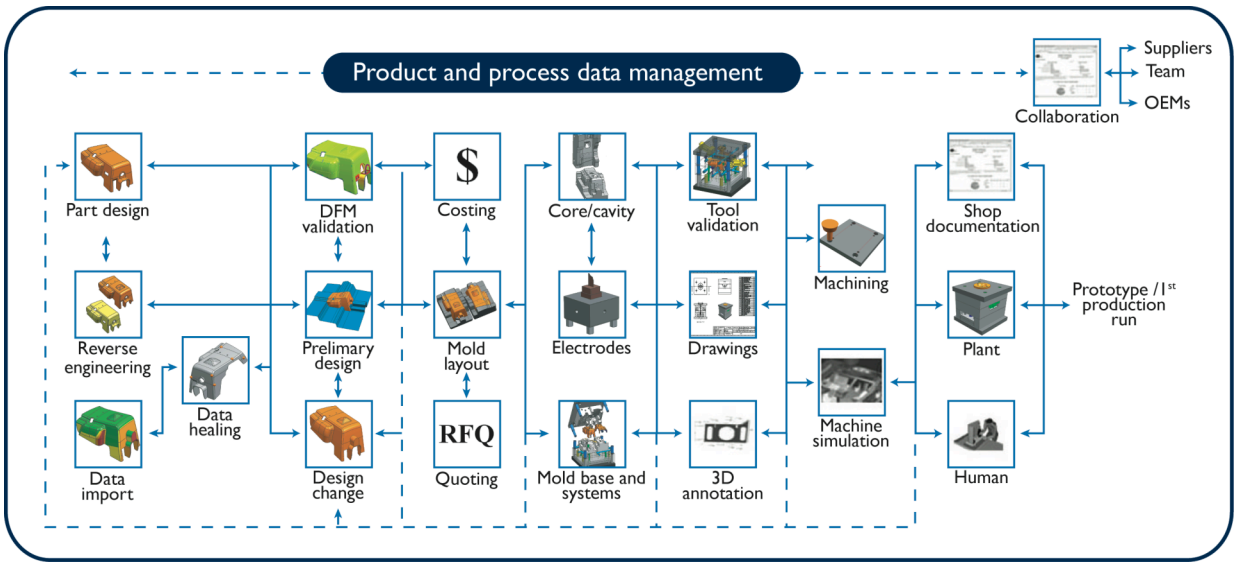

Figure 5—Teamcenter Provides Product and Process Data Management Across the Entire Tool-Making Activity for UGS and 3rd-Party Applications

3. Teamcenter Manufacturing

Teamcenter Manufacturing (TCM) is an information management engine for manufacturing. It is based on Teamcenter Engineering, with extensions that optimize its applicability to the manufacturing environment. Teamcenter Engineering is a cPDm system focused on managing product definition and related information. The tools available in Teamcenter Engineering for workflow, change management, integrated visualization options, configuration management and integration tools are all available and directly relevant for those using Teamcenter Manufacturing. In addition, TCM manages a wider set of data created in the manufacturing planning stage of the product lifecycle.

While UGS does not currently offer a product that automatically estimates the price and delivery of molds and dies for quoting, UGS does offer Teamcenter Community. It is used to manage and share the information necessary to facilitate the quoting process between toolmakers, customers, and suppliers. Capabilities provide a secure environment to exchange data, host 3D design reviews and track visual issues.

Teamcenter Manufacturing is a powerful and unique product. No other vendor offers such extensive and distinctive information management functionality focused on manufacturing. It serves as the information management engine for all NX 4 manufacturing applications. The integrated combination of CAM, digital manufacturing, and tool design utilizing TCM as a core component is unmatched in the industry. The information management functionality greatly exceeds that offered by CAM-centric vendors and the combination of functionality and focus on manufacturing is beyond that provided by the PLM vendors.

Within NX 4 Tooling, Teamcenter Manufacturing provides tool designers with the ability to access the right data at the right time for the right job. The tool designer can access part designs and store and re-use tool and fixture designs. A complete library of design and process knowledge promotes standardization through design re-use in a managed development environment. The ability to access the right data at the right time also extends as far as the shop floor by enabling the manufacturing team to visualize assembly drawings, shop documentation, and work instructions.

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