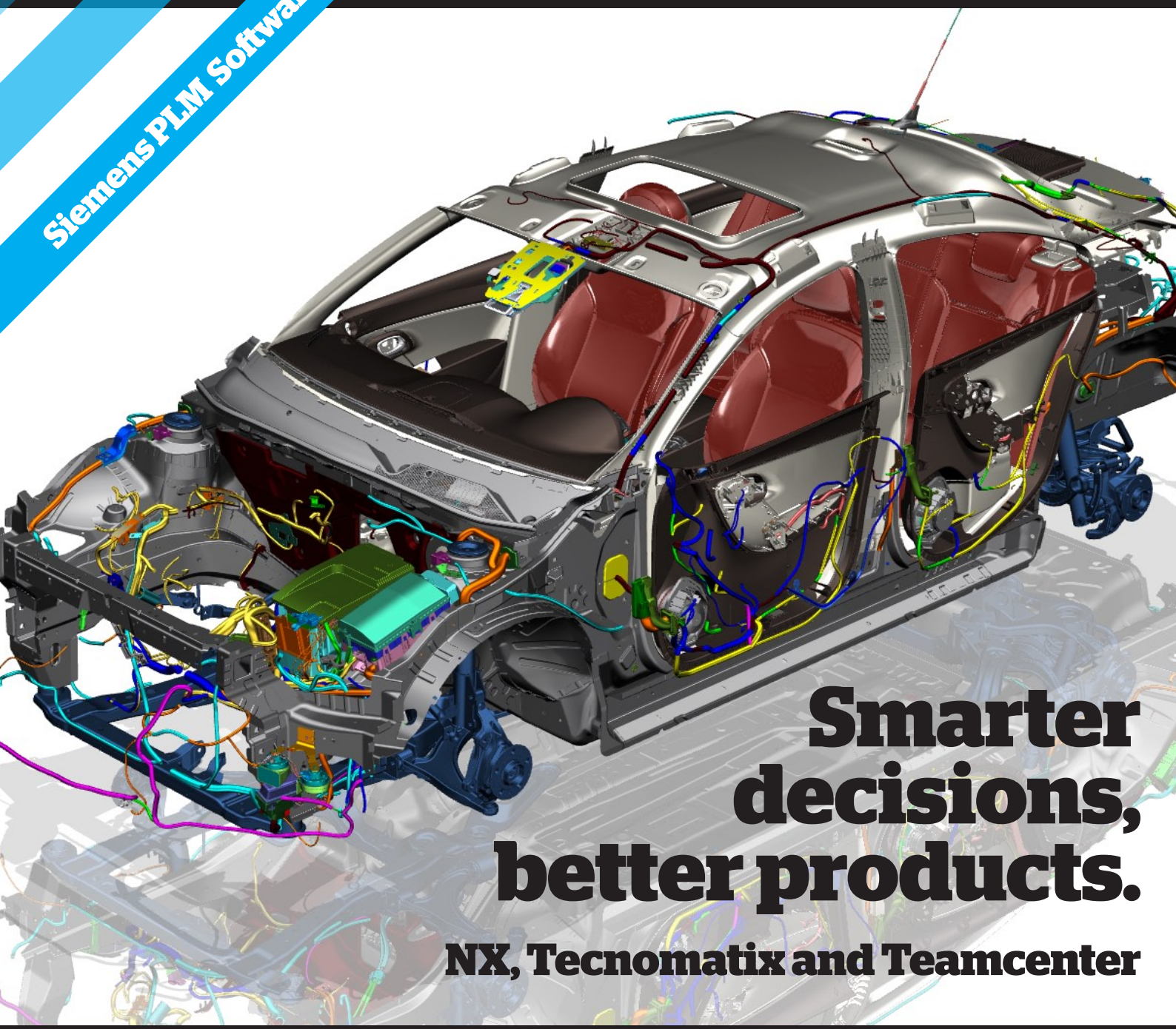
DEVELOP 3D
TECHNOLOGY FOR THE PRODUCT LIFECYCLE

Siemens PLM Software supplement

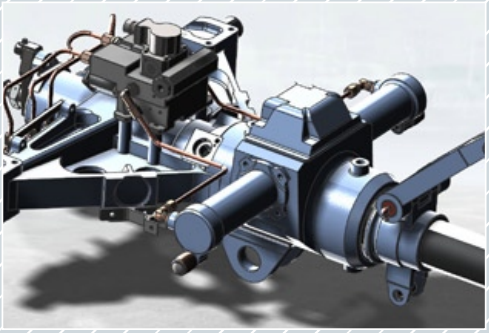


Smarter decisions, better products.

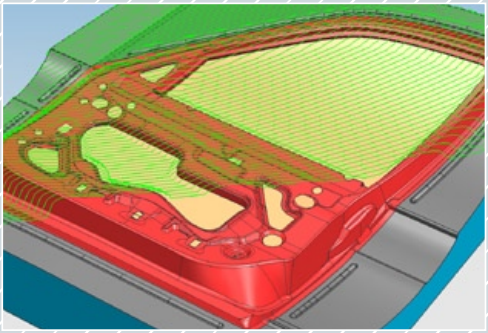
NX, Tecnomatix and Teamcenter

FEATURING

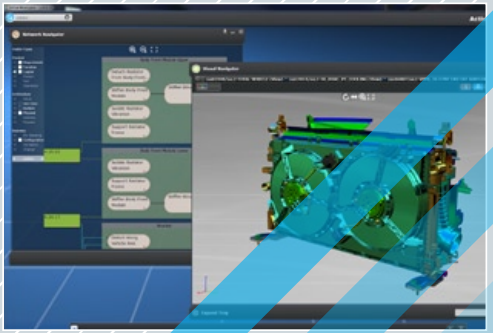
Product engineering
Helping overcome the key challenges



Part manufacturing
From 3D model to finished part



Teamcenter PLM
Bringing power and richness to PLM



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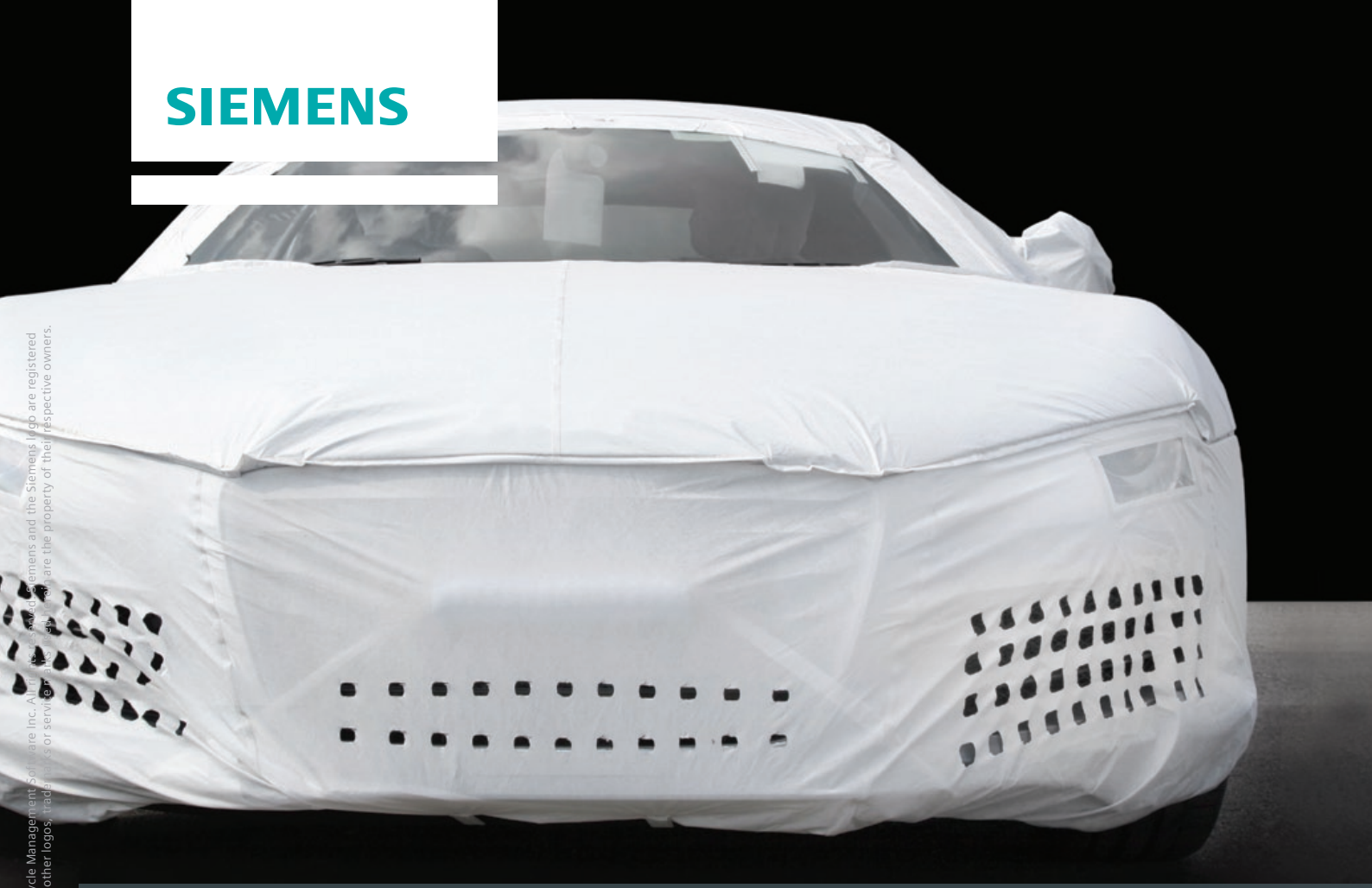


Great moments in product decision-making.

An automaker releases a new sensation... because an engineer re-used an old design.

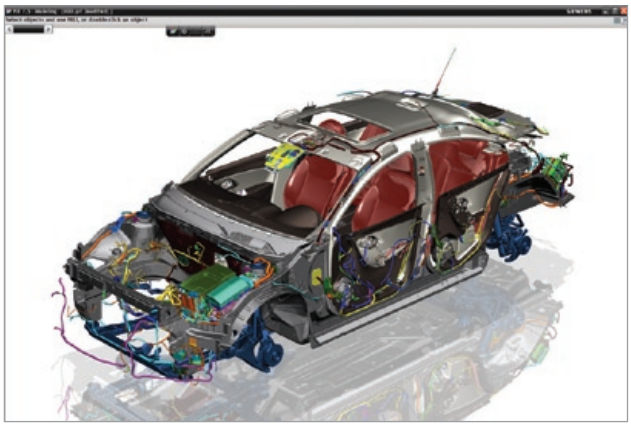
Siemens PLM Software: Smarter decisions, better products.

Every great product is the product of great decisions. Not just the big defining moments, but the millions of decisions that lead up to them. Anyone can make the decision that makes the difference in your product's success. The engineer in Evansville. The machinist in Munich. The supplier in Shanghai.

For leading companies throughout the world, Siemens PLM Software is an essential platform for collaborative product decision-making. Our solutions give everyone involved in making your products "high-definition PLM." HD-PLM ensures that people get the information they need, when they need it—with absolute clarity—to make more informed decisions faster.

No matter what industry you're in—automotive or aerospace, electronics or energy, marine or medical, machinery and more—Siemens PLM Software helps you make the smart decisions that go into making great products.

Learn more at **siemens.com/plm.**



Siemens PLM Software provides a common decision-making platform that understands the cross-functional dependencies in your product lifecycle process. This helps ensure that everyone gets the information they need in the proper context to make more informed product decisions.

Answers for industry.

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Technology for the product lifecycle

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Key challenges for product engineering

From complexity and sustainability to quality and performance, the challenges in product engineering are very different from those faced by our forebears. We take a look at the big six and how Siemens PLM Software's NX can help overcome them.

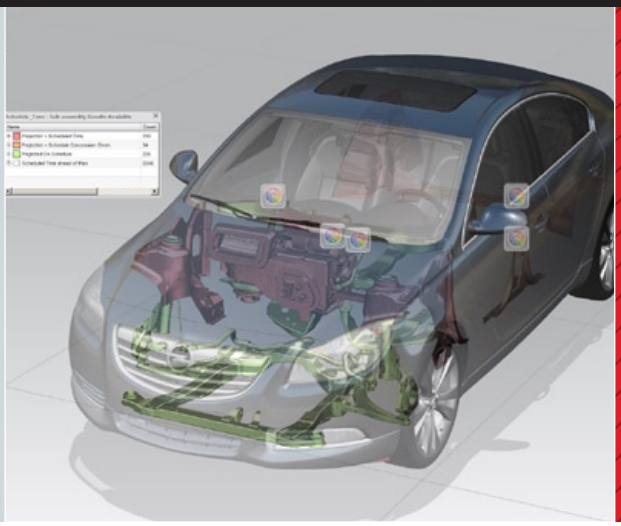
Complexity

Modern products are incredibly complex. From the smart phone in your pocket to heavy duty industrial equipment, they often fulfil multiple roles and can be customised to cater for discerning customers. Designs not only comprise mechanical form and function, but electronics, electrical control systems and connectivity.

