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by Jamie J. Gooch

Searching for Simplicity

Leonardo DaVinci called it the "ultimate sophistication." Walt Whitman called it the "glory of expression." Frederic Chopin called it the "final achievement." If you read the headline of this column, you may have surmised that they were all talking about simplicity. Great minds have been searching for it since time began.

Why is simplicity so valued and so difficult to find? It's complicated. We're hard-wired to want more, more, more ... until we have so much that we can't keep track of what we have, much less use it all. Then we want only what we need, and we want it to come easy. That evolution sums up the paradox many engineering software developers face today. Software suites have to be packed with lots and lots of powerful features for all types of users, each of whom only wants (and only wants to pay for) easy access to the features they need.

But as another great mind, Bob Seger, asked "What to leave in, what to leave out?" Software developers, tired of running against the wind, have some ideas on how to answer that eternal question while simultaneously expanding their user base.

Simplicity is the "ultimate sophistication" in software.

Divide and Conquer

Imagine if the applications in the Microsoft Office suite were all one program. You could check your email, update spreadsheets, polish your PowerPoint presentation and spellcheck your document all in the same place. Now imagine all you wanted to do was write a quick email, but the new message command was buried somewhere among the new worksheet, new slide and new document menus. There's a happy (or at least content) medium in the suite, which incorporates a familiar user interface (UI) across the different programs to allow users to quickly switch among them. This, coupled with the ability to share data among the applications in the suite, satisfies most end users.

Many engineering software vendors take the same approach to divide CAD and different simulation types in their suites, for instance. In fact, they're starting to make even more granular divisions (see page 22). However, design engineers often use different software applications from different vendors, all of which have different UIs. This has led to an array of plugins and connectors that make it a challenge for developers to create a seamless and simple user interface.

It has also spawned a small industry of translation software providers to help end users move seamlessly from one format to another. It will be interesting to see what fruit the recent interoperability agreement between Siemens and Autodesk bears (see page 12). Perhaps other leading vendors will follow suit to help make their products more interoperable.

Customization and Control

The complexity of making the right features in CAD and simulation software available to the right users pales in comparison to what product lifecycle management (PLM) software developers face. PLM software is most useful when it is all things to all people — not just engineers from different disciplines, but people in different departments throughout an enterprise, often on a global scale. Simplicity is indeed the "ultimate sophistication" when it comes to PLM software.

At the Aras users' conference, ACE 2016, held in Detroit last month, the company's Founder and CEO, Peter Schroer, shared his thoughts on the challenges of simplicity when it comes to the systems-level thinking today's product engineering demands.

"This is getting really complicated, very, very quickly," he said of system design. "The products we're building have become just too complicated to think about without thinking about the whole system."

The "system" includes not only how all parts of the product work together, but how the product is packaged, used and serviced. According to Schroer, systems engineering is PLM. That's a lot for a software tool to connect, especially when it all needs to be accessed by different people for different purposes.

Schroer said he has recently come to the conclusion that all that data can't be addressed by one system. "I'm starting to believe that we need to think about a two-level architecture," he told ACE attendees. "There is a very real reason to buy a PDM (product data management) system." The PDM architecture that is designed to manage 3D CAD file configurations is not the same architecture that is needed to drive the business of engineering processes.

How would those two architectures be linked together? Schroer didn't say. However, he did address the challenge of presenting that information to end users. "We need a very simple interface, but we need to handle very complex topics," he said. "We have got to create a system that just simply works, that engineers can enjoy working in PLM."

So the search for simplicity continues, but a later ACE presentation showed one example of a simple user interface that connects to a world of complexity: Google.com. DE

Jamie Gooch *is the Editorial Director of* Desktop Engineering. *Contact him at DE-Editors@deskeng.com.*

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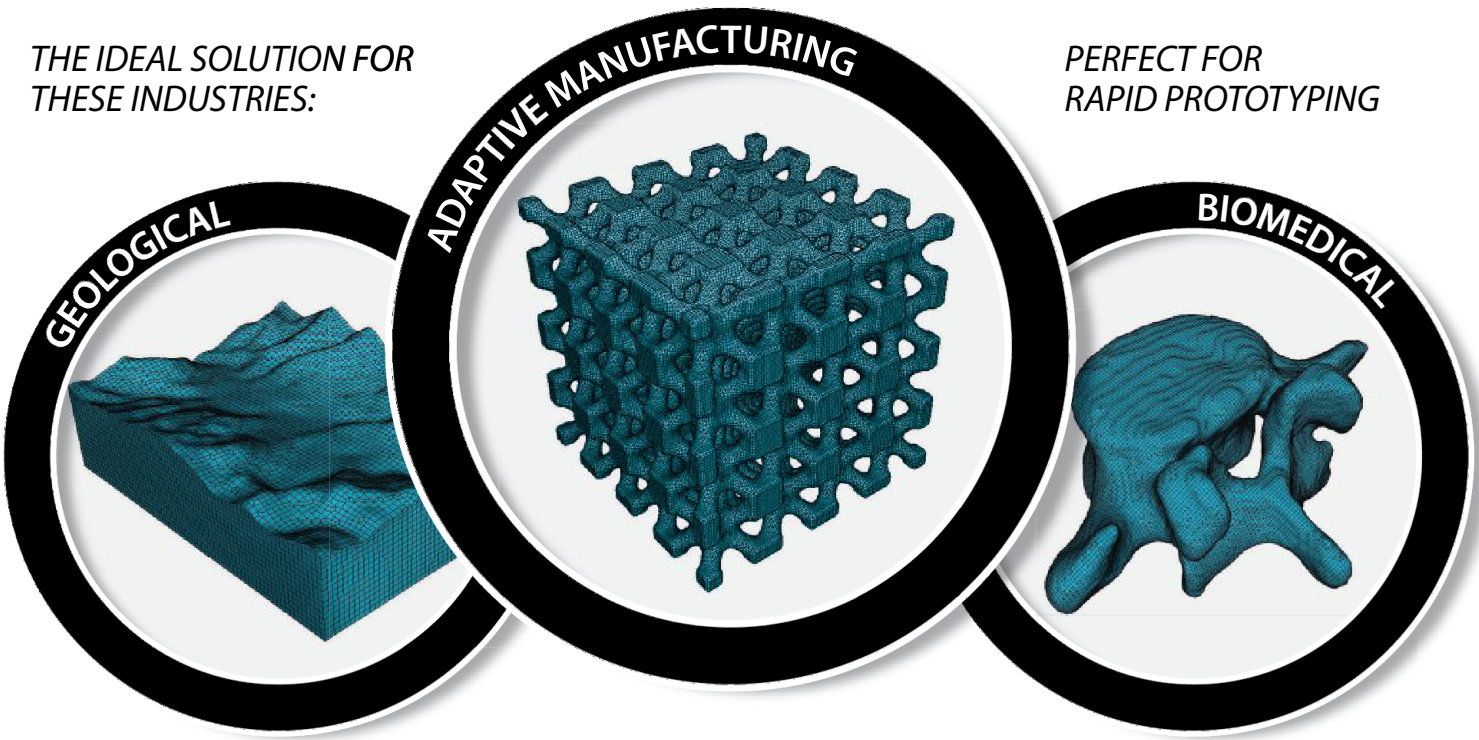

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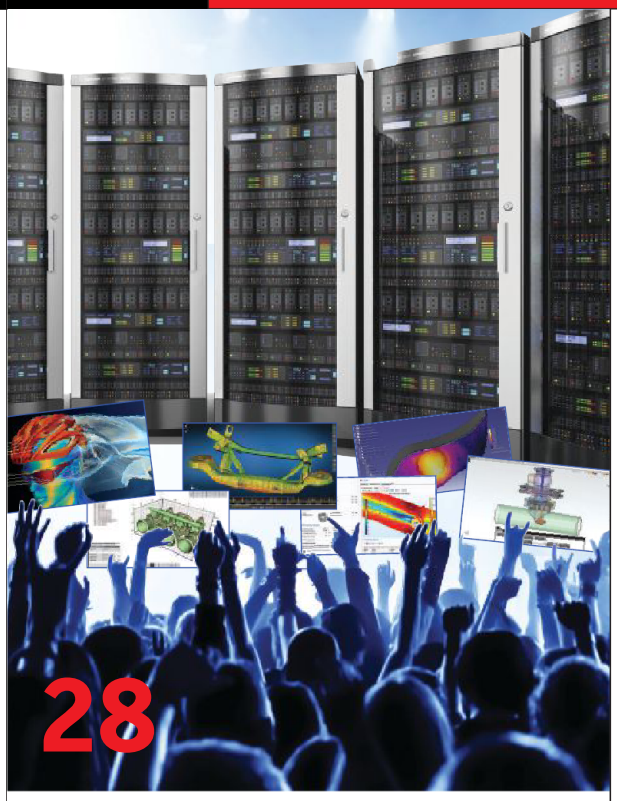

Preparing for the Floodgates to Open

On-demand hardware and pay-per-use licensing are essential in opening new markets for HPC.