NX supports all design elements in a modern product – tools to generate concepts and variants more quickly, the integration of electronics data and into the realms of mechatronics and systems design.

With the integration of Teamcenter, it's also possible to manage customer or functional requirements, options and variants and pull that information into the design environment.

To put this all in context, turn to page 7 to find out how the Space Research Centre at the University of Leicester is using NX and Teamcenter to assist in the development of complex instrumentation for space missions.



High Definition 3D (HD3D) technology in NX can help users dive into the wealth of information held within complex product models

Sustainability

The responsibility for reducing the environmental impact of products rests in the hands of the design and engineering profession. This includes the development of cleaner, greener power sources, the reinvention of transportation and more localised and smaller scale improvements on a per product basis.

With consumers also demanding greener products sustainability will be a key focus for the design industry for years to come.

But how can sustainable design be accomplished when profitability is still the number one driving factor? Techniques such as whole systems design, light-weighting, materials selection and design for disassembly can all contribute and NX has a broad set of tools to support them. From the ability to rethink existing processes and products at a root level, to the ability to find, test and refine designs based on new materials and into the world of product compliance, the combination of NX and Teamcenter gives the design and engineering team everything they need.

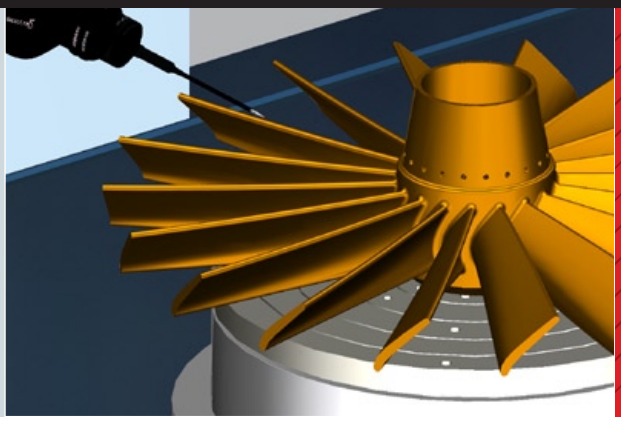
Visual reporting can provide visual feedback on material choice, weighting and compliance. This can give vital feedback to help improve the sustainability of a design

Quality

Quality is hard to quantify. Does it relate to the perceived quality of a product – will the user love it and cherish it? Do the materials used give a product an air of quality and therefore command a higher price premium? Does it come down to lower reject rates on the production line?

Many of these things can be designed into a product during its development, but are often hard to evaluate with basic 3D geometry displayed on a monitor.

NX supports photorealistic rendering to enable stakeholders to gain a better insight into how a product will look and feel. And once prototypes are required, data can be created for use in various processes, from NC controlled milling machine tools to 3D printing machines that build parts from raw materials.



NX CMM Programming can help provide quality assurance on manufactured products

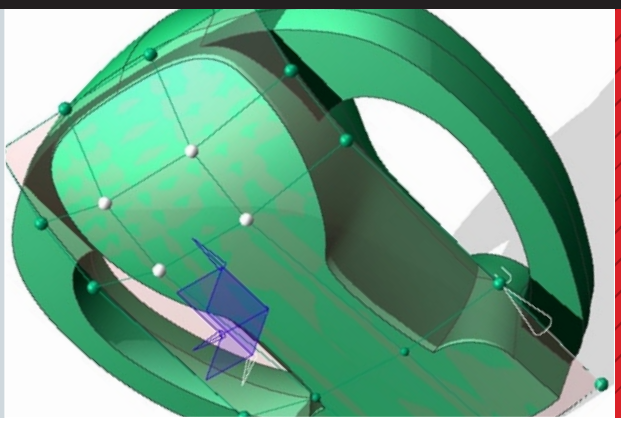
Aesthetics

Consumers no longer tolerate bad looking products – whether that's a member of the public shopping on the high street for a new TV or a contractor investing in construction equipment.

Traditional "function-first" products from the likes of JCB now differentiate themselves by incorporating the types of design aesthetics typically reserved for the automotive industry. And this is an industry wide movement.

By integrating advanced, but easy to use surface modelling tools, alongside the core engineering design feature set of NX, users have the ability to develop exterior style to the quality required, then move the product forward into detailed design and engineering.

We explore this further on page 6 with a look at NX's freeform design tools.



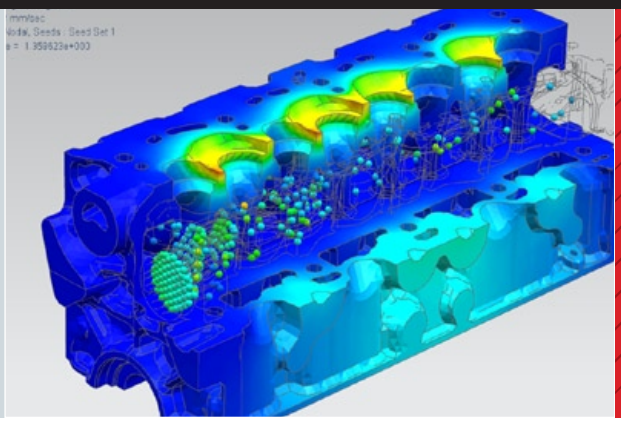
NX offers a range of advanced surfacing tools to help design forms that are aesthetically pleasing

Performance

We all want our products to perform better – whether it's motor vehicle or a kitchen top coffee pot, we want it to function well throughout its entire life. This places a burden on the designer or engineer to explore the operating limits of a product iteration before it even gets to the prototyping stage.

Using a range of simulation technologies, NX allows designers and engineers to explore a product's operating conditions, to find areas where mechanical strength can be optimised, where heat dissipation can be improved and form can be adjusted.

NX also offers a range of new tools to assist with capturing an organisation's knowledge and expertise in easy to reuse and deploy templates for simulation. This is explained in more depth on page 4 and 5.



NX CAE can be used to asses the operating limits of a product before it gets to the prototyping stage

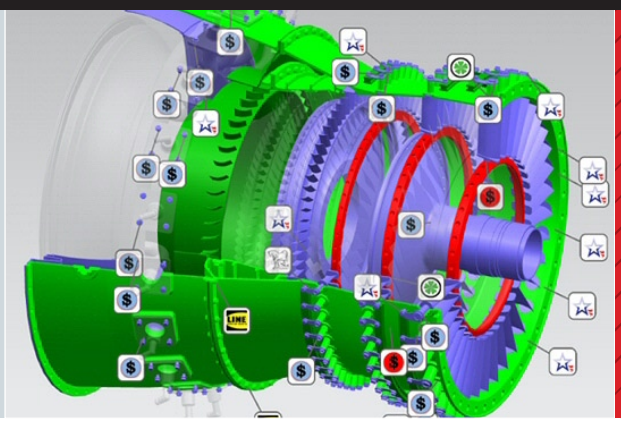
Cost

In the current economic climate there has rarely been more pressure to reduce costs in product development.

Rapidly increasing materials costs, the need to increase profitability and the drive to reduce overheads through outsourcing, must all be considered by the design and engineering professional.

The full feature set of NX allows an organisation to reduce material use through optimised design. It also allows new materials options to be explored and geographically dispersed development teams to be managed.

With access to the full suite of manufacturing tools in NX the software can then help users reduce costs further by taking products into a more efficient manufacturing process.



Visual reporting can be used to identify which components are over budget or contributing the most cost.

Deriving value from knowledge capture

Knowledge capture in CAD has always promised great things, but unless the knowledge is easily reused, the return on investment is minimal. We explore the Product Template Studio within NX that aims to truly deliver on that vision.

With the introduction of digital design tools came the mantra 'create once and reuse many times'. Pretty soon after this, we started to hear the term 'knowledge capture'.

Knowledge capture differs from data reuse in the sense that it's about much more than just reusing geometry and copy/pasting lines, circles and arcs. It is about capturing the thought processes and inputs that went into making that geometry, and re-using that knowledge to create new designs. Specialist knowledge held by a designer or engineer can be transformed into a digital asset that can be harnessed by other users.

Historically, knowledge capture or knowledge-based engineering (KBE) systems have been highly specialised, often more of a consultancy gig than a user focussed tool. They are often expensive and time consuming to program from scratch. If it takes six months of consultancy to automate a process that might only take the designer or engineer a week to complete, you have to ask yourself is it really worth it?

In highly complex applications, such as conceptual engineering on turbine engines, knowledge-based engineering systems have proven beneficial but, for mainstream applications, the pain and cost of setting up such systems often didn't make sense. But does that mean that the benefits of knowledge-based engineering can't be applied to the masses? Of course not.

The Siemens PLM Software team has been building tools into NX that allow us all to do just that. So let's explore how they work, the benefits they offer and what some of Siemens PLM Software's customers are doing with it.

A different approach

NX and its Unigraphics predecessor have included knowledge capture and reuse tools for many years, in the form of Knowledge Fusion (KF). This was a traditional style tool which required the use of a visual programming language to define each instance of capture and reuse. It was powerful, but complex and very time consuming to program.

With NX 4, Siemens PLM Software introduced a new set of tools for capturing design and engineering knowledge that were equally as powerful, but dramatically easier to use. This culminated in the release of the Product Template Studio (PTS) in NX 6.

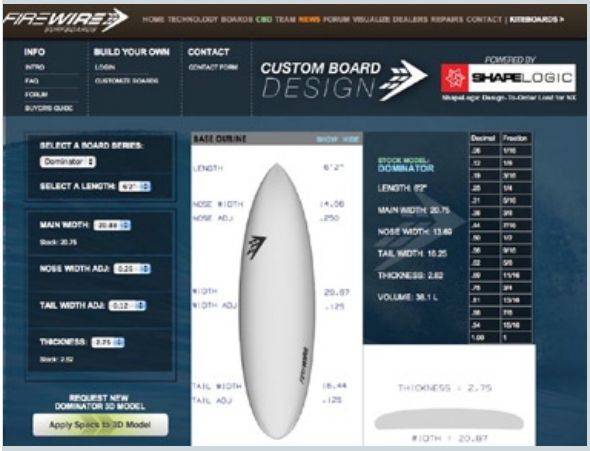
Product Template Studio represents a breakthrough in capturing commonly repeated and reused processes, workflows and tasks and making them available for reuse. It combines parametric modelling tools, logic and equation-based parameterisation (using Expressions) and an environment that allows anyone to create templates graphically: no programming required.

Getting started

The starting point for knowledge capture in PTS is the geometry. The user needs to ensure that it can be parameterised and works correctly.

A native NX model is the ideal, as this contains all of the parameters and

Firewire Surfboards pushes knowledge direct to the customer



One of the biggest challenges for Western Australia's Firewire Surfboards is how to serve hardcore surfers who want custom boards to suit their individual styles and local wave conditions.

"It's important for any premium, high-performance surfboard brand to offer custom boards if they want to be recognised as an industry leader," says Firewire Surfboards CEO Mark Price.

The firm's web-based Custom Board Design (CBD) system enables registered customers to select models from Firewire Surfboards' standard surfboards, then alter the design with their own dimensions. CBD users can tweak the board's length, wide point, nose and tail width, and thickness to tailor the board to their preferences.

The Product Template Studio (PTS) in NX was ideal for prototyping the custom surfboard design-to-order system. Using drag-and-drop tools, Firewire's development partner, ShapeLogic, devised a simple user interface to drive the parametric surfboard models. This interface served as a template for creating Firewire Surfboards' web-based interface. The use of PTS also facilitated testing of multiple parameter combinations to ensure the robustness of the models.

www.firewiresurfboards.com

expressions required to drive its form and function. For older legacy data, however, or even non-native data, Sync Tech pays some dividends. It can be used to quickly re-parameterise the geometry so a template can be built off a new version of the original geometry.

Alongside a sound geometry model, additional tasks can also be incorporated into the template. Essentially, anything that's used within the NX environment to define a product's form and function. An obvious example is the increasingly common use of CAE (Computer Aided Engineering) or simulation. Not only can simulation studies be incorporated into a template to validate the geometry that's created, but it can also be used to feedback into other areas, such as including part checks against customer requirements or performance limits.

Adding a user interface

One of the key innovations in PTS is that the resultant templates are driven from a graphic user interface, which is often indistinguishable from those used in vanilla NX. The user interface provides direct access to the parameterised model and associated processes.

The range of input values presented in the dialogs are set so those reusing the template across the organisation can't work outside the defined boundaries and limits.

If the organisation is using Teamcenter, it is also possible to link a Product Template to design requirements, calculation worksheets, dialog images, tabular engineering data, help documentation, and other relevant knowledge resources stored in the Product Data Management (PDM) system. Changes made to this knowledge, which can be centralised within Teamcenter and maintained by non-CAD users, can quickly be reflected in the Product Template, ensuring that anyone who uses it will be leveraging a design based on the most up-to-date information possible.

Deployment of templates

Once the template has been defined and everything is in place, it can then be deployed. Luckily, Siemens has done a lot of work to centralise the mechanisms for data reuse within NX. Consolidated into the Reuse Library, this goes beyond the typical standard features, parts and sub-assembly libraries and is the central place to locate reusable data. Anyone within the organisation can then drag the appropriate template into their work space and make use of that mission critical knowledge.

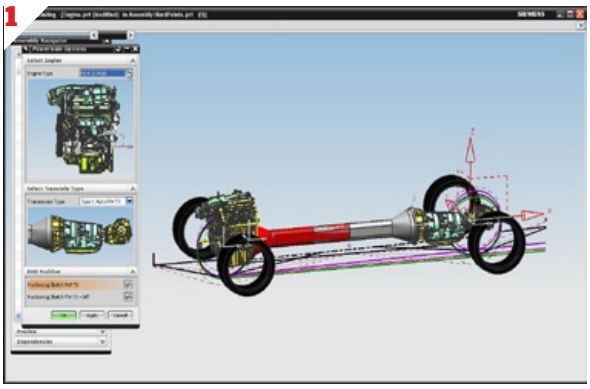
The benefits of knowledge

We're all aware of the knowledge gap that the design and engineering profession is currently facing. There are fewer entrants into the industry while an ageing workforce is retiring, taking with it a lot of knowledge and expertise within an organisation.

Alongside this, we spend much of our time repeating work that if not done by ourselves, certainly has been carried out elsewhere within our organisation. Design and engineering is often a case of adapting existing products, parts or concepts to a new set of requirements. It makes no sense to do everything again from scratch.

Digital design tools like NX can help, but the problem is that even if knowledge is captured in digital form, those that need it often don't know where to start looking.

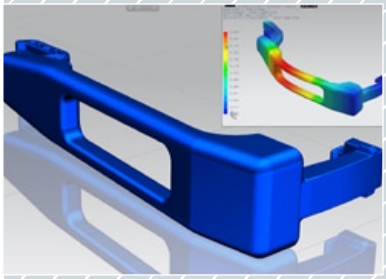
This is where NX's Product Template Studio and the Reuse Library can pay massive dividends. Knowledge and expertise can be captured and formalised in an easy to use and very powerful manner. But, just as importantly, those templates can be accessed by those that need them, when they need them. When you combine these two factors, it's clear that the value of capturing your organisation's knowledge can be truly realised.



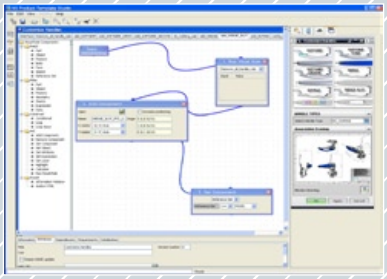
1 Powertrain design with knowledge captured using the Product Template Studio in NX.

Workflow Setting up a Product Template within NX

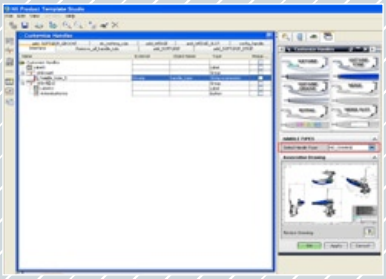
1 The starting point is a fully developed, parametric part model with any associated CAE studies and other processes.



2 Intelligence is then added. This connects the different variables, inputs and parameters as well as providing the ability to 'nest' multiple templates within a single deliverable.



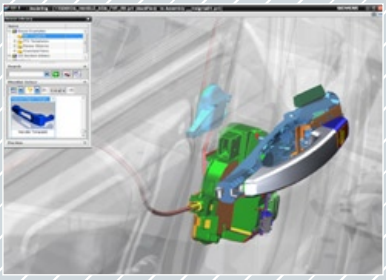
3 A dialog is created matching native NX user interface standards. Only those inputs and options that the user can experiment with are shown, ensuring best practice.



4 The user interface elements are then connected to the appropriate model elements.

5 Lookups pulling Requirements or other managed resources from Teamcenter allow enterprise-level best practices and standards to be integrated into a Product Template.

6 Once placed in the Reuse Library, the template becomes available to anyone that needs it, allowing them to reuse that data at will and gain full benefit from it.



Integrated form design

NX has always had a reputation for supporting those that require the ultimate in form development. We explore how its surface modelling tools, when used as part of an integrated design and manufacturing process, can benefit firms of all types.

The requirement for high-quality aesthetic design is no longer the preserve of the automotive industry or manufacturers of exclusive designer products. Today, more than ever before, design is in the mind of every consumer and everything from industrial machinery to the objects we previously considered to be purely functional, needs to look good as well as perform to specification.

This has caused a shift in what designers and engineers are demanding from their CAD tools. Whereas prismatic shapes used to be sufficient in a product development system, now everyone needs to be able to create and edit high quality surface models.

While modern CAD tools have developed advanced surface creation and editing functionality, they are often disconnected from the software that is used to take a product further into production.

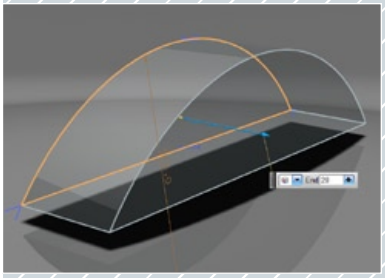
Siemens NX software has always provided a rich set of surface manipulation tools. These have recently been boosted by the introduction of Synchronous Technology. Fine edits made to surface geometry can now be quickly propagated throughout the whole model.

The result is an integrated toolset that's easy to use, contains deep and rich functionality from intelligent geometry creation, as well as the industry standard analysis and validation tools that are expected.

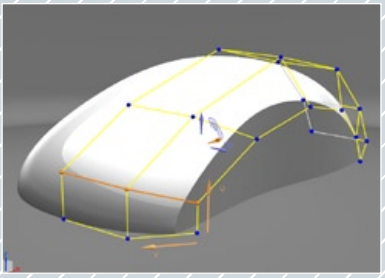
But the real benefit of using this integrated system is that advanced surface creation and editing tools now allow the user to take the same data through into design, engineering and production readiness.

Workflow Using freeform modelling to develop a mouse

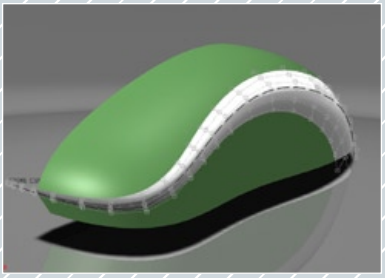
1 Freeform design conceptualisation can begin from simple geometry, employing familiar concepts such as sketch and extrude to quickly arrive at an initial form.



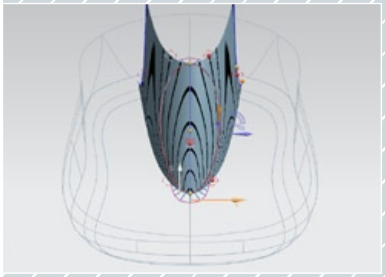
2 To give it more desirable aesthetics the integrated high quality surfacing (styling) capabilities can be used within the NX Synchronous Modelling toolset.



3 A full suite of high quality (Class-A) blending tools are available for defining complex transitions. All tools work the same across surface or solid model geometry.

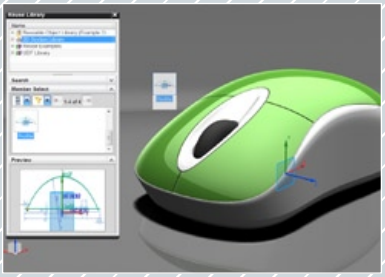


4 Zebra stripe reflection analysis can be used in combination with surface to surface intersection analysis while shaping the thumb wheel scoop.

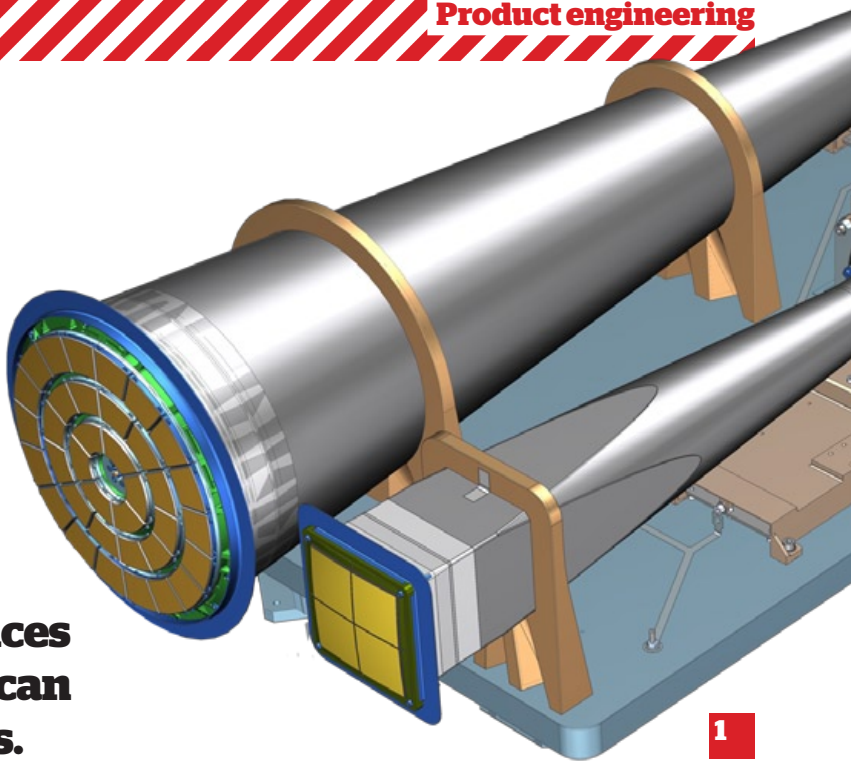


5 The full capabilities of NX can be used including support for engineering surfacing, component breakout and detailing, and template based parametric design tools.

6 All design data from styled to mechanical can be reused from the NX Reuse Library making it possible to capture and reuse elements of a product's "design language".



The final frontier



1

The Space Research Centre relies on NX to ensure the devices it develops for space missions can survive in harsh environments.

Sending spacecraft into orbit to explore the unknown is inherently exciting. The Space Research Centre (SRC), part of the University of Leicester Department of Physics and Astronomy, has a long history of involvement in major international space missions. Stretching back more than five decades, its activities are diverse with its core engineering pursuit being the development of instrumentation for space missions.

Considering that it costs in excess of £20,000 per kilogram to launch hardware into space, product assurance and reliability are paramount at SRC. In conjunction with its in-house facilities, including test laboratories, environmental test chambers, clean rooms, electronics design and manufacturing facilities, it uses Siemens NX for mechanical design, analysis and manufacturing.

"NX and Teamcenter are very much core to our research as it really has allowed us to be a lot more efficient in how we deliver quality to schedule and budget," says Piyal Samara-Ratna, mechanical engineer and CAD administrator for the SRC.

The SRC has been using Siemens PLM's software solutions for around 15 years and over the past four years it has slowly moved completely over to a fully integrated NX and Teamcenter solution – a transition managed by Siemens' software reseller, TEAM Engineering.

Out of this world

One of SRC's ongoing projects that has benefited from Siemens software is its work on the MIRI (Mid InfraRed Instrument) for the James Webb Space Telescope (JWST), the next-generation mission to replace the Hubble Space Telescope. Led by NASA, the project represents an international collaboration of around 17 countries and has a rather hefty goal of studying the birth and evolution of galaxies.

"Siemens products have been used extensively in this programme for design, analysis and manufacturing and have been essential tools in ensuring that the flight instrument passed its structural testing with flying colours," explains Jon Sykes, University of Leicester lead mechanical engineer for the instrument.

The SRC is also involved in the development of the Mercury Imaging X-ray Spectrometer Instrument (MIXS), one of the key instruments onboard the BepiColombo spacecraft that is being developed by the European Space Agency. Due to launch in 2014, it will reach its final destination of Mercury in 2020. MIXS will be used to help determine the composition of the planet's surface by measuring fluorescent X-rays.

Unlike MIRI, the SRC are actually leading the MIXS project and are responsible for managing the overall consortium, which consists of a number of international partners and teams. MIXS represents a leap forward in scientific capabilities and, because of the challenges involved, an iterative design, analysis and test campaign has been undertaken, with increased functionality introduced at each stage.

"We are designing a product of optimum efficiency with strictly controlled margins of safety," comments Samara-Ratna. "If our instruments fail in space then there is nothing that can be done to fix them. Therefore we undertake an extensive analytical and test programme to ensure reliability. We find that the NX Nastran solver is an industry standard tool and this promotes the sharing of models and data with our project partners."