By Kenneth Wong

PROTOTYPE

ON THE COVER: Supercomputing is becoming more accessible, helping to drive simulaiton-led design. Images courtesy of Thinkstock, ANSYS, CD-adapco, COMSOL, Mentor Graphics, MSC and NUMECA.

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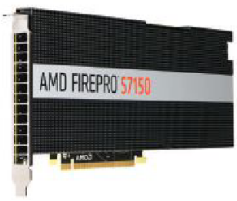

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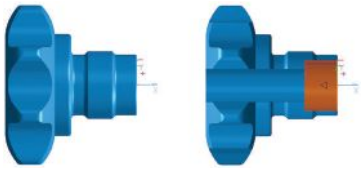

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BPA WORLDWIDE

by Tony Abbey

The Three 'Topos': Optimization Jargon Explained

In my February column, I explained the background to topology optimization. The piece prompted discussion via various social media, including requests to clarify the differences between topology, topography and topometry optimization.

I will explain in this article what the different methods do. However, it is difficult to distinguish between the terms based on normal language usage. Being an engineer, I like to know where things come from, as well as how and why they work.

Some Semantics

I had no clear idea what the three terms meant in general usage, other than we talk of topology in the context of maps and FEA (finite element analysis) meshes. Topography also has something to do with maps doesn't it? As I write this, my spell-check is happy with the first two, but topometry? Forget it!

Each uses a different approach to explore a design configuration.

The earliest clear definition I can find is a learned paper[1] written in 1912 by an American geologist defining these new French terms. He takes six pages to explain that it is a classification that better defines professional standing. The pure science of landforms and shapes is topology. When considering usage in a trade such as map making, it is called topography. When used for creating just local maps, it is called topometry.

Definitions

So how does that help us? Well I would suggest the following as a memory aid:

- **Topology** is the general 2D or 3D big picture. As explained in the previous column, it uses 3D or 2D space to define an efficient distribution of material that takes load paths from application region to reaction region.
- **Topography** is a 2D shell height mapping that can push elements out from a nominal surface to form beads or swages to increase bending stiffness and strength.
- **Topometry** is a 2D shell thickness mapping, which allows a free form distribution of thickness in a surface to vary stiffness and strength. It was generally known as free sizing optimization and the idea has been around for a long time. My company, BAC, was using this approach in the 1970s to evaluate wing skin thickness distribution. I believe the term was first used commercially around 2000 in the GENESIS product.

I have asked some of the key developers in this area for the reasoning behind the terminology. Nobody is quite sure where topometry came from!

Let's look more closely at topography and topometry.

Topography Optimization

Topography relies on offsetting shells from their original datum plane as shown in Fig. 1. A line of shell elements has been offset from the datum plane to increase bending stiffness. The user can define:

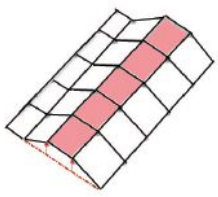

FIG. 1: Line of shell elements offset from datum plane to form a bead.

- The maximum height of the element offset.
- Whether it is a normal or local direction.
- The width of a typical bead or swage that will be formed (which controls the grouping of offset elements).
- Active or inactive regions.

The method is a variant of classical element shape optimization. The nodal degrees of freedom (DOF), which define the design variables in shape optimization, are controlled by definition of the above input parameters. This is a neat way of overcoming one of the difficulties of shape optimization: How to control potentially hundreds of thousands of independent degrees of freedom nodal directions. Any of the formal optimization definitions for constraints or objective function can be applied to any response (stress, displacement, frequency, mass, etc.). This means that potential configurations that evolve using this technique can be rigorously checked, unlike topology optimization. However, it is very likely that the particular distribution of stiffening beads or swages will be too organic and will need some tidying up to create a manufacturable component. A subsequent check will be needed on this cleaned up configuration. However, it usually does not drift too much from the original optimum.

Topometry Optimization

This is a variant on traditional size optimization and operates on shell thickness. A zone of shell elements is defined that al-

lows free-form variation in shell thickness. At its simplest, the method allows each shell thickness to be an independent design variable. This is free to adopt a thickness between upper and lower limits. The resulting distribution of thicknesses is almost certainly not manufacturable. That does not matter. It is the idea of the overall configuration suggested by the thickness distribution that is important. However, the configuration will be rigorous, obeying whatever constraints we apply. The solution drives toward minimizing or maximizing a true objective function. It is up to us as engineers to decide what guidance we can derive from this in our search for a real design. The response you'd have gotten in the '70s from hard-bitten Lancashire aircraft designers was: "Daft lad, get a real job!"

I think the role of conceptual configuration design tools is more widely accepted today.

Exploring Designs

Each of these three techniques allows exploration of design configurations suggested by the optimization solution. All three can give very radical results, and each uses a different approach to the solution. Topology is truly the wild child. As described previously, it can provide very creative designs that have to be tamed after mapping to real designs and checking actual strength, stiffness, etc.

Topography is limited to 2D shells and can be controlled more. It may give hints on bead or swage configuration, which are close to something we could actually make. Strength, stiffness and other criteria can be more closely monitored. It is more rigorous from an optimization perspective.

Topometry is also limited to 2D shells and is rigorous — but is another conceptual tool. Its purpose is to suggest distributions of thickness to give most efficient designs. The method is also described as free form optimization, which is really a better description.

In summary, all three "topos" are here to stay — particularly with application to additive manufacturing. Today it is generally understood these are tools to explore creative new ideas — no longer the daydreams of a daft lad. DE

Tony Abbey *is a consultant analyst with his own company, FETraining. He also works as training manager for NAFEMS, responsible for developing and implementing training classes, including e-learning classes. Send e-mail about this commentary to DE-Editors@deskeng.com.*

References

[1] Topology, Topography and Topometry. Francois E. Matthes. Proc. American Geological Society (1912).

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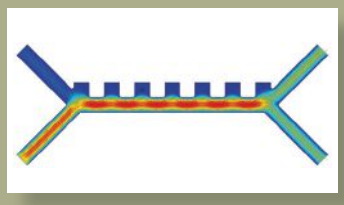

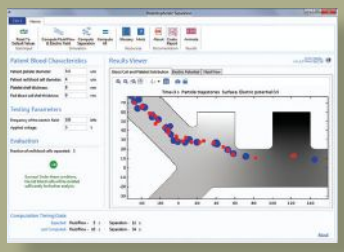

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By Chad Jackson /// PLM

The Democratization of PLM

Today is a time of dramatic change for software solutions. Larger development organizations, including OEMs (original equipment manufacturers) and suppliers, now have more flexibility than ever when it comes to these technologies. But it is also a time of unprecedented accessibility, with small organizations and startups now feasibly accessing the same technologies that were previously reserved for their larger peers. From top to bottom, it truly is a time of democratization.

Many of these technologies, such as CAD and CAE offer significant new advantages and benefits as part of this democratization revolution. Yet, no solution is undergoing as dramatic a change as product lifecycle management (PLM). Oft considered costly and difficult to deploy, a range of advances make this class of software widely available, for companies large and small.

Relaxing IT Requirements

To deploy a traditional PLM system, you needed to have some serious computer server hardware somewhere, either in a data center or in a dedicated IT room. On top of that, dedicated personnel were needed to monitor and tune the software and hardware to ensure it performed as expected and to avoid outages. The same personnel were also required to update the solution as new versions of the system became available. These facts alone often kept many organizations from pursuing PLM.

No solution is undergoing as dramatic a change as PLM.

Cloud computing has dramatically changed how companies deploy and maintain software solutions — and PLM is no different. With the software system hosted in the cloud (sometimes even by the software developer) manufacturers are freed from much, if not all, of the responsibility for acquiring server hardware, maintenance and software updates. Eliminating these requirements frees companies to experience the advantages and benefits of PLM without paying the painful price to acquire it.

Easing Cost Challenges

Of course, there are other ongoing changes with PLM solutions. How a company compensates software providers for the system that is being overhauled is one in particular. In the past, manufacturers had to acquire licenses for their users to access the PLM system. These licenses were purchased upfront, often representing a significant capital expenditure for the company. Such costs required justification to earn purchase approval from executives. But just as importantly, the individuals championing such investments found their careers tied to the software's success or failure to provide the expected return on investment. That's a serious detriment to championing and justifying PLM solutions.

Instead of demanding that manufacturers purchase licenses to use their software, developers are now offering subscription-based access. This allows companies to pay a monthly charge per user, which translates into an operational expense instead of a capital one. Charges can be rolled into an ongoing IT budget instead of requiring cost justifications, executive approval and being personally associated with the success or failure of the solution.

Trading Customization in for Better Configuration

It is rare for any software solution to perfectly fit the requirements of every organization. PLM solutions are no different. There always will be a need to tweak it to supply capabilities to that enables the company to address problems.