The group has recently finished the structural thermal model, which combines the flight structure with partial electronics and optics. The next stages will be launch load simulating vibration and environmental testing. "This is an expensive process and we rely on our analysis data to give confidence that the design will work. To move efficiently through these design phases quickly we need a multi-functional tool like NX," comments Samara-Ratna.

Technology transfer

Although the core of what the SRC does is space science and related instrumentation it is also heavily involved in technology transfer. "Our work is applicable to a board range of industrial sectors," stresses Samara-Ratna. "Currently research is being carried out into medical detectors that use technology spin-offs from space instrumentation to detect tumours."

"We are also making increased use of new manufacturing technologies like additive manufacturing and for this we make extensive use of NX's wave-linking and synchronous modelling tools to allow us to take advantage of the geometries feasible with this technology," he adds.

Now that the SRC has fully transitioned to NX and is using Teamcenter for CAD management, the next phase is to incorporate document and project management. "We want to use the full breadth of what Teamcenter is capable of doing," concludes Samara-Ratna.

1 CAD model of the Mercury Imaging X-ray Spectrometer Instrument (MIXS). In collaboration with Magna Parva.

2 CAD model of the Mid Infrared Instrument (MIRI) for the James Webb Space Telescope.

3 The University of Leicester Space Research team in the clean room with their hardware contribution to the MIRI.

At the University of Leicester, JWST activities are funded by the UK Space Agency (UKSA), BepiColombo activities by UKSA and the European Space Agency.

2

3

Simulation at the core of design

Under pressure to shorten time-to-market, manufacturers are seeking to take advantage of simulation earlier in the design process, writes Jan Larsson at Siemens PLM Software.

With traditional product development workflows, analysis and physical prototyping are used to confirm the intended functional performance of a design. But, if design problems are found at this late stage, development schedules can slip, costs can skyrocket and products can often fall short of market and business requirements, increasing the risk of customer dissatisfaction and/or recalls.

In many instances, the design team and the simulation analysis team are working almost entirely independently. Even when bringing simulation into the process earlier, teams are using disparate, specialised tools that are disconnected from each other. This creates redundant data and workflows, and ultimately impedes the speed of simulation.

According to a report by the AutoSim Consortium, of the total time needed by engineers to perform a full simulation for a system or subsystem, 80 per cent is devoted to generating the model.

To speed things up, every step in the simulation process must be aligned. The goal is to get to a point where simulation is in sync with design and, in some cases, leading design so analysis results can be fed back into every design decision. Simulation models (such as finite element models) with detail matching the accuracy desired at a particular design stage must be available.

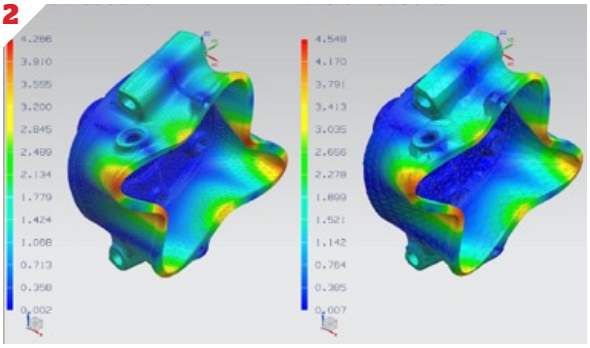
In a simulation-driven design process, engineers have access to powerful geometry editing tools, like direct modelling and dimension-driven design. The most recent advance comes in the form of synchronous technology, a unique capability that combines the speed and flexibility of direct modelling with the precise control of dimension-driven design. These powerful tools allow engineers and analysts to easily edit and obtain the idealised geometry they need without having to wait for designers to perform these tasks. This enables them to respond rapidly to design changes or suggest changes to the design based on simulation results.

Because models and data can be shared easily, this level of integration can provide confidence for a manufacturer's decision makers. Through a centralised hub, it's possible to deliver tools which allow designers to run basic simulations, and analysts to make any necessary tweaks to a model's geometry. This helps garner greater synchronicity and trust between the designers and the analysts, and gives both teams the ability to make alterations without having to go through a complex and time-consuming back and forth process.

By turning to a simulation-driven approach and introducing it right at the concept stage, product developers can reuse existing models and design geometry instead of rebuilding them from scratch. This allows them to explore alternatives, spot flaws and optimise product performance before the physical prototype or detailed design is created. The process allows important decisions to be made on functionality, geometry and materials early in the cycle based on simulation results.

This high level of coordination between designers and analysts can be achieved through the implementation of a complete suite of integrated process automation tools, such as Siemens PLM Software's NX software. By using NX – which integrates high-end analyst modelling tools with world-class geometry capabilities - and combining it with data management software, such as Siemens PLM Software's Teamcenter, users are able to develop and share analysis models faster than with traditional CAE workflows.

1 Jan Larsson, marketing director, NX, EMEA Marketing at Siemens PLM Software.



2 NX enables you to compare physical test data with CAE analysis results and to optimise your models to ensure results will accurately predict physical tests.

Changing the culture

The simulation-driven design process represents a significant cultural change for many companies. In addition to new technology, these requirements will also call for dramatic changes in processes and attitudes. It may mean re-organising the way groups work together and it is likely to mean changing old habits.

People that used to hold data for as long as they could to get as much context from other groups and to minimise their chances of revision, for example, have to be encouraged to release preliminary information early to support a more rapid process. Each group working on the design has to learn the needs of the other groups.

This kind of concurrent and collaborative engineering – where 3D models, data and results are shared so everybody is able to see the geometric model in real time – creates workflows that help facilitate design reviews and enables multiple departments to review and approve or reject the design. As an added benefit, by properly synchronising and centrally managing processes, companies can more easily adhere to all regulations around tracking and traceability.

Innovation

Simulation guides critical trade-off decisions to balance competing product objectives such as reliability, cost and weight requirements. But it also plays a major role in product and process innovation. New ideas have to be tested, qualified and refined before they can be put into practice.

Usually hundreds of concept alternatives are evaluated before detailed design is begun. In the past this required physical testing, so very few design alternatives or radical ideas were tested and products evolved slowly.

Advances in technology and processing power, combined with the coherence of a centralised design and analysis hub mean that there is much greater scope for experimentation. This is crucial to innovative product design. If the simulation and feedback process is fast enough, even radical but unfeasible ideas can reveal useful information and increase insight into a design. This is especially true early in the design process when you want to eliminate potential 'losers' and focus subsequent efforts on a smaller set of potential 'winners'.

The message is clear – by putting simulation at the heart of the design process, engineers are better able to understand, predict and improve product performance digitally. More design concepts can be explored, which in turn reduces direct costs associated with expensive physical prototypes and enables faster, more informed decisions.

Pump up the volume

PLM and CNC integration provides seamless data flow from CAD/CAM to machine tool controllers, automating production and saving time & money

Andritz Ritz manufactures pumps and submersible motors used for municipal and industrial water supply and sewage systems, mining applications and offshore platforms. The firm is a leading manufacturer in its market segment with more than one million pump systems installed worldwide. It produces pump systems and replacement parts, and on occasion embarks on spectacular engineering projects, such as the world's largest pump, which was created for the Las Vegas, Nevada municipal water system.

Andritz Ritz's IT infrastructure is constantly evolving and improving. For example, after implementing abas ERP software for 58 users it was able to retire four legacy systems. An upgrade from 2D CAD to a 3D design process using Solid Edge from Siemens PLM Software improved the efficiency and accuracy of the engineering department.

The next goal was to improve numerical control (NC) programming and cutting tool management. "We have organised all of our technical and commercial systems in such a way that colleagues benefit from the work of others throughout the design-through-production process chain," says Hans-Juergen Steeb, manager of IT and organisation at Andritz Ritz. "Therefore, our CAM system selection criteria were heavily focused on the ability to establish a fully integrated process."

A number of computer-aided manufacturing (CAM) systems were evaluated based on selection criteria such as cycle time reduction, quality improvement, user friendliness, and the ability to deliver a higher degree of process automation between engineering, NC programming and shop floor machining. The company chose the Adanos partner network, led by A+B Solutions. The latter partners with Siemens PLM Software to provide solutions such as NX and Teamcenter, as well as comprehensive product lifecycle management (PLM) services including implementation.

The implementation proposal included streamlining the manufacturing planning and shop floor production processes by integrating Teamcenter (data and process management) with Shop Floor Connect (a web client for use on the shop floor to access, manage, view and deliver CNC programs to machine controllers).

Integrated PLM environment

Today, when an engineer begins a session using Solid Edge, Teamcenter is started at the same time and every newly created component is registered and managed by the PLM system. All design changes, update notifications, and release processes are initiated and carried out automatically.

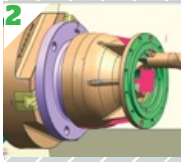
Design and manufacturing revisions are also managed and tracked throughout the entire process, from initial design, to each design variant, and on through to manufacturing. Standard parts are classified within the library for fast and easy retrieval, and their use is tracked within every design. Finite element analysis (FEA) simulations are also saved and managed with Teamcenter. The NC programs are created at two NX CAM workstations, which are connected to Teamcenter. Even the packaging and release of NC data to production is managed by the manufacturing release process of Teamcenter. Using Teamcenter, NC programmers can easily find and select the required tools and clamping devices for their respective CNC machines.

Before running the actual machine, all NC programs are run through a virtual machining simulation using NX CAM. These simulations allow NC programmers to check tool paths in the context of the complete machine assembly, providing comprehensive collision protection. Finally, tool lists and setup sheets are created and stored together with the work plan, detailed drawings, NC data and machining simulation videos.

1 Andritz Ritz produces pump systems and replacement parts for a wide range of industries

2 Andritz Ritz uses a variety of software from Siemens PLM Software, including NX CAM, Solid Edge and Teamcenter

3 Pumped up: the team at Andritz Ritz



Closed-loop manufacturing

Another important aspect of Andritz Ritz's implementation is the seamless transfer of project information from manufacturing planning to production. On the shop floor, workstations are connected to one or several machine controls. There, machine operators log into Shop Floor Connect to gain role-specific access to released data. For each job, the user is shown only the information that is needed. Simulation data, CAM parts, CAD models, pictures, videos, and work plans may supplement the default information of NC data, shop floor drawings and tooling sheets.

NC programs are transferred directly to the controller. Sometimes, programs need minor adjustments and optimisation at the machine controller. When this occurs, the machine operator can easily record the changes, and then notify and transfer the modified program back to NC programmer via Teamcenter.

Shop floor information within PLM

By bridging the worlds of engineering and manufacturing with PLM, smarter decisions can made to produce better products. Andritz Ritz has established an integrated work environment that ensures a reliable process chain, from design through production. Project cycles became more efficient, while continuing to remain lean. The ongoing trend toward business growth suggests the need to hire more. All the while, the fundamental principles of process reliability and continuous improvement remain uncompromised. "We are able to identify and fix potential issues much earlier in the process," says Steeb. "We save a lot of money, because we can avoid finding errors late in the process when they are the most costly to fix."

Key challenges for part manufacturing

Beset by pressures on all sides, part manufacturing is ripe for optimisation, both in terms of process and workflow. We look at six of the top challenges and how Siemens PLM Software's part manufacturing solutions can help overcome them

Efficiency

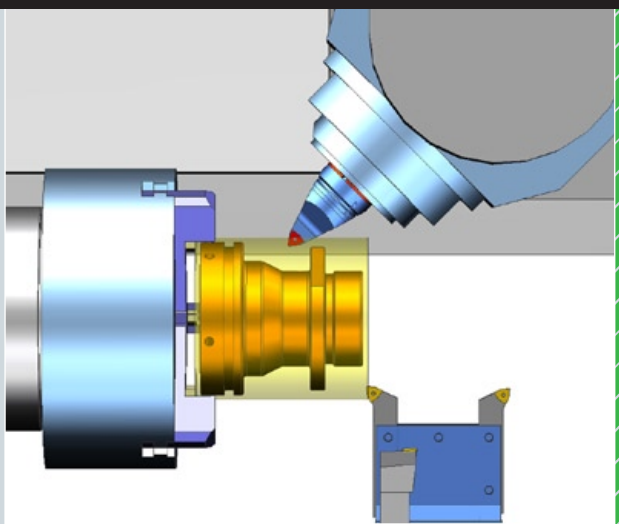
In the context of manufacturing, discussions on efficiency often focus on the optimisation of a limited band of processes – such as NC programming and machining.

Today's leading organisations, however, are widening their gaze to the entire process – from the preparation of a 3D model all the way to the production of the finished part.

But optimisation is not just about tuning individual parts of a process. The connections between the various applications, systems, people and equipment also need to work as efficiently as possible.

Building intelligence into the process – such as by reducing the need for repeated data entry, introducing more encompassing search tools and enabling access to up to date information – can pay huge dividends here.

Siemens can assist with 'whole process efficiency' by providing intelligent design and NC preparation tools sitting on a Teamcenter powered digital backbone.