For PLM systems, this has traditionally translated to modifying the underlying data model, which defines and describes things like parts, end items, change orders, specifications and more. To meet those needs, software specialists would hard code the modifications as customizations. Such changes were difficult to update and would often break when updating to new versions of the software solution, requiring more hard-coded modifications that could take days or even weeks to resolve. The potential for this sort of catastrophe often held manufacturers back from updating their solution — if they invested in PLM at all.

In the past five years, the capability to make such changes has morphed dramatically. PLM solutions now include highly functional, but also very accessible tools to configure existing and new aspects of the data model. These changes are now handled differently, in ways that make them far easier to adapt as the software system is updated. This is yet another advance that is ultimately making PLM more accessible to companies.

Realizing Democratization

The PLM solutions that are most accessible are hosted in the cloud, accessed via subscription and provide better configuration. The convergence of these capabilities has a real impact on the democratization of PLM solutions.

A range of software is undergoing dramatic changes, but none are transforming as much as PLM solutions. Democratization is finally feasible. DE

Chad Jackson *is president of Lifecycle Insights (lifecycleinsights.com). Send email about this commentary to DE-Editors@deskeng.com.*

Making the Jump to Virtualization

The Dell Precision Appliance for Wyse enables centralized workstation management and anywhere, anytime access to your workstation.

Workstations have long been a status symbol for engineers. Big cases, faster processors, more RAM and storage were all bragging rights as the engineering department moved from drafting tables to computer-aided design and engineering. But now that mobility, security and workflow are paramount, their world is evolving again. In this new world, they need to work from anywhere, on any device, without worrying about workstation downtime or whether they're accessing the most recent version of a file. They want their work to take center stage and the hardware to fade into the background. Virtualization can make that happen.

THE DELL PRECISION APPLIANCE FOR WYSE: Each virtual workstation appliance, shown here with a zero client, is designed to support four to eight engineers.

Virtual Workstations are Here

Virtualization is not new, but its ability to push the pixels needed by CAD and CAE software has taken a quantum leap in recent years. With the Dell Precision Appliance for Wyse, it's now possible to deliver workstation-class user workspaces to a zero client, an older workstation, a laptop, or even a tablet. Deploying the appliance is easy and can be performed in a few minutes using the free Quick Start Tool.

Doing real engineering design work over Wi-Fi or a cellular connection may sound too good to be true, but Dell has engaged virtualization and graphics technologies from leading providers like Citrix, VMWare, Teradici and NVIDIA to overcome the challenges of delivering rich user workspaces remotely. Dell has even created Workstation Virtualization Centers of Excellence around the world to let users evaluate the benefits of running their own engineering applications on an end-to-end virtual workstation solution so they can experience virtualization themselves with no fiscal outlay or risk to the existing production environment.

"We realized early on that end user experience is of paramount importance, so we've done rigorous testing in partnership with leading ISVs (independent software vendors) such as Autodesk and Dassault," says Rishi Manocha, Head of Workstation Virtualization Marketing for Dell. "In real-world scenarios, we've found that users are unable to distinguish between a local workstation and a virtual workstation environment. In fact, users are impressed by how quickly they're able to load data and render models."

Why Virtualize?

1. **User Experience.** The virtual workstation does all the heavy lifting in the background, so users don't even realize they're not working on a local workstation.
2. **Secure Mobile Workflow.** Improve user collaboration by providing access to a common set of applications and data from a variety of fixed and mobile endpoints. Data stays secure in the data center while only display pixels and user input are transmitted.
3. **Centralized Management.** The IT department can manage user workspaces, data and applications more efficiently, and scale resources up or down as needed.
4. **Certified by Software Providers.** The Dell Precision Appliance for Wyse is certified and supported by leading software vendors, including Autodesk, Dassault Systèmes, Siemens PLM Software and PTC.

Secure User Access and Improved Workflows

File replication can be an issue with today's global, connected collaborative workflows. Multiple people working on various models in a system design sometimes duplicate or even overwrite each others' work, wasting time and creating errors. With the Dell Precision Appliance for Wyse, proprietary engineering data is kept secure in the data center because only the pixels are pushed to the end user. Of course, having the hardware in a central location means IT can quickly scale computing resources as needed, add or remove users and apply software updates efficiently.

The Dell Precision Appliance for Wyse allows engineers to take advantage of the many benefits of a mobile, more collaborative workflow. For more information, visit dell.com/precisionappliance.

by Tom Kevan

Building Sensors for the IoT

To accelerate the deployment of sensors and sensor nodes, design engineers will have to come to terms with a complex array of market demands. These range from achieving high levels of interoperability and integration to streamlining design cycles and reducing price points. To succeed, designers will have to forge harmony from diversity, combining processing, communications and sensing components into systems while accommodating a wide variety of form factors and I/O interface protocols.

One of the issues inhibiting the growth of deployments is the absence of open sensor standards. As a result, the market overflows with proprietary devices that sport a collage of form factors and interfaces, crippling efforts to achieve real, broad interoperability.

Building on Existing Technology

To remedy the situation, an industry body consisting of Advantech, ARM, Bosch Sensortec, Sensirion and Texas Instruments has come together to offer an open standard for sensors and sensor nodes called M2.COM. The new platform builds on the standardized and modularized form factor defined by the M.2 specification for computer expansion cards, aka NGFF (next-generation form-factor).

M2.COM reduces design complexity and eliminates the need to build everything into the board.

The PCI-SIG and SATA-IO standards organizations tailored M.2 to provide greater physical flexibility, specifically aiming to maximize PCB (printed circuit board) space usage while minimizing the unit's footprint. As a result, M.2 allows for longer and double-sided component populations. In addition to this form factor flexibility, the specification provides a variety of interfaces. This allows M.2 modules to support multiple functions, such as communications and processing.

M2.COM uses the type 2230 M.2 form factor and a 75-position interface. All told, the module measures 30 mm by 22 mm.

To enable M2.COM modules to connect to the full spectrum of sensor types, the platform's edge connector provides Swiss army knife-like connectivity by including USB, PWM, SDIO, I²C, I²S, UART, GPIO, SPI, and ADC bus support. This feature not only promotes greater integration and micro system implementation, but it also allows the design engineer to more easily create complex systems using multiple types of data acquisition and control components. Supporting this level of connectivity speaks to the core concept of the IoT.

An Evolutionary Module

By providing a standard module form factor, M2.COM reduces the complexity of the design process and eliminates the need for sensor makers, module makers and sensor integrators to build everything into the sensor carrier board. They no longer have to re-invent the wheel every time they want to add wireless communications and compute capabilities to sensor nodes. Instead, they can develop the two components separately, plugging the smaller module into their carrier board.

Sensor designers can also mix and match different M2.COM modules with their sensing devices to meet different communication requirements, and device designers can develop M2.COM modules that support different combinations of sensors. This simplicity and flexibility shortens the length of the development cycle and streamlines the learning curve for design engineers, allowing them to focus on their own areas of expertise.

A Question of Speed

The M2.COM standard organization has instituted a certification process that promises to deliver proven hardware solutions and thus speed up the time to market. This is particularly true when the designer is combining wireless connectivity technologies. The standard's RF certification aims to reduce or eliminate the time and expense of applying for national or global RF certification for IoT sensors and sensor nodes.

In addition, the standard's adoption of the modular approach streamlines the production of IoT sensors and sensor nodes. The creators of M2.COM contend that these factors will shorten development cycles by as much as 50% and reduce the resources required.

Not There Yet

Sweep aside all of the rhetoric about the IoT and it becomes clear that a lot of work still has to be done before consumers and providers can reap its benefits. It is also clear that open standards must be in place before design engineers can build sensors that will allow the IoT to become a reality. While M2.COM is a step in the right direction, it is just that — a step. Standards deliver on their potential only when there is broad adoption.

Tom Kevan *is a freelance writer/editor specializing in engineering and communications technology. Contact him via de-editors@deskeng.com.*

Embedded World Becomes An IoT Standards Fest

The recent Embedded World 2016 conference and trade show in Nuremberg, Germany, saw the presentation of two standards-based proposals for creating Internet-aware products and the sensors they will require: the S3P Alliance (for Safe, Secure and Smart Platform) for Internet of Things (IoT) products, and the M2.COM consortium for IoT sensor development. Both initiatives are born of the understanding that everyone needs to learn from the lessons of recent history by cooperating on the foundational technical fundamentals and compete on the distinctive promises of each vendor's IoT-aware products.

S3P and M2.COM offer open standards proposals for Internet-aware products.

How big is the market? Gartner Research says there will be more than 1 trillion connected devices by 2040. Gartner also foresees manufacturers investing $166 billion in IoT technology by 2020. Competing research firm IDC has its own numbers; the global Internet of Things market in 2014 totaled $655.8 billion and will grow to $1.7 trillion by 2020. IDC also says the number of IoT endpoints (connected devices from oil platforms to watches) will grow from 10.3 billion devices in 2014 to more than 29.5 billion in 2020. The market will divide into consumer-facing and business-facing products, with a wide variety of both end-user and industrial applications. It is into this milieu of opportunity that both S3P and M2.COM propose their solutions.