NX provides the manufacturing engineer with a single platform for part preparation, tooling and fixture design, CAM and CMM programming

Teamcenter provides complete data and process management for the entire process including the ability to connect release work packages to the shop floor

Quality

Across all industries there are increasingly complex design requirements for ever more sophisticated products.

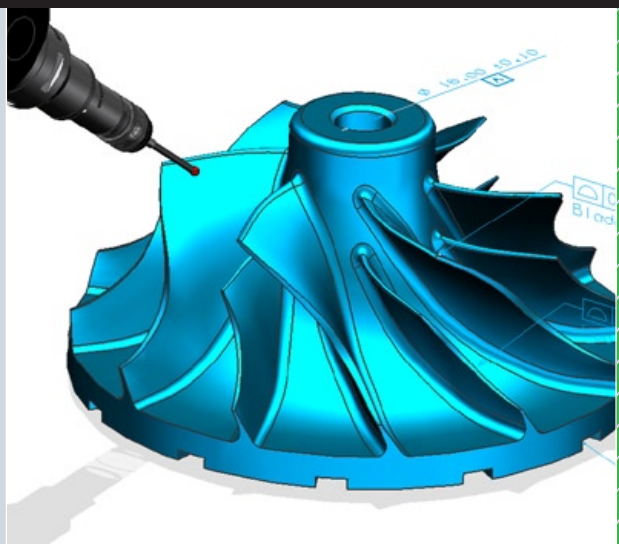
Quality has always been a prime concern, but it is often difficult to quantify – particularly in these hyper competitive times.

The idea of perceived quality is paramount to many customers, with the key drivers being improved surface finishes, accuracy and fit.

Alongside this, 'quality' relates to manufacturing parts according to their specification with better management of the complete process, using a fully documented plan. As traceability gains more importance, this will only become more key to many organisations.

And of course, there's then the traditional metrics for quality and ensuring that parts are manufactured to the required tolerance.

NX has a range of tools to integrate the use of coordinate measuring machine (CMM) inspection into the digital process, from CMM programming to reuse of 3D PMI.



NX uses design requirements to automate the programming of CMMs directly from the model-based measurement and tolerance annotation (PMI)

Cost

Within a manufacturing context, cost often relates to both raw material and machine running costs, but in today's economy, it is also about making the most of all resources; materials, machines and people.

Standardising the manufacturing process is one way to maximise cost savings. For example, this could mean using a standard set of cutting tools across all machining facilities (see the Manufacturing Resource Library on page viii of this document).

When it comes to machining time optimisation, Siemens PLM Software's NX CAM suite is perfectly placed to help create operations which are lean and efficient. It not only helps save time, but can reduce wear and tear on both machine tools and cutter hardware.

Teamcenter for managing standard resources such as cutting tools and fixtures

Control

Efficient working processes based on digital part manufacturing data require control. Often seen as an additional burden, if done correctly, data control can actually make processes more efficient.

While control helps ensure that data is centralised and up-to-date, it also has the advantage of delivering a much richer set of information to those that need it. Within the context of manufacturing, this means that work packages are based on the latest release data. It also allows consumers of that data to interact with the related assets and to feed back errors when they occur – quickly and efficiently. Teamcenter is an intelligent backbone through which data is controlled, complete and made accessible to all those that need it.

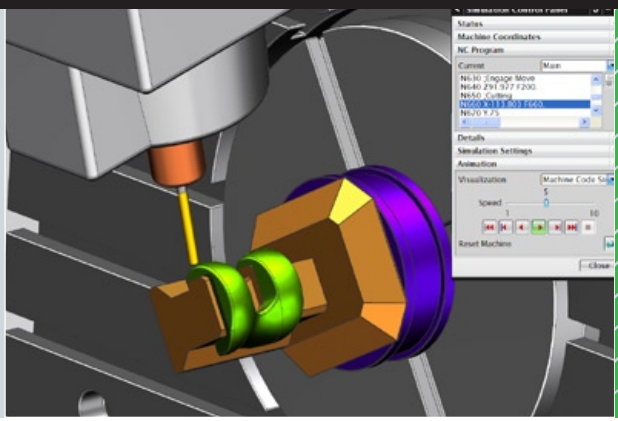
Teamcenter for data and process management - revision control, workflow notifications, and the production release of work packages

Compliance and traceability

Many industries are now facing increasing regulatory and compliance demands. While already widespread in the aerospace and medical sectors, traceability is now a key requirement for many more organisations.

Satisfying this demand for record keeping and data tracking presents a serious headache for organisations without data and lifecycle management systems in place. Additional problems arise when the data moves from design and development into manufacturing – where data management processes aren't as commonplace.

Siemens' Teamcenter can assist with these challenges and help ensure that a complete record of change and decisions is maintained from development right into production and inspection.



Teamcenter with secure access, full records of change, and managed delivery of the work package all the way to the point of execution (machine tool)

Globalisation and flexibility

Globalisation is a major challenge faced by many manufacturing organisations. While the mainstream media tend to portray it as a threat of impending doom, those in the know see globalisation as a opportunity for expansion and business growth.

What is key – particularly when dealing with multi-site, geographically dispersed manufacturing centres – is the ability to balance workloads, keep the production facilities flexible enough to handle rapid introduction of new business lines, cope with demand fluctuation and handle new machine tool deployment efficiently.

Siemens PLM Software's NX and Teamcenter have been developed to meet these many challenges of globalisation for some of the world's leading global players.

NX is used by the smallest job shops to the biggest global companies. Teamcenter provides a platform for a design-anywhere build-anywhere business

Planning to production

From world-leading design and engineering to the provision of tools through the PLM Software group, Siemens is synonymous with innovation. We detail how it can help take parts to production with a rapidly expanding product portfolio

Manufacturing is the rapidly changing stage of a process that leads a product from conceptualisation, through design and engineering and into production.

While historically, the 'design, make, sell' company has been common place, global pressures, lower cost economies and the battle for survival have meant that the manufacturing sites of our fathers are not ours – and far from it.

Manufacturing today sees the tools used to design a product combined with the manufacturing execution tools that allow data to be reused. That same intelligent 3D data source can be used to drive the development of tool-paths, to create and optimise inspection processes, and to produce job sheets and work lists.

The problem is, this process can often become fragmented, disconnected and unmanaged.

Into this fray steps Siemens, an organisation steeped in global engineering and manufacturing heritage. In the manufacturing sector, Siemens has been a supplier of machine tool control and drive equipment for decades. Its Sinumerik machine controllers have long been leaders in the aerospace industry and many more machine tool builders are now offering Siemens controllers.

The establishment of the Siemens PLM Software division, with the NX product suite, has brought with it a set of tools to assist not only in the design of new products and parts, but also with the preparation of those parts for production. This includes mould and die design, advanced applications for the programming of multi-axis machine tools, mill-turns and into CMM programming and inspection.

Part manufacturing

Siemens's part manufacturing solution, taken in the context of the whole NX offering, takes this foundation, along with Siemens' activity in manufacturing in general, and builds a complete solution that can truly benefit any organisation that takes it on board.

From the development of the part geometry within the context of NX, it's possible to develop, iterate, simulate and finalise the form and function. When required, this same geometry with associated tolerance and manufacturing information, can be taken further. Here technologies such as NX's Synchronous Technology, which enables history free editing, can be taken advantage of to create tooling, add machining stock and other preparatory processes.

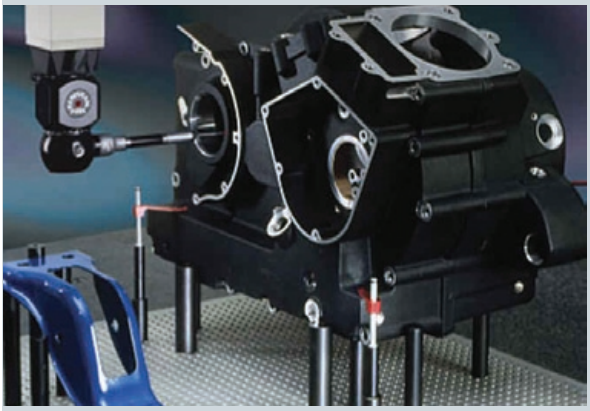
CAM programming is something that NX has been well respected for since its beginning, building on the tools already present within Unigraphics. These have been expanded since.

This means that production-ready machining programs can be created, optimised and output. This output can then be combined with the documentation required to produce a part to form an intelligent work package for delivery to the shop floor

As a result of the legacy of the NX system and the direct experience Siemens has at the controller or DNC level, the system is able to control not only the mainstream machine tool equipment, but also the advanced technology now becoming available such as embedding the Siemens'

Mirko Baecker – EMEA Marketing Director; Digital Manufacturing Solutions

Delphi Thermal - improving profitability with intelligent processes



Delphi is a leading global supplier of mobile electronics and transportation systems, including powertrain, safety, steering, thermal, and controls and security systems, electrical/electronic architecture and in-car entertainment technologies.

Faced with increasing competitive pressures in a contracting automotive market, subsidiary Delphi Thermal realised that 'good enough' wasn't going to accomplish its ambitious goals nor satisfy automotive OEMs that are demanding lower cost components with tightening quality requirements.

One of the key components of the automotive supplier process is a strict compliance to OEM quality requirements through Production Part Approval Process or PPAP. With a quality solution for inspection programming and execution built on Teamcenter, Delphi Thermal has been able to meet PPAP requirements much more efficiently while increasing its final PPAP acceptance rates.

This has had a positive impact across multiple domains, but especially in removing delays from production.

www.delphi.com

controller cycle software code into NX CAM.

Data and process management

Alongside the core creation and preparation tools, Siemens also has Teamcenter, its Product Lifecycle Management solution. While PLM is often seen as a 'design-heavy' solution, Siemens is building a new set of tools into the system for managing and controlling all manner of manufacturing and production information.

This ranges from the direct management of the part geometry, through to the various constituent parts of the CAM tool-path, such as fixtures, machine tool models, cutters, work piece and individual operations.

The new Manufacturing Resource Library provides a new integration between NX (for geometry creation) and Teamcenter which allows the modelling of both form and metadata of the cutter so the whole enterprise can access a standardised and centralised library. This saves both time and cost in procurement (see page viii for more details on the Manufacturing Resource Library for Teamcenter).

Teamcenter is well versed in process management and now has specialised workflows and processes to support part manufacturing. This includes production plan building, task assignment, job approval and release, change management and traceability – which is becoming increasingly important.

1 The full suite of Siemens solutions relating to part production, from design through machining and into inspection and quality inspection. All are built on a backbone managed and controlled by Teamcenter

Effective connection to production

To support the deployment and use of these tools, Siemens has now released the Shop Floor Connect for Teamcenter. While you can read more about the benefits of this technology on page vi, the concept is as follows: The shop floor is a dramatically different environment to the design or production planning office, but the same access to data is fundamentally key if efficiency is to be boosted.

Shop Floor Connect for Teamcenter provides a web-based architecture for those on the shop floor to interact with the Teamcenter-managed work packages and supporting information, along with process integration. This is delivered in a stripped back manner that makes it suitable for lower powered PCs, tablets and even more advanced DNCs, right where it's needed.

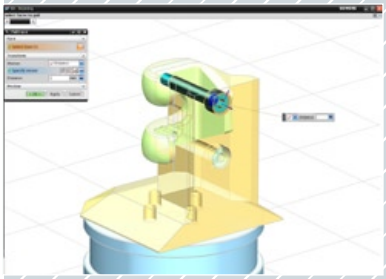
Integrated quality solution

When it comes to building a complete workflow around intelligent data and process management solutions, it is essential that the complete process is covered and closed out. For part manufacturing, the final stage in the process is quality inspection.

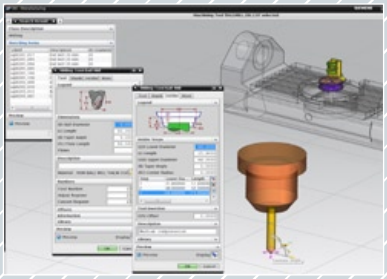
Again, there is often a disconnect between the quality department and shop floor inspection and the core backbone of data. However, the combination of NX and Teamcenter can bring this back into the production loop. Capabilities include CMM programming with the new tools introduced into NX, the management, distribution and execution of those routines using Teamcenter, and the storage and sharing of the resultant reports with those that need them.