S3P for Smart Device Deployment

S3P was announced December 2015 in Paris, but the alliance's first meeting and press conference was at Embedded World this year. The goal of the S3P Alliance is to define a common IoT software development platform that will enable "rapid deployment and exploitation of IoT-capable devices and applications, combining unprecedented safety, security, agility and portability." S3P is led by Esterel Technologies, a wholly owned subsidiary of ANSYS. A variety of technology developers and industrial users are also involved, including CEA Tech, Krono Safe, SYSGO, Airbus, Alstom, Axa France, Freescale Semiconductor, Schneider Electric, STMicroelectronics and Thales. The alliance has received a three-year funding grant from the French government.

The goal is to create a technology and development stack as an open and interoperable ecosystem for all emerging IoT platforms. The focus is on standards for security, industrial safety, agility/portability and IoT platform development.

The technology vendors and the industrial users are working out the details in a series of use cases. Examples include air traffic control on distributed platforms (Airbus); rail signaling on next-generation platforms (Alstrom); a secure gateway for 3D printing (Freescale); and an e-health platform (Altran).

"The creation of S3P Platform, Project and Alliance is a key contribution to building a smart, safe and secure software development and execution platform for the worldwide deployment of IoT," says Eric Bantegnie, CEO of Esterel Technologies. "It also contributes directly to the objectives of building a comprehensive digital trust solution for the development of the economy."

S3P describes the fundamentals of IoT as:

- Collect (data from smart connected things).
- Connect (with efficient gateways, protocols and networks).
- Correlate (with databases and applications in a cloud-enabled IT infrastructure).

Nicknamed "Android for machines" by the French media on its introduction, the S3P initiative is less an operating system and more a description of distributed processes supporting millions of nodes operating with high autonomy and security. "We want to design something smart, safe and secure. It must trust the data and the data environment," says Bantegnie.

Recent history teaches that digital technologies thrive as commercial products when standards are widely adopted. Without standards, many innovations fade away for lack of sufficient adoption, not for lack of utility. Today the IoT is a digital frontier. Many software vendors and electronics manufacturers are bringing products to market, hoping to be the successful first-mover in a hot market. What is needed to ensure the widest possible acceptance are open standards for common problems the industry faces in creating IoT products. Innovation can then be delivered without the artificial maze of proprietary approaches. DE

(Editor's Note: For more on M2.COM, see the author's full Embedded World coverage at deskeng.com/de/embedded2016 and Tom Kevan's "Building Sensors for the IoT" on page 10.)

Randall S. Newton *is principal analyst at Consilia Vektor, and a contributing analyst for Jon Peddie Research. He has been part of the computer graphics industry, in a variety of roles, since 1985.*

Bra Startup Supports Women with Technology

Trusst Lingerie is focused on creating a new type of bra that relies on a proprietary support system to provide better comfort for larger-busted women. To do so, the company has taken an engineering-based approach, relying on technology and software from SOLIDWORKS, ANSYS and MakerBot to manufacture its line of three bras: the Jessica, Suzanne and Marjory.

"We use a MakerBot [printer] and SOLIDWORKS models to do a lot of our rapid prototyping in-house," says Laura West, CPO and co-founder. "We've

[also] started using ANSYS to do some introductory FEA (finite element analysis) to study the motion of forces and potential failure points, and how that correlates to what comes from our manufacturer."

MORE ➜ deskeng.com/virtual_desktop/?p=11479

Dell Updates Data Protection Portfolio

Dell's series of new data protection solutions is designed for organizations to better protect systems, applications and data on premise or the cloud. The portfolio includes Rapid Recovery, Endpoint Recovery and NetVault Backup 11.

Rapid Recovery integrates features from AppAssure and Dell IP (intellectual property) to reduce downtime for customer environments.

Endpoint Recovery will be a lightweight, easy-to-use software offering for endpoint protection and recovery for Windows clients, Dell states.

NetVault Backup is a cross platform, enterprise backup and recovery solution. It offers high-performance file system multi-streaming capability and restartable VMWare jobs.

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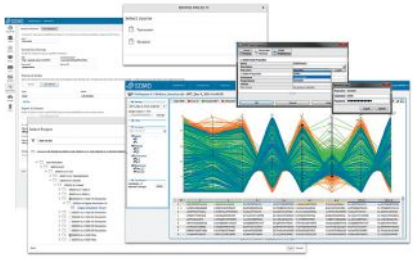
ESTECO Releases New Enterprise Suite

By leveraging PROSTEP AG OpenPDM software, ESTECO Enterprise Suite allows design teams, focused on the simulation and optimization stages, to connect with external repositories (PLM, PDM and file storage service databases) such as



Siemens Teamcenter and PTC Windchill, the company states.

Users of modeFRONTIER can also import models and single-discipline projects stored in corporate PLM databases according to standard procedures. In this way, a company press release states, integration experiences and fine-tuned optimization plans are replicated by exploiting a template-driven approach and automatically connected to the enterprise data infrastructure.

MORE ➜ deskeng.com/de/?p=29103

MakerBot Swings Back in Intellectual Property Fight

Major concerns about 3D printing and intellectual property (IP) have generally revolved around what happens when someone prints an object or image owned by someone else, but a recent event with MakerBot owned Thingiverse and its Creative Common license has altered the discussion. A store named Just3DPrint popped up on eBay that offered a number of CAD designs for print. It didn't take long for someone to recognize the digital items on display as files downloaded from Thingiverse.

This turn of events quite naturally spawned a storm of complaints and criticisms from Thingiverse users, including those who didn't have a design show up on the new eBay store. The users felt that their IP had been stolen by Just3DPrint, which was offering neither recognition nor compensation to users who had created the designs it was now selling.

MORE ➜ rapidreadytech.com/?p=9983

Autodesk, Siemens Enter Interoperability Agreement

Autodesk and Siemens PLM Software have entered an interoperability agreement aimed at helping manufacturers decrease costs associated with incompatibility in product development software. According to both companies, the agreement brings together two CAD software organizations with the common goal of streamlining data sharing and reducing costs in organizations with multi-CAD environments.

The companies are aiming to improve not only interoperability between Siemens and Autodesk programs, but also environments that have current configurations of the software.

"Interoperability is a major challenge for customers across the manufacturing industry, and Autodesk has been working diligently to create an increasingly open environment throughout our technology platforms," said Lisa Campbell, vice president of Manufacturing Strategy and Marketing at Autodesk. "We understand that our customers use a mix of products in their workflow and providing them with the flexibility they need to get their jobs done is our top priority."

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intrinSIM, Modelon Partner on Embedded Tech

Optimica Compiler, Optimica Testing and FMI toolkits will be added to instrinSIM's offerings for embeddable technologies for engineering applications. The following libraries are also to be made available:

- Electric Power Library
- Engine Dynamics Library
- Environmental Control Library
- Fuel Cell Library
- Fuel Systems Library
- Heat Exchanger Library

"The cooperation with intrinSIM will allow us to assist more software vendors to make the next step to Model-Based Systems Design," says Magnus Gäfvert, CEO of Modelon. "Continually growing product and systems complexity will dramatically increase the demand for Modelica and FMI-based technologies for modeling and simulation. Our relationship with intrinSIM helps us meet this increasing demand through expanding our indirect channels."

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Trenz Electronic Ships TE0808 SoM

The TE0808 UltraSoM+ system-on-module integrates Xilinx's Zynq UltraScale+ MPSoC with up to 4GB of DDR4 SDRAM main memory with 32-bit width, up to 512MB of Flash memory for configuration and operation, and assembly options to add additional volatile or non-volatile memory. Micron XTRMFlash and Spansion/Cypress HyperRAM or HyperFlash devices are supported. Also integrated is an onboard switch-mode power delivery subsystem that includes 14 DC/DC converters and 13 LDO regulators controlled by an ultra-low power MCU to provide flexible power-saving modes. Rugged board-to-board stacking connectors provide a total of 480 terminals supporting high-speed transceiver I/Os to the processing system

and programmable logic in the FPGA part. An ultra-low jitter PLL provides all required clocks to the 20 serial transceivers.

"The TE0808 UltraSoM+ is the first implementation of the Zynq UltraScale+ MPSoC in a system-on-module," says Thorsten Trenz, CEO of Trenz Electronic. "In many ways, the technological advantage it delivers is so significant that it is hard to scope. It gives design engineers the technical edge they have been looking for as they grapple with the significant demands of developing the next generation of multi-tasking embedded systems."

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Saab Chooses Aras PLM for Product Complexity

Saab, a provider of products, services and solutions for military and civil security, has selected Aras to support its product complexity workflow for the Gripen fighter aircraft.

Saab will be using the Innovator and Minerva platforms in partnership with its current PLM (product lifecycle management) platform.

The open architecture of Aras with an open data model, open interfaces and use of open Web standards was important in order to simplify integrations to existing systems in place at Saab, a company press release states.

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CD-adapco Adapts to Changes

Company announces new features in STAR-CCM+ and addresses acquisition by Siemens PLM Software at its STAR Global Conference.

In a city that has seen significant change over the course of its 1,100-year history, CD-adapco shared recent and upcoming changes to its software at the 2016 STAR Global Conference (SGC16) March 7-9 in Prague. But there was another topic on many of the 600+ attendees' minds: Would anything be different now that CD-adapco is set to be acquired by Siemens?

"If we look at 'why Siemens,' it wasn't Steve's passing that initiated the sale process," said Sharron MacDonald, president and CEO of CD-adapco, referring to her late husband who had led the company for 35 years. "We've been looking to sell the company to a strategic partner for more than a year and a half, and the process was started seriously about a year ago."

MacDonald said three serious buyers were considered, but Siemens best complemented the culture of CD-adapco.

"We were seeking a company that performs well, highly values its people and takes care of their customers — that is extremely important to us," she said. "Also, of course, that the people who run the company are ethical and already have strategies and plans in what they want to do in making an acquisition of this type … I'm specifically speaking at this moment of CFD [computational fluid dynamics, CD-adapco's specialty]. We spent a lot of time with the three companies. Now, I will tell you that price was also important."

She didn't mention further details of the $970 million offer that haven't already been reported, except to say: "I have the highest confidence that it will be a win-win-win: a win for CD-adapco, a win for Siemens and a win for our customers."

Land Rover BAR's yacht flies across the water. ***Image courtesy of Harry KH/ Land Rover BAR.***

Discover Better Designs Faster

Keynoter Martin Whitmarsh, CEO of Land Rover BAR, is looking for a win as well. Land Rover BAR is the British racing team founded in 2014 by four-time Olympic gold medalist and 34th America's Cup winner, Sir Ben Ainslie. The team's goal is to bring the America's Cup back to England. The America's Cup race began in Britain in 1851, but the nation renown for its prowess at sea has yet to win the prestigious trophy.

Design and simulation are critical to creating a winning boat. America's Cup rules prohibit the final craft from being used in the preliminaries leading up to the final race in Bermuda in June next year. Until then, teams rely on slightly smaller vessels, which are also used as test platforms, to develop the final design. Some of the technology Land Rover BAR is using to design its final yacht includes CD-adapco's STAR-CCM+, Dassault Systèmes SOLIDWORKS, Siemens PLM Software's NX and LMS Imagine.Lab Amesim, ESTECO's collaborative engineering software and Renishaw for 3D printing.

Like the America's Cup contenders, speed is all important to competitive bicycle racers and athletes who compete in IRONMAN competitions. Reducing drag is the name of the game said Kevin Atkins, aerodynamicist at Cervélo Cycles, in his STAR Global Conference 2016 presentation.

To that end, Atkins initiated a review of how Cervélo designed its racing bikes in 2013. He placed a focus on automation, accuracy and efficiency, beginning with an update to the latest version of STAR-CCM+.

His efforts took simulation runs from about 26 hours down to 3 hours. "Now we have a new challenge," Atkins said. "The designers can't keep up with the CFD." DE

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Take a Systems Approach to Workstations

If you're only comparing the parts that make up your computing solution, you're only getting part of the story.

BOXX TECHNOLOGIES has computing solutions designed specifically for design enigneering work in a form factor to meet your needs.

When the ancient Greek philosopher Aristotle said "The whole is more than the sum of its parts," he wasn't talking about workstations, but the adage still applies. All computing solutions are made up of basic components such as processors, memory, storage, cooling, power supplies and networking. But when you invest in a workstation, you're not just buying a box of components. A workstation is a complicated system of hardware, drivers, operating systems and applications that either all work together to be greater than the sum of its parts, or crash separately and routinely.

Engineering is Not a Game

Take computers sold to hardcore gamers as an example. Gaming rigs may run 3D applications at high frame rates utilizing consumer graphics cards, so that when you frag your friends in *Call of Duty* or cast a spell in *Skyrim*, the animated action is smooth. That means a dedicated gaming machine and a professional engineering workstation may have similar specifications, but that doesn't mean you should run your CAD, simulation and rendering software on what is basically a tricked out consumer PC, or beefed up gaming console.

Here are the top factors to consider when investing in a new workstation, according to the engineering workstation experts at BOXX Technologies.

1. Engineered for peak performance. Not all components are created equally. At BOXX, you can customize a solution to meet your needs with plenty of processor choices — including Intel® Xeon® processors, which are required to use error-correcting code (ECC) RAM — safe, professional overclocking with speeds that are guaranteed for the life of the warranty, liquid cooling that prolongs the life of system components, and high-speed storage options. BOXX*labs* tests all of its configurations with the applications you use to ensure they're reliable and built for speed. In addition, all of BOXX's chassis are designed in-house, using SOLIDWORKS, and fabricated right here in the USA, not stamped out in metal and plastic overseas.

2. Optimized for creative workflows. Engineers have needs different from those of gamers and other computer users. In fact, different types of engineers require different solutions, so your workflow should determine your workstation needs. You might benefit most from a safely overclocked CPU that significantly speeds up single-threaded applications like CAD design and 3D modeling. But overclocking for professionals greatly differs from overclocking for gaming. You also may need multiple professional GPUs for applications that can take advantage of them like rendering and visualization. Whatever your needs, BOXX Technologies focuses on creative workflows and can help you configure the best system for your specific requirements with room for future expansion.

3. Supported for solving problems. We've all been through the tech support phone trees and scripted dialogs that seem like they're intended to force you to give up, rather than to help you solve a problem. BOXX Technical Support is staffed by experienced professionals in the company's Austin, TX, headquarters who understand your applications and can solve your issues. The company has partnerships and certifications with key hardware and software vendors — including Intel, NVIDIA, Autodesk and Dassault Systèmes — so that it can isolate the source of an issue and quickly resolve it.

Specs are important to note when comparing systems, but they only tell part of the story. How those components interact with the engineering applications and plugins you rely on is the difference between meeting and missing deadlines. How customer support interacts with you if there's a problem can be the difference between a frustrating failure and a successful solution.

For more information, visit boxxtech.com.

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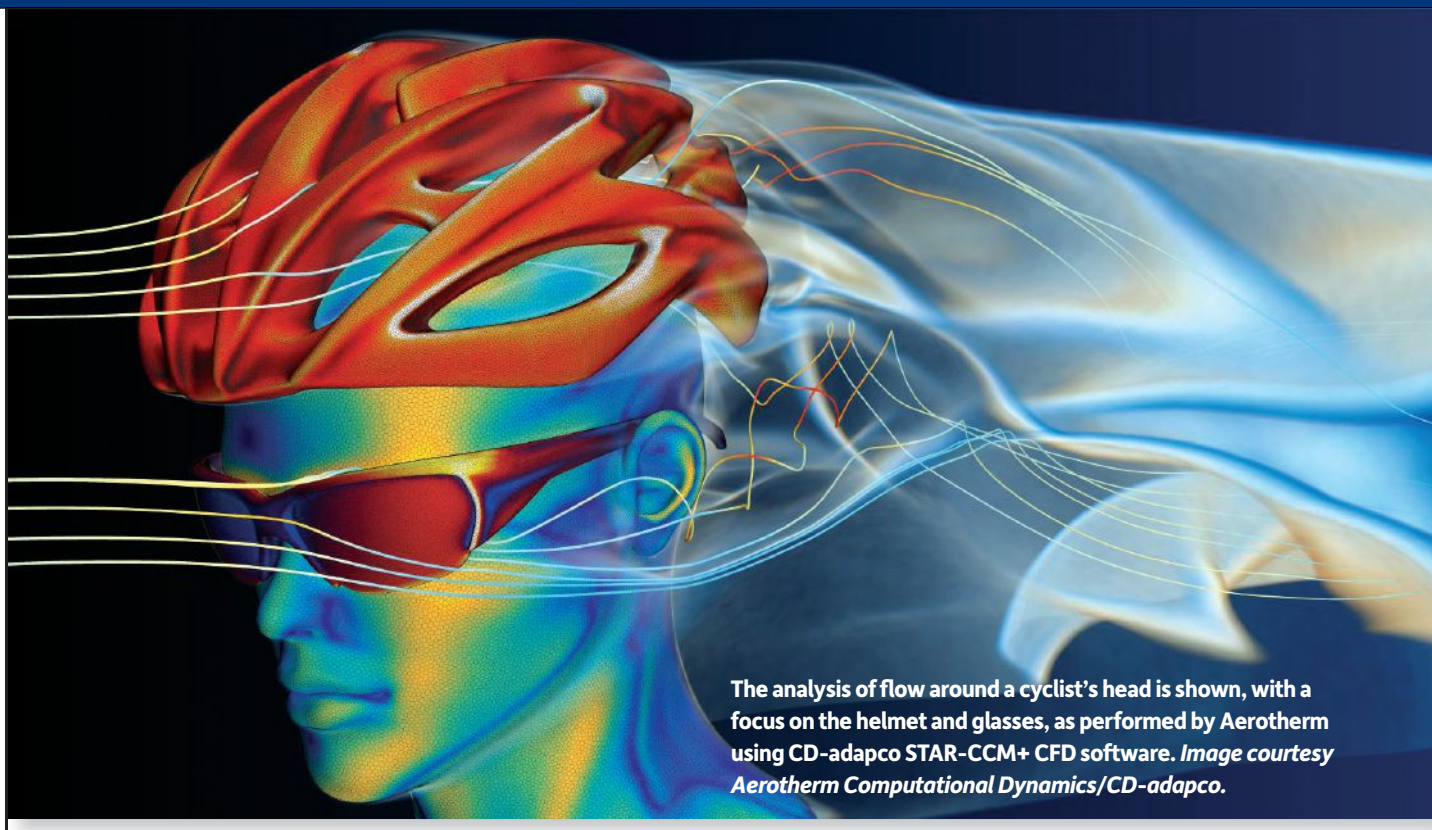


The analysis of flow around a cyclist's head is shown, with a focus on the helmet and glasses, as performed by Aerotherm using CD-adapco STAR-CCM+ CFD software. *Image courtesy Aerotherm Computational Dynamics/CD-adapco.*

Simulation Software: A Price and Performance for Everyone

SMBs used to ask: Why? Now it's time to ask: Why not?