Workflow The CAD/CAM/CNC process chain

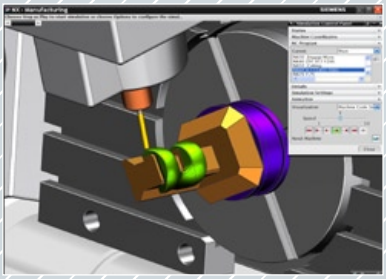
1 Siemens' Synchronous Technology allows geometry (either part or fixture) to be edited and re-purposed without prior knowledge of its construction or source



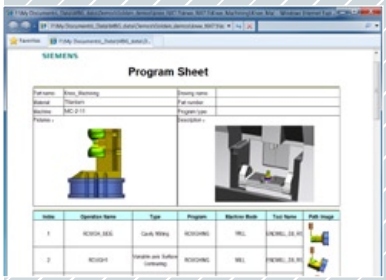
2 Using the new Manufacturing Resource Library for Teamcenter, tools can be selected from a centralised library, which is optimised and managed across the enterprise



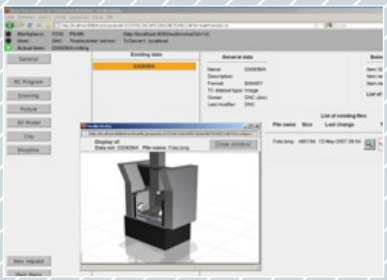
3 NX CAM provides the environment in which to create, optimise and output the NC code required to drive all manner of machine tools and cutters



4 Using Teamcenter in combination with NX's production preparation solutions, a work package can be put together and distributed efficiently to those that need it



5 Siemens' Shop Floor Connection allows the entire up to date work package to be accessed in a controller environment on the shopfloor - and allows feedback to be given



6 From basic parts to complex programming of multi-turret mill/turns, 5 axis mills, NX has all the bases covered. It can then move into inspection and quality

Connecting the work package

Data and process management are becoming commonplace, but their benefits often break down when projects move into production. To bring order to this chaos, the new Shop Floor Connect for Teamcenter aims to keep production in the loop

When considered in the context of the whole product development process, manufacturing is one of the most complex stages. However, it is often unmanaged, disconnected from the source data and fragmented.

Then come the connections from the shop floor to the critical data used for actual manufacture. Due to the reliance on paper and a lack of appropriate search and retrieval tools, even if an organisation is using a data management solution, there can be problems with incorrect or out of date data. There's often no reliable change record available and it's difficult to ensure that those tasked with managing production can find the right information at the right time.

On the shop floor there are multiple disconnected databases and applications. These include tooling, jigs and fixture supplier catalogs, cutting libraries, 3D models and stock management – perhaps even machine tool specific applications. All of these disparate sources of information add to the complexity and potential for error.

Many of these issues can be traced to the methods available to the enterprise to take the information – already part of a data management process – and make it available to the shop floor. However, the tools available to search, view and retrieve key information in the design or management office are often entirely inappropriate for the shop floor. This is where Siemens PLM Software's new Shop Floor Connect (SFC) for Teamcenter comes into play.

The higher level concept of SFC is to build on the capabilities within Teamcenter for managing, tracking and controlling product data across all manner of industries, then provide access to the manufacturing information right at the point of use – namely, the shop floor.

Task appropriate interaction

Teamcenter has been extended beyond the existing tools that manage and control CAD geometry and lifecycle during the design and development phase to manage part preparation, tooling and fixture design, CAM and CMM programming process management and tool libraries.

With the addition of Shop Floor Connect, those on the shop floor now have a number of ways to interact with Teamcenter.

Using a server-based solution, SFC can be accessed by any device available. Much of the extraneous functionality of the fully functional Teamcenter client is stripped away and a much simpler interface used. This means that the data can be accessed not only on a standard or lower-end PC, but also other hardware platforms with lighter requirements, whether that's an iPad or a more modern machine controller with a web browser.

1 Today's DNCs are much more powerful allowing the shopfloor to access manufacturing critical information directly at the point of use

2 Shop Floor Connect for Teamcenter provides a stripped back interface to access production data live from Teamcenter which can be delivered to a range of devices from the DNC or Apple's iPad

1

2

Manufacturing Resource Library

Siemens PLM Software's Manufacturing Resource Library takes a novel approach to tool management and allows you to get even more from your resources

When you need a cutting tool for NC programming don't waste any more time hunting through that clunky library or separate vendor catalogues. With the latest release of Teamcenter, Siemens PLM Software introduces the Manufacturing Resource Library (MRL) offering a new approach to managing resources that lets you easily find and use the tooling you depend on every day.

Nowadays, most CAM systems come equipped with built-in tool libraries. Unfortunately many of these libraries come with a hidden cost. These systems require your time to populate them with tool records and to maintain them whenever a new version of a vendor catalogue is published. Plus, each vendor's catalogue is organised differently, so you can't easily import their data into your system or you will spend countless hours sorting through these catalogues to find the tool you need.

The MRL stores and classifies its content in Teamcenter, with a full range of search functions and graphical displays so you can easily find and access your tools. Most importantly you can easily import vendor catalogues and then select the tools you want to use. You can even add your own content if you have special types of tools or other resources such as special fixtures to manage.

Direct access to the tool library

Siemens PLM Software's NX CAM system, with its connection to Teamcenter, directly accesses all of the resource information using built-in menus. From NX CAM, you can search the library, find the tools you need, and pull accurate 3D models of the selected cutting tools right into the CAM programming session. This helps you create NC programs faster, run more accurate machine tool simulations, and automatically create complete shop documentation that contains up-to-date and correct information about the tools used.

The MRL supports current standards for defining and categorising cutting tools including the DIN and ISO standards. It is also flexible. Although the system is provided with an advanced classification structure, you can create your own structure. You can also use it for the other resources around your shop including machines, fixtures, robots, and tool handling equipment. You can even use it to keep your digital assets organised, such as CAM process templates, CAM wizards, drawing templates, programming setup templates and almost any other digital item you can think of.

Working with tool vendor catalogues

The MRL is divided into three areas that keep the tooling vendor's catalogues and your tool components and assemblies separate. If a cutting tool vendor provides a CD or DVD with its catalogue content you can import this data directly into your library's Vendor Catalogue with a few simple clicks. The MRL intelligently maps the vendor's tool classes and attributes to its matching fields.

With the vendor data in your system, you can pull from this data to populate your Customer Area (the working library) with the tools and tool assemblies your shop uses. This way you don't clutter your working library with thousands of tool components that you never use.

Cutting tool assemblies

Of course the system has to be able to handle both the tool components – tool holders, extensions, cutting inserts and so on – as well as fully assembled tools that are needed for machining. The MRL system helps you assemble tools based on rules that define connection points for the various tooling components.

PLM integration

Because the MRL uses Teamcenter technology it means that the full range of PDM type functions can be used in the tooling area. For example it's possible to search for all jobs that used a specific tool assembly or component. If the selection of tools in the customer (working) area is changed you can easily see which jobs or NC programs would be affected. This can help you make decisions on how to maintain your working database of cutting tools.

1 Drive the use of standard tooling from your working library to help reduce tooling inventory costs - rather than have NC programmers select new tools from vendor catalogues

2 Teamcenter can be configured so that tool lists for released jobs are sent to the shop floor for inventory checks in case new tool supplies will be needed for job

3 The data in the library can be used in the CAM system to populate output in tooling lists, shop documentation, and run machine tool simulations

What the Manufacturing Resource Library doesn't do

The MRL is not intended to replace shop floor or other production systems that manage physical tool inventories or resource procurement solutions. The MRL is designed for use in the manufacturing engineering stage of the process where programmers and planners are defining methods and setting up work packages. It can be set up to synchronise with shop floor tool management systems; for example to allow the programmer to check inventory levels before selecting a tool for a job.

Key value

The big benefit associated with the Manufacturing Resource Library is the ease with which you are able to handle multiple tooling vendor catalogues and construct your own working library. This advantage, coupled with the tight solid model based integration with Siemens PLM Software's NX CAM, makes the MRL a step up in handling critical cutting tool information.

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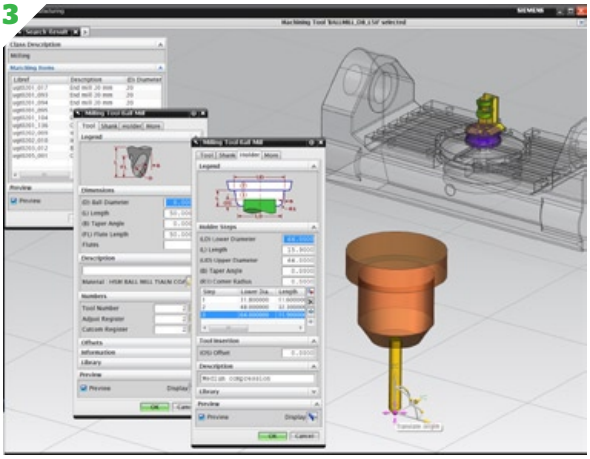


Teamcenter solves key challenges for the Product Lifecycle

As increased product complexity, dispersed supply chains and the onslaught of globalisation continue, many organisations are looking to Product Lifecycle Management to help solve the key challenges facing many in today's environment

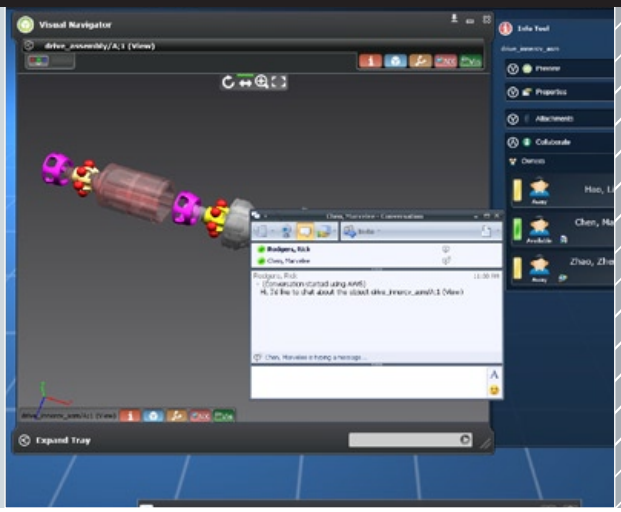
Collaboration

Collaboration is increasingly proving to be a key strategic advantage in quickly and securely delivering product information across the entire value chain.

To reduce costs and pursue global markets, leading companies are increasingly dispersing engineering, design and manufacturing, as well as marketing, sales and service activities to where they're most effective. This poses challenges to keeping these teams in sync with one another and with up-to-date product information.

Many organisations are deploying collaboration capabilities in a tactical, piecemeal fashion. The end result is often expensive systems that are poorly integrated, costly to maintain and which in some cases cause more problems than they solve.

Without a holistic approach, the negative impact can greatly overshadow the benefits. A balance between functional local level focus and collaboration at the enterprise level is needed.



Teamcenter provides a unique and highly productive collaborative environment that supports company specific business processes

It simply and easily extends product lifecycle information to help eliminate functional and organizational silos across a distributed enterprise

Compliance and Sustainability

Managing the risk of failing regulatory compliance has become an important part of the product development and introduction process.

Organisations today face an overwhelming number of regulatory requirements that impact their daily activities, product development, time to market, and their cost to bring a product to market.

Leading companies recognize that record keeping practices have significant legal and financial consequences - they cannot afford to be found non-compliant.

An approach to solving these issues is to provide a controlled environment to reduce risk by promoting awareness, ensuring ownership, enforcing control, tracking accountability and auditing for regulatory compliance.

When combined with advanced tools this allows companies to manage and anticipate issues by "embedding" regulatory compliance needs and requirements into development activities, across the lifecycle, to quickly and simply identify any areas of non-compliance.

Teamcenter supports document and record management for Records Management Application (RMA), International Traffic in Arms Regulations (ITAR), CMII (Configuration Management II) Environmental Compliance, End-of-Life Vehicle (ELV), RoHS, WEEE and REACH.

Globalisation

Dispersed locations, multiples time zones, localised processes, different applications and systems, alternative cultural attitudes can all provide significant obstacles to success.

Companies are continually challenged to reduce engineering & development costs and improve productivity, while pursuing global markets. Engineering is not in a single location. It has gone global. Engineers are wasting too much cycle time on engineering changes and reviews, and making design decisions based on out-of-date information.

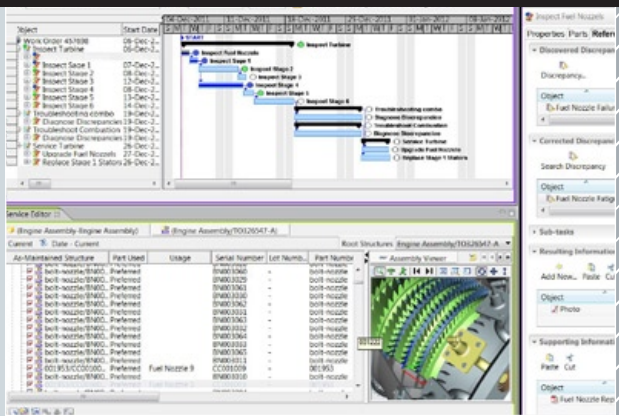
The ability to manage these complex design tasks and collaborative change process is critical to remaining competitive in the global market place.

Teamcenter integrates the extended enterprise into all stages of the product development process and automates the process of supplier integration, managing supply chain design and process data at a granular level

Portfolio and Project Control

Companies must carefully examine all of their development projects to ensure that product development portfolios are making the best use of valuable scarce resources. A majority of companies don't know whether they are fully leveraging all their resources for the greatest impact and prioritising their products in a way that drives forward their strategic business objectives.

Most companies have been focused on execution of programs/projects. Too often they find their portfolio is not aligned with the company growth strategy, or thatthey have no resources for the right projects or they continue to invest in loosing projects. Companies need a way to compare ROI, cost, resources, and schedules of each project so they can make informed decisions.



Teamcenter allows companies to connect their strategic portfolio plans to program and project management and to detailed operational execution to improve time to market and optimise their Product Portfolio

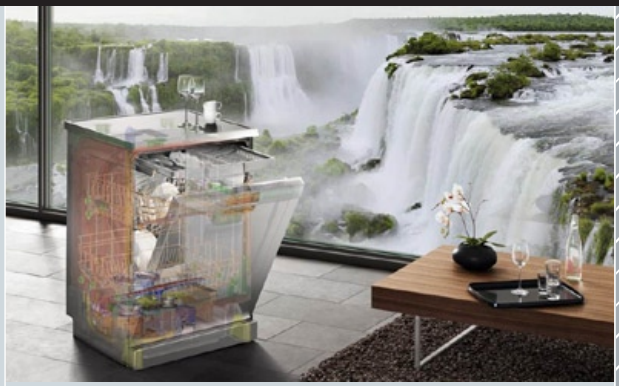
Up to date information / Building the right product

Research indicates that about 65% of product launches fail. The future value of a company is dependent on the successful launch of new innovative products and services.

Customers buy products that meet their needs. Best-in-class companies are much more likely to work closely with customers to identify needs and problems than their poorer performing peers.

Requirements gathering activities are one of the strongest discriminators in determining marketplace success.

Requirements must be aligned with customer and market needs, then balanced with other requirements such as regulations, quality, cost, capacity, etc.



Teamcenter's capabilities for systems engineering and requirements management improve the delivery of products that reflect the voice of the customer.

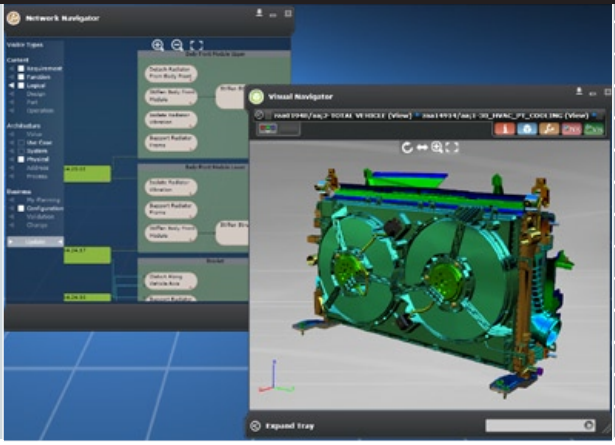
Clarity across the enterprise

More and more people in product lifecycle processes need access to design data in a format they can understand.

In order to make better informed decisions, early enough to impact product development, PLM stakeholders and contributors - not just engineers - need ready access to the 2D documents and 3D models used to describe a design.

It is estimated that for every author of design data, there are 10 - 100 times as many people who need to consume the data.

Unfortunately design and process data is typically maintained in proprietary and incompatible CAD formats making them hard to share. Many companies spend significant time and money converting CAD data from one authoring format to another with mixed results.



Teamcenter for provides a view of your products throughout their lifecycle with a complete, scalable family of solutions for allowing lifecycle participants to visualise product data in 2D and 3D formats even when this data is created using different authoring applications.

Active Workspace bringing rich 3D & context to PLM

In today's competitive environment, pressures on all manufacturers bring the need for a new breed of solution to help manage a product's lifecycle and to foster greater collaboration. Eduard Marfà, marketing director at Siemens discusses

Economic, demographic, and competitive realities have contributed to creating a challenging environment for product companies. For many, success depends on the quality and speed of decisions. In an ever-expanding universe of product data from multiple disciplines and sources, being able to make sense of the data is critical.

Today's design engineering is less isolated or limited to physical variables. Not only does an engineer have to consider a given design in and of itself, but also as part of a bigger ecosystem, having to factor in a variety of other considerations, across a variety of increasingly multi-disciplinary teams.

The product lifecycle environment is increasingly multi-disciplinary, bringing engineers, industrial designers, marketing and sales professionals and finance experts together. This enables richer, more comprehensive trade-offs across form, function, features and price.

Currently, decisions are frequently made in a vacuum, with no way to communicate their impact. The best decisions are made when every person involved has access to all the relevant data they need, in a way that makes sense to them and when they know the impact their decision will have. However, the very nature of this environment creates several significant challenges.

1 The Visual Navigator brings high performance, rich 3D data to the centre of product management and collaboration

The challenge

The modern manufacturing engineering design process comprises a number of different aspects including research, conceptualisation, feasibility assessment, sustainability, establishing design requirements, preliminary & detailed design, production planning and finally production.

Each involves different stakeholders making decisions, and different processes and tools working under challenging cost and timing constraints. This challenges many design decision applications because the type of information and the representation of that data varies across each discipline, making it difficult to find common analytical solutions. Either each stakeholder ends up sub-optimising their piece of the problem or, more likely, decisions are made subjectively, through negotiation rather than calculation.

This kind of decision making often leads to various trade-offs, which can be complex in nature. Furthermore, preferences for these attributes typically differ across stakeholders, such as customers, operators and manufacturers. These compromises are also subject to many uncertainties regarding stakeholders' different buying or manufacturing preferences, department, role and even language. These decisions usually cut across disciplinary boundaries in terms of balancing weight, power, speed, cost and economy of use. They also require data from a number of sources including design, manufacturing, quality, analysis and even end-user feedback.

All of this leaves designers faced with growing volumes of increasingly complex data. This information is all interconnected, but individual users often can't see these relationships. Users need to be able to frame and resolve these trade-offs, by processing large amounts of information, from a wide number of sources, with input from other people, and all in a timely manner.

Under these conditions, the quality of most decisions can be improved through the application of computer-based tools that allow for better contextualisation, collaboration and visualisation.

Context-centric design

Each decision maker needs to know that, at any point, they have the complete context for their decision. At the heart of this is the need for information to be aggregated into a single database or common backbone without the user needing to know exactly where all the data comes from.

A central backbone of information eliminates the need to search in multiple systems, helping users to find the right information as quickly as possible.

Centralising the data is just one part of delivering a context-centric model. Adding context to this, means that the system can adapt itself to the navigation needs of the user. Furthermore, by adding intuitive filters to search on results further removes complexity and ensures users have all information they require, but no more.

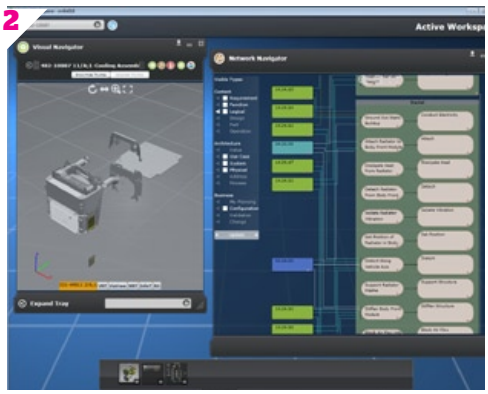
Context-centric design means providing tools that inherently understand and adapt themselves to the context of the user and the data. In this case, for example, a system will recognise that a given user is not just a CAD operator, but also a powertrain engineer or airfoil designer and automatically personalise the workspace to put that individual in the right context for the tasks being performed. The system will then proactively assist the user in accomplishing tasks by informing them of issues to be addressed, seeking out pertinent information to consider and individuals to collaborate with.

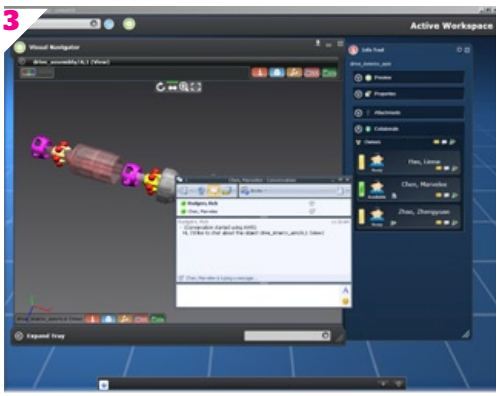
Sharing the context of a decision is difficult, but providing a tool to store the 'recipe' for how a user got to a set of data and enabling the sharing of these 'recipes' enables effective communication amongst colleagues and partners.

Collaboration

Bringing together different decision makers as part of the product lifecycle creates a fundamental need for a platform that allows them to collaborate, exchanging information and reaching decisions, as well as understanding the ramifications of those decisions on other stakeholders. This platform should allow individual decision makers to work more efficiently, look at data in a way that is more conducive to the right decision making, ultimately resulting in products that are cheaper, of higher quality and reach the market faster.

As well as assisting users in proactively making collaborative decisions, the ideal system helps to aggregate, analyse and monitor information, notifying the user when action is required and suggesting collaborators to aid in their decision making. It should be able to access different data stores and tools, and provide a way of synthesising all this data together into a single view that is easy to use and accessible to all.





2 Systems Engineering relationships are clearly displayed in Active Workspace with the Network Navigator

3 Active Workspace suggests key stake holders for a user to collaborate with

4 Eduard Marfa, Marketing Director, Teamcenter, Siemens PLM

This allows all pertinent information necessary to a process to be instantly delivered to the right people, regardless of location, via a wide variety of supported devices including smart phones and tablet computers. By intelligently navigating, integrating and applying meaning to broadly dispersed stores of heterogeneous data, and then engaging with that information in a visually compelling way it becomes possible for an organisation to make the most informed design decisions possible.

Visualisation

A key part of any multi-disciplinary tool is the ability to clarify information by presenting it in a visually intuitive way, making it easy to access further detail from a variety of disciplines.

The visual representation of product information facilitates the effective communication of complex data to technical and non-technical participants and allows for the inclusion of a wide range of stakeholders. For example, personnel can easily identify out-of-compliance parts in an assembly or measure the ergonomic impact of a product or a process on manufacturing line personnel.

Good visualisation tools allow complex data sets to be more easily absorbed. Using visualisation it becomes possible to level the playing field across the boundaries and barriers that exist to improve the efficiency of decision making and making decisions visible to other members of the process.

Also, understanding how that product relates to the wealth of information related to it, particularly systems engineering information, is very difficult. Essentially, visualisation simplifies access to information by decoupling the intimate product knowledge and skills required to use complex tools from accessing information and applying it to decision-making activity.

The intuitive aspects of visual data representation take on more of the burden of bringing to the foreground information that is relevant to a given user's role or task. The visual delivery is more proactive and less dependent on the user to search and find information.

Providing a user interface that is intuitive for users of all levels helps clearly show relationships between data from all disciplines, thereby aiding collaboration and providing greater context to enhance decision making.

Conclusion

In today's highly connected and competitive global environment, pressure is intensifying on companies to deliver more innovative, high-quality new products to market faster. This requires hundreds or even thousands of critical decisions to be made throughout the entire product lifecycle by different individuals from different disciplines all along the value chain. The quality and speed of these decisions can have a profound impact on the market success of a product. Yet each decision may be based on a vast and constantly expanding digital data stored in a wide variety of formats and sources.

What's needed is an application with the ability to efficiently access all the information spread across an organisation's systems. This provides a system that enables users to see decisions made by others, facilitating best practice and helping validate new decisions against previous ones.

Addressing these challenges was the impetus behind Siemens PLM creating Active Workspace, a visual, collaborative and contextual application to aid the entire decision making process. It allows the capturing of filtered search results, saving that search adn results and making it avialable to other team members.

This is the core of what we call 'high definition' PLM, a technology framework that is designed to efficiently turn this massive, widely distributed and heterogeneous collection of data into knowledge, through a tightly integrated set of solutions that permeate Siemens PLM Software's entire suite of enterprise applications.

This approach can significantly enhance decision making throughout the product lifecycle by taking users into the realm of advanced data interaction that actively applies meaning to data and intuitively presents rich information in a way that facilitates understanding.

Systems Engineering: an integrated approach in Teamcenter

Increasingly sophisticated products means a pure geometric and functional modelling isn't enough and the Systems Engineering approach is growing in adoption. Teamcenter 9 brings greater tools & integration with the systems commonly used in the field

Systems Engineering, where a product is captured, simulated and managed, from requirements capture and planning, through functional definition, then into design and delivery, is by no means a new concept. What has changed is that many more organisations are facing the challenges of managing not only a geometric definition of a product, but also integrating mechatronics, electronics and software development of increasing complex products and product families.

Requirements capture

As with all things System Engineering, the process starts with requirements capture. For some time, Teamcenter has provided requirements capture tools but the latest Teamcenter 9 release has extended these and made them easier to adopt. This has been made possible with integration of industry standard Microsoft Office tools, such as Word, Excel as well as tools such as DOORS or using the RIF interchange format. Within the scope of requirements capture, this means that the tools used by those engaging with customers can still be used, but that input can be pushed directly into Teamcenter, captured, managed and reused wherever needed.