PAMELA J. WATERMAN

So you get that simulation is good, but have you got it? Caution is understandable, but what's stopping you, and many others in small- and medium-sized businesses (SMBs), from simulating designs well before building them? Although the concept is definitely spreading industry-wide (check out the *DE* publication, *The Design Engineer's High-Performance Computing Handbook* at hpc.deskeng.com, for savvy examples) perhaps you just haven't found the right tool for your budget, timeframe and experience.

DE asked a wide range of analysis-software providers what they're doing to address the barriers (perceived or actual) of cost, compatibility, accessibility, ease-of-use and more. You'll find offerings for individual parts or complete assemblies, single-physics or multiphysics, cloud options, flexible licensing and open sources. The possibilities should have you taking a second look at adding more analysis to your workflow.

Starting With What You Know

Familiarity breeds comfort, not contempt. Because most engineers still begin the design process with a CAD model, it's no wonder that adding simulation directly inside a favorite CAD program is an appealing solution. PTC and SOLIDWORKS have spent decades adding mechanical analysis functions to their geometry-creation packages and platforms. CAD-embedded tools can offer perhaps some of the power of comparable functions found in dedicated analyst software, at much less cost.

Jose Coronado, product manager at PTC, knows that SMBs need a quick and reliable simulation engine that doesn't require a Ph.D. in finite element analysis (FEA) modeling to make it work. He notes that PTC Creo Simulate, a general purpose simulation tool, will cover many of the cases that an SMB engineer typically encounters; it handles thermal and structural analysis and simplifies the process using automated meshing. Creo Advanced

Simulation Extension software adds nonlinear and buckling capabilities that are still manageable by the non-expert. And PTC offers embedded tutorials, reseller support and a complete distance-learning training course for added ease-of-use.

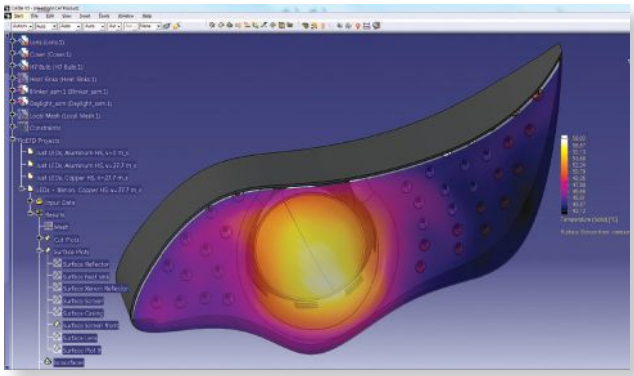
SOLIDWORKS product portfolio manager, Nicolas Tillet, says his company is always looking to lower barriers to entry via ease of use. SOLIDWORKS Simulation software, fully embedded in SOLIDWORKS 3D CAD, includes structural, fluid-flow, thermal, vibration and plastics-injection simulation for both parts and assemblies. Depending on the version used, engineers can investigate a range of materials and behaviors. "SOLIDWORKS Xpress offers free SOLIDWORKS Simulation 'light,' for users to play with basic stress analysis (on individual parts). We also offer free tutorials and forums," Tillet says.

More recently, Autodesk has taken on the challenge of adding simulation functions to its CAD products. Greg Fallon, vice president of Simulation Products at Autodesk, cites a number of influences, from the need for SMBs to demonstrate a competitive edge (without prohibitive startup and maintenance costs) to the fact that those users have varying skill sets and are geographically spread throughout the country and around the globe.

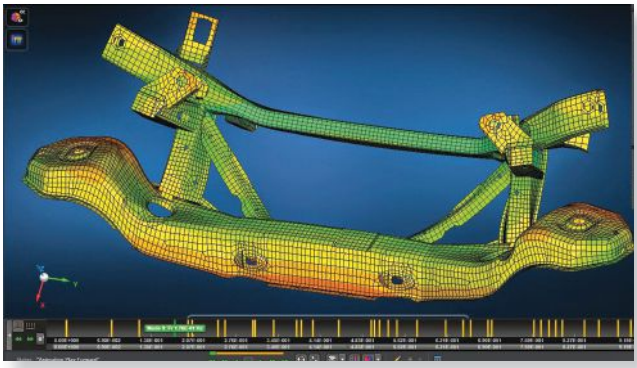
Designers and engineers can address these points with Autodesk Fusion 360, the company's project to revolutionize simulation access and capabilities. As a cloud-based system, Fusion 360 lets user access full functionality for as little as $25/month, and there's a special free one-year license for startups for in-depth tryouts. Supported analysis types include linear static stress, modal frequency and thermal/thermal stress. User-written apps are encouraged and often discussed on the Fusion GitHub Website. For a taste of things to come, check out Autodesk Labs' Project Arro, termed "a technology preview for an emerging simulation product called SimStudio" at https://goo.gl/EH55Gv.

It's refreshing to see new and lesser-known analysis-software companies also working to ease the perceived pain of doing mechanical simulation and fluid dynamics analyses. SIMSOLID co-founder and CEO Ken Welch says the needs of SMBs are exactly what his company targets. "There are two fundamental roadblocks for simulation usage in SMBs: price and complexity of working with design geometry," he observes. "Cloud-based access, pay-as-you-go is a good start, and we do low monthly subscription rates." But beyond this, his company's tagline — "simulation reinvented" — points to a fundamental difference in SIMSOLID's philosophy. "We accept the design geometry as is, without the need to modify it for the meshing process," he explains. (For details of how SIMSOLID simplifies structural, modal and thermal/thermal stress analyses, see Welch's write-up at simsolid.com/2016/01/geometry-change-or-accept/.)

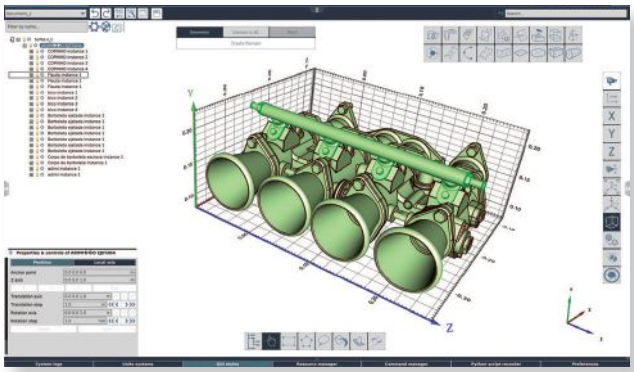
Another interesting cloud-based simulation platform is Sim-



FloEFD flow/thermal analysis software from Mentor Graphics allows designers to perform CFD analyses within their own CAD environment. *Image courtesy of Mentor Graphics.*



MSC Apex, part of the MSC One Start Edition from MSC Software, helps users evaluate design behavior through modal analysis. *Image courtesy of MSC Software.*



An example of OMNIS, the new-generation graphical user interface (GUI) from NUMECA for its FINE family of CFD and FSI software products. The GUI is designed to be extremely simple, with no menu, automatic grid generation on less-than-perfect geometry, and parallel batch and graphics operations even on large datasets. *Image courtesy of NUMECA.*

Scale, from the company of the same name. Through a standard Web browser, users upload a CAD model, choose and set up an analysis and analyze the results. The website states that SimScale is "an ecosystem in which simulation functionality, content and people are brought together in one place" with both free and low-cost monthly subscriptions. Simulation processes are founded on CalculiX (for structural work) and OpenFOAM (for fluid analysis) software. (Check out https://goo.gl/hafwbB for some thought-provoking user insights on SimScale.)

Speaking of OpenFOAM (open source) software, Chris Greenshield, director at CFD Direct (and one of the original co-developers of OpenFOAM), sees this software used by consultancy companies across a broad range of engineering, and often for simulating processes rather than products. (Think of predicting how a valve in a chemical plant might clog and how to improve its design or usage.) Greenshield notes that providing the software at no cost lowers a major barrier to entry for CFD (computational fluid dynamics) simulation, avoiding recurring fees and per-seat licensing. His company provides services and training courses to customers to help them build their CFD competence while continuing to develop, maintain and release OpenFOAM.

Lastly, a designer-targeted simulation product that may not have surfaced on your radar is Midas NFX, first released in 2009 by Midas Information Technology. These solutions address contact, nonlinear, fluid-structural, CFD, heat transfer and other behaviors. Users say that Midas NFX presents a very intuitive interface, with extensive online guidance in the form of interactive tutorials and FEA analysis guides. The company offers a 15-day trial license, with special support plan pricing available for small businesses and consultancies.

SMB Outreach From Classic Sources

CAD-integrated simulation can work in the other direction, too. Autodesk offers Nastran In-CAD, which can even work in SOLIDWORKS, along with higher-level simulation packages addressing mechanical, injection-molding, CFD, and composites specialties. Companies such as Mentor Graphics (with embedded and tightly-integrated CAD options), COMSOL (with its LiveLink packages) and Siemens PLM (with third-party solvers linked to NX Advanced FEM) have created seamless operations between standard CAD systems and advanced simulation.

Quick design iterations are what Mentor Graphics sees as crucial for SMBs. With the company's options for its FloEFD built into Siemens NX, PTC Creo and Dassault Systèmes CATIA V5, engineers can run simulations directly on CAD models without leaving their preferred environment. A version can also integrate with Autodesk Inventor and Siemens PLM Solid Edge.

"Our software developers and scientists didn't spend their time creating a scientific tool that requires only scientists to use it; instead, they created an engineering tool that has the know-how of CFD science built into its core," says Boris Marovic, industry manager for Mentor Graphics. If desired, FloEFD can be customized for applications such as combustion or hyper-

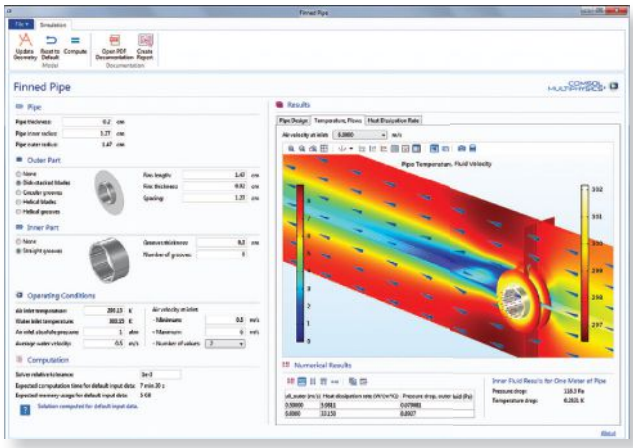
sonic flow, but, notes Marovic, keeping these specialties as add-ons keeps the price down. FloEFD is not cloud-based but is available through a browser for a 30-day evaluation.

Valerio Marra, technical marketing manager at COMSOL, also understands that small businesses need to get the most value from their investments; his company offers several ways to do so. "One option, a six-month single-user license," Marra explains, "would include a COMSOL Multiphysics product combination suitable for mechanical engineering and CAD import. The user would have instant access to customer support and training opportunities." Secondly, COMSOL offers tools in its LiveLink product line that links 3D designs created in various CAD, mathematical and spreadsheet programs directly to COMSOL Multiphysics, supporting synchronous, two-way design development. Lastly, a COMSOL Certified Consultant can build an app (using COMSOL Application Builder software), which can then run at an SMB on a low-cost COMSOL server license.

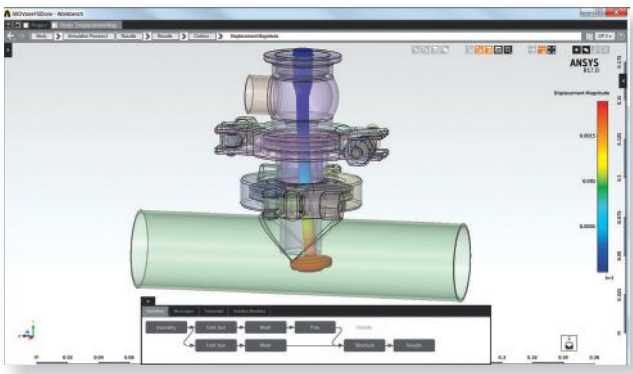
Siemens PLM has already put years of effort into broadening its user base beyond the Ph.D.-level analyst. Because SMB users might be doing structural analysis one week and thermal analysis another, the company has partnered with the Rescale platform to offer on-demand access to NX Simulation products. Within the software, wizards and simplified interfaces called roles guide non-experts from design changes through simulation in a seamless flow with just a few clicks. Ravi Shankar, director of Simulation Product Marketing at Siemens PLM, describes two additional aids: Experts can employ the NX Open tool to capture and publish simulation processes for designers, while new users can get comfortable with NX CAE products by connecting with the vibrant online NX community.

These well-established simulation companies aren't alone in reaching out to SMBs. Simone Bonino, vice president of Marketing for Altair HyperWorks, says his company makes sure prospective users understand what simulation means to them and why they are pursuing it. "It is important to find the subset of simulation that will be manageable (i.e., meet their ROI goals) without becoming overwhelming or impossible to implement," Bonino explains. "It's about making them see that a few weeks of inconvenience can mean months and months of increased throughput and improved designs. With a small team, everyone has to be flexible. The right tools can allow them to handle the design phase then switch right into analysis with ease." Several of Altair's cost-effective entry options come via the line of HyperWorks Unlimited virtual and physical simulation appliances.

If you don't generally think of ANSYS in the same sentence as small business, you may want to think again. The company's cloud-based AIM product, introduced quietly in early 2015, is all about democratizing simulation for broader use. Christine Wolfe, ANSYS lead product manager for Multiphysics, says, "The products that SMBs are designing are themselves becoming more complex — nobody makes a simple product anymore — [so] users need a way to get up to speed fast on both single- or multi-physics analysis. We understand that they may not be using



Finned Pipe custom application created by an analysis expert with COMSOL Multiphysics' Application Builder. ***Image courtesy of COMSOL.***



The ANSYS AIM user-friendly interface for setting up and performing a multiphysics (mechanical and fluid) analysis on a valve assembly is pictured. ***Image courtesy of ANSYS.***

simulation day in and day out. Non-experts need a tool that can guide them but still give an accurate answer." Users get a free two-hour trial, including four guided sample analyses, at ANSYS.com/TryItNowAIM where they can set-up runs automatically without any sign-up.

Don't overlook one of the grandfathers of simulation software companies: MSC Software. Leslie Bodnar, vice president of Global Marketing, says smaller firms can't always afford the necessary investment in software and a full-time analyst, so one solution is to have an outside source perform modeling, meshing or the full simulation. "A service project is much less risky," says Bodnar, "and is a cost-effective way to get started down the path of integrating virtual test methods into the design process."

Another MSC Software approach for SMBs is the MSC One Start Edition, a new token-based, annual subscription licensing system. "The tokens give the (SMB) access to a range of physics and applications including structural analysis, multi-body dynamics, nonlinear and multi-physics, and our new CAE platform, MSC Apex, for approximately $10,000," says Bodnar.

Fluid Dynamics for Non-Experts

While many designers have become comfortable doing mechanical simulations, the realm of CFD can still seem out of reach. However, this perception is changing for both simple and complex applications as CFD companies of all sizes tackle ease-of-use, education, pricing and accessibility (see "Expanding the Search for CFD Solutions," deskeng.com/de/?p=25188).

For years, CD-adapco (currently being acquired by Siemens PLM Software) has helped companies access the power of CFD analyses. The company was a pioneer in the licensing concepts of Power-Sessions and Power-on-Demand. David Vaughn vice president of Worldwide Marketing at CD-adapco, says these options take away any penalty for doing more simulations. "Such flexible licensing, combined with improved hardware and easier-to-use software, make it possible for one person to do CAD, meshing and simulation within a small business," notes Vaughn. "It's a power tool, so we provide all the attachments and fittings to use it for specific cases; we have some vertical applications such as for mixing [plus] a Java API (application programming interface) and a portal called Macro Hut for sharing scripted macros. But probably our biggest contribution is our support, where we have a dedicated support engineer for even the smallest customer."

As a small business, Flow Science can understand the complexities and difficulties of bringing a highly technical product to market and competing with bigger players. Its FLOW-3D package supports multiphysics CFD processes coupled with thermal and structural analyses. "Our aim is to give our customers a highly accurate simulation tool that ultimately improves their bottom line," says Amir Isfahani, vice president of Sales and Business Development at Flow Science. "We offer consulting services, which is a great way for smaller companies to explore CFD, or an affordable short-term license. Our trial license offers new customers the opportunity to explore the software under the tutelage of experienced hands." Flow Science also offers batch processing for added speed, plus custom scripting for its FlowSight visualization tool.

Supporting small- and medium-sized enterprises with reliable, cost-effective CFD and multiphysics simulations is the primary goal of NUMECA International. This Belgium-based company offers worldwide support for a family of products that includes AutoMesh, CFView, FINE/Open with OpenLabs, FINE/Turbo, FINE/Acoustics and FINE/FSI-OOFELIE (the latter for fluid-structure interaction simulations).

Marc Tombroff, NUMECA general manager, says his company's new OMNIS user environment addresses the need for a user-friendly interface with features such as automatic creation of high-quality grids on "dirty" CAD files, a fast mesh preview option, a simple no-menu GUI (graphical user interface), close links to CAD systems and fast simulation return time on coarse grids. Tombroff adds: "We are amazed to see how many SMBs start using our NUMECA cloud solution based on UberCloud containers." NUMECA has also recently launched an app called WindTunnel CFD for real-time CFD on tablets.

Symscape and Hanley Innovations are two more CFD software vendors that understand the needs of small businesses. Symscape's Caedium is a great place for the SMB to start fluid analysis with a focus on internal and external flows, with or without heat transfer. Richard Smith, principal engineer at Symscape, says users can download the basic version of Caedium at no cost; it functions as a viewer for Caedium files and provides a feel for Caedium's capabilities. The software's interface is very contemporary, based on drag-and-drop and multi-level undo/redo functions that are easy to navigate. To step up to performing CFD simulations, users download various targeted Caedium add-ons; all are available as free 30-day trials; purchase prices are listed on site and one-on-one support is available.

For some users, a more application-specific program is just what they need. For example, designers seeking guidance on lift, drag and aerodynamic moments should look to Hanley Innovations. Among its software products, the company's Stallion 3D software analyzes 3D CAD designs (e.g., planes, cars, sailboats), while its MultiElement Airfoils package helps users evaluate the behavior of 2D airfoil shapes. As owner Patrick Hanley notes: "You don't necessarily need the power of a thousand cores to get CFD answers." Both programs use automatic grid generation and can produce results in just hours on laptop computers. DE

Contributing Editor **Pamela Waterman**, DE's *simulation expert, is an electrical engineer and freelance technical writer based in Arizona. You can send her e-mail to DE-Editors@deskeng.com.*

INFO
- **Altair:** Altair.com
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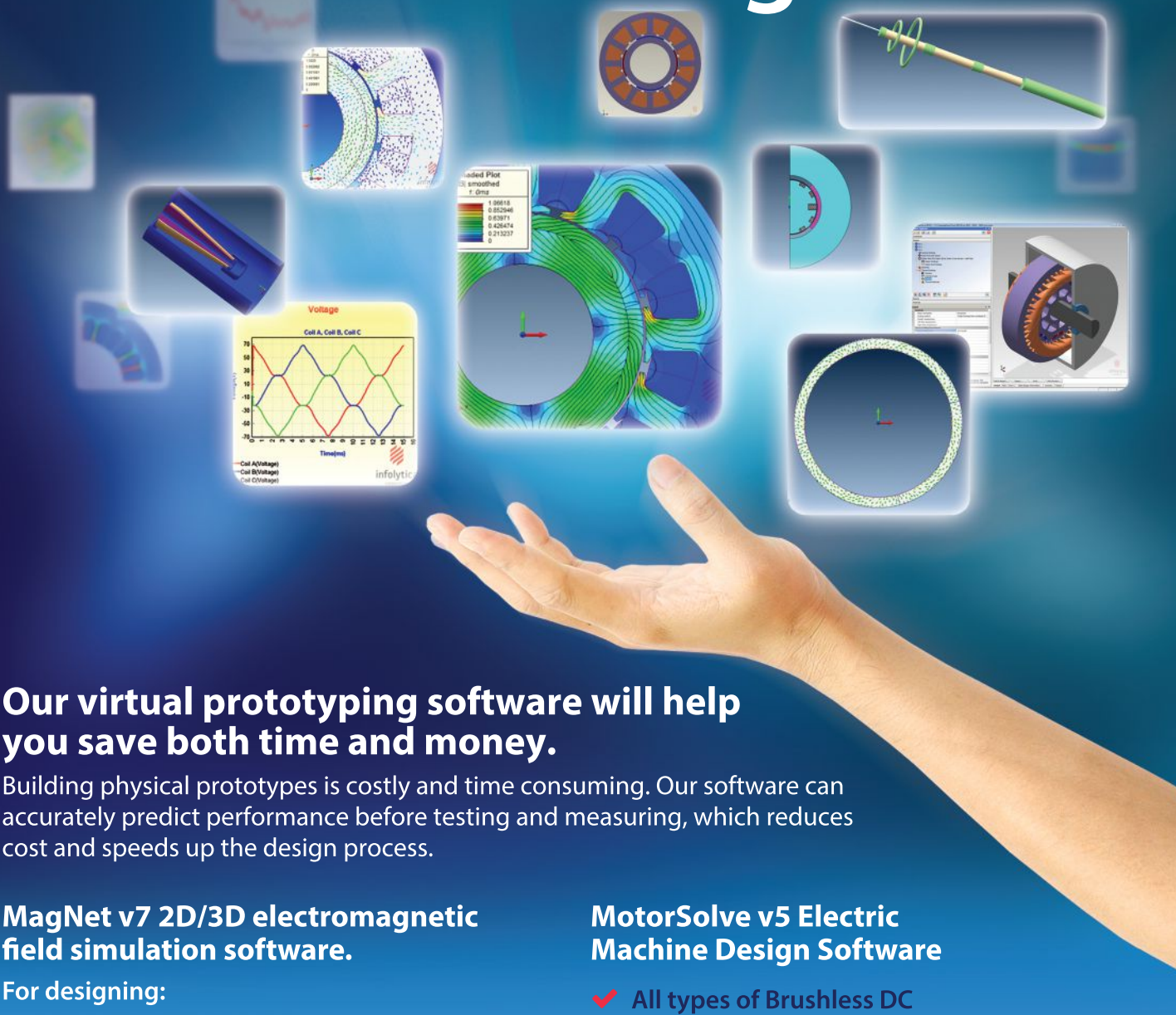

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From All-in-One to Pick-What-You-Want CAD

Design and engineering software may shrink — and that's good news for many.

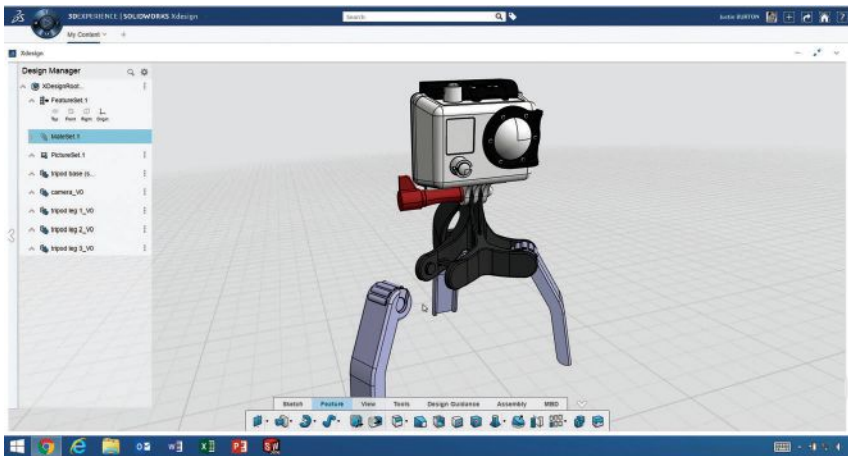
BY KENNETH WONG

The general practice in the design and engineering software industry is to bundle everything you might possibly need into a single package. A standard 3D CAD program usually comes with 2D drafting, 3D mechanical modeling, sheet metal, photorealistic rendering and basic stress analysis. In some, you might even find rudimentary free-form modeling, surface modeling, collaboration functions and workgroup-level document management tools. If you routinely make use of all these features in your workflow, you're probably what people call a "power user" and you're certainly getting your money's worth. But if you're like most CAD users, you may use only about 35%-45% of the commands regularly, you occasionally delve into the remaining features, and you've only launched some of the most advanced features once or twice.

With the shift to subscription software (see "The Growing Demand for On-Demand Licensing," deskeng.com/de/?p=28953) some CAD vendors are going back to refashion their all-encompassing products as a series of smaller modules instead. Others are introducing smaller, lighter design programs aimed at hobbyists and makers. Either way, it has serious implications on software cost and adoption.

Small Fish Can Fill an Ocean

"In the last few years, our strategic focus has been shifting from the top of the pyramid to the global customers in the lower tiers," says Brent Edmonds, PTC's senior director of CAD Segment. "That's where we see the CAD business growing — specifically PTC Creo."



SOLIDWORKS Xdesign, a new product from the creators of the SOLIDWORKS CAD program, runs