Defining & documenting the system

Alongside requirements capture, another key area of focus for Teamcenter 9 is defining the system. This is often done using a schematic diagramming system. Recognising this, Siemens has built a live link with Microsoft Visio - which again, is used heavily in practice.

Embedded into Teamcenter, it allows the user to use the standard diagramming tools, stencils and such to define and maintain a system model and the relationships between between each object. Rather than providing a purely visual representation of the system, each of these objects has a bi-directional link to the Teamcenter database. Each object is automatically stored with the appropriate metadata and all of the logic and function objects are intelligently linked. Edits made in Visio will automatically populate to Teamcenter and conversely, if you're making edits to the Teamcenter metadata, then the Visio objects will update.

Data reuse

Another clear benefit of performing systems engineering within a managed environment is the ability to search, filter and locate information from previous projects and reuse it in new projects. Teamcenter 9 sees the intoduction of new property filters, the ability to save and recall searches, whether searching on metadata or notes added to each object for decision support.

System simulation

Of course, while linking requirements to logic and function is useful, the real benefit of an integrated Systems Engineering environment is the ability to prove out a complete product during development. While Siemens can provide both mechanical design, structural and fluid simulation and mechatronic simulation, other systems are often used. A good example is Matlab, often used to provide functions of each object. Teamcenter can now link the system definition to the system. Again, eveything is done from within Teamcenter so models created and edited within Teacenter can be pushed to Matlab for verification.

Defining & documenting the system

Systems Engineering is growing in adoption across many fields of design and production. More sophisticated products means that a more holistic approach is required from the very outset of a project. By centralising the use of not only native tools, but also industry standard tools within Teamcenter, Siemens are enabling a team to work on defining a system model, linked to core requirements and downstream process to foster not only greater collaboration, but also greater data reuse.

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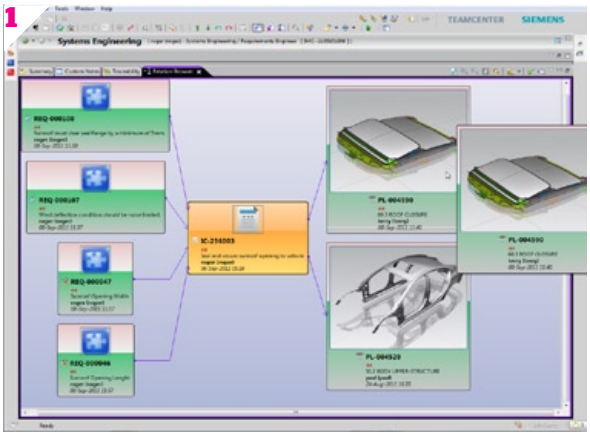

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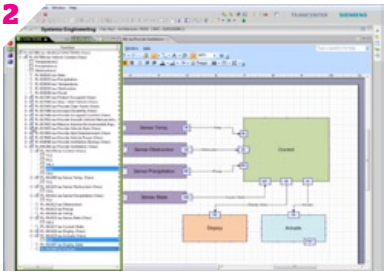

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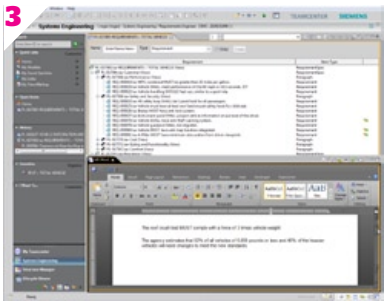


1 Requirements are linked to design elements across multiple domains, as well as other functional areas providing proof of compliance to contract specifications or standard

2 Leveraging Microsoft Visio functional, logical, interface, port and connection objects dynamically populate the product structure in Teamcenter where they are linked to product requirements

3 In Teamcenter you can review, edit and publish and established links to other objects. In Teamcenter all requirements and changes are tracked and managed.

Sponsored by Siemens PLM Software

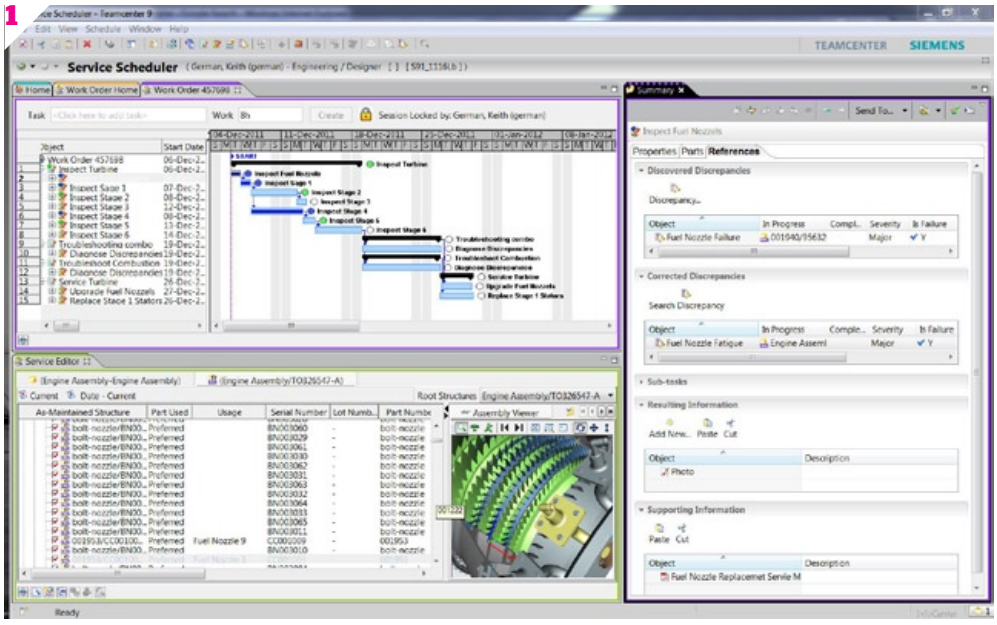
Service Lifecycle Management from Siemens

Many organisations are looking to shift their business practices from a pure supply and maintain model to service-based provision. Whether in aerospace, defense or industrial sectors, asset up time and service scheduling is key to profitability

The move away from traditional manufacturing business models into a service-based model means that many organisations are looking for ways to not only provide key ad hoc service requests from customers, but to transition to a more proactive approach.

When dealing with highly complex products, be they aircraft, power plant or naval vessel, the nature of a product's use means that the data captured up to production isn't sufficient to assist with service procedures. It's here that the descrepancies between the 'as built' and 'as maintained' records become abundantly clear. If effective servicing is to be provided to ensure maximum asset "up time" then the teams involved in every stage of the process need access to the most up to date information possible.

It's into this new world that Siemens has stepped with a new addition to the Teamcenter product portfolio. Given the name Teamcenter for Service Lifecycle Management, this is comprised of three key areas of functionality, so let's explore those.



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Configuration Management

These are the tools that allow an organisation to ensure it has accurate records not only of the "as built" product delivered to the customer as found in most PLM systems, but also the evolution of the product in the field during its lifecycle. Teamcenter 9 now has tools to assist with not only asset definition, but also improved and serialised structure management to track service procedures, part and sub-system changes, and to provide the essential tracability aspects so key to many.

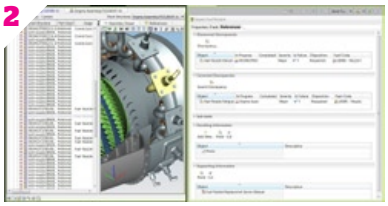
Service Process Management

Service management takes two key forms. Reactive service operations where a customer requests the operation and the whole process is managed from request to completion. Teamcenter provides a raft of tools from customer management, through work scope definition, business, technical and completion disposition as well as the all important time and cost estimation and tracking.

Service Planning

Teamcenter provides tools to plan these in advance, whether frequency or condition driven. Most organisations will face both streams of service activities, but the good news is that these are both supported. Teamcenter will also manage task breakdown and work instructions that link to the as maintained BOM, manage resources whether tools, equipment and materials as well as personnel skillset.

It also provides tools for tracking signoff authorities, part movement (in terms of installs or removes) and time estimation. Of course, a key benefit to conducting this type of work in a managed environment is the ability to not only control the tasks at hand, but to use information to further improve subsquent service operations and tasks. Then it can all be reused in the the next generation of products by identifying potential areas for improvement.



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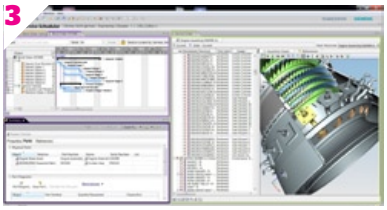

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1&2 Teamcenter makes it easy for the service scheduler to understand the details of any assigned work order by showing the flow of work tasks, the affect asset and any relevant information

3 Quick view of the asset configuration in both a visual and text-based structure to show installed parts, the work schedule and the steps within the schedule to be executed

Teamcenter and NX at Kesslers International

Teamcenter and NX enable Kesslers International to differentiate its point of sale manufacturing services and win new business from the competition. All this while making significant improvements in time, cost and quality

Kesslers International is a leading manufacturer of permanent point-of-purchase display and merchandising units for clients such as Revlon, Christian Dior, the UK Post Office, Bosch Home Appliances and Sony Electronics.

Located in Stratford, London, the company's state-of-the-art complex houses the latest technologies including large machines for laser cutting steel and plastics, fast metal presses, injection moulding, wood processing, silk screening, new 3D CAD systems and computer-controlled machinery.

"We are a multi-material and hi-tech manufacturer. We process wood; we process metal; we process plastic. We are a project-based design and make-to-order business," describes George Kessler CBE, group director at Kesslers International. To meet its demanding challenges and optimise operations, Kesslers International decided to leverage product lifecycle management (PLM) technology from Siemens PLM Software.

Changes cut in half using 3D

Over 20 years ago the company invested in Anvil 5000, a 2D system with some 3D. "We decided to move over completely to 3D with then SDRC's I-deas software (now part of Siemens' NX software) ten years ago and received massive advantages," says Kessler.

"We also were investing heavily in CNC machine tools and wanted to make sure our operating model took advantage of all the technologies that were available at the time. Teamcenter software provided vital functionality so we could make the transition from I-deas to the NX system, so we decided to take the opportunity to integrate our MRP system with our CAD system at the same time – in effect, to share one database."

Integrated design and manufacturing

Paul Copping, technical manager at Kesslers International, explains that over the past three years the company has moved to a more project-based environment where the project managers actually control the design cycle and the design phases.

"Our engineers understand about designing for manufacturing – so we don't have the additional delays, additional redesign or additional costs that people who subcontract manufacturing suffer. We can have a sample part within 30 minutes of designing it and if the customer decides to change it, we can respond immediately. That's another competitive advantage for us," explains Copping.

There are other advantages. Copping notes, "For injection-moulded parts, we include draft angles, injection points and so on. Then we give the toolmakers the real-world model electronically with full supporting information, including the runner balancing and machine to be used. The tools are high-speed machined in aluminium directly from the NX model. This method has saved money, improved quality and reduced errors. One recent Revlon design required 50 different injection moulding tools, so you can imagine the benefits."

One company's pain is another's profit

Teamcenter serves as a global portal and is tuned to enable a rapid response to the company's customers. "The projects we undertake have to be very front-end oriented," says Kessler. "We need certain rules and protocols so that when we build on the screen, we build everything right down to the fastenings. This is because everything migrates through Teamcenter. If you miss one screw, it won't be in the product. So we have lots of checks and validation upfront."

Kessler notes, "Our CAD/MRP integration has worked very well. It has removed a huge amount of re-keying and eliminated a massive risk of error. We've reinvested the time saved into product and concept development. In turn, this gives our customers more opportunity to change the designs later (in the process). Up to two years ago, if the finished product was 90 per cent of what they wanted, they would have gone for it. But today, it needs to be 99 per cent. That's a huge pain for other companies, but for us it's a commercial advantage."

1 Kesslers International manufacture point of sale units for some of the world's leading brands incliuding Revlon, Dior, Bosch Home Appliances and Sony Electronics to name but a few

Driving design via configurator

"We were considering buying a separate configurator package until Siemens PLM Software pointed out how we could get the same superb functionality with Teamcenter and NX," says Kessler. "Using this for the ITL merchandising unit is a good example of why this matters. The Teamcenter configurator allows us to specify the width of the shelves. Then, it will add the side panels and work out the header and back panel parametrically. It also will know how many fasteners, back straps and other features are needed. In effect, Teamcenter is driving the design while leaving the designer to concentrate on the more important design issues. This gives us some real commercial advantages."

Proof of success

Kesslers International recently upgraded its NX software to the latest version with help from Majenta PLM, which provided training and mentoring.

Now with Teamcenter and NX, business is very good. "We know it works because we measure success through order increases and complaint reductions. We have a very, very low level of complaints. We have a good level of customer satisfaction and our customers keep coming back. And we have important new customers. That is the best proof we can have," sums up Kessler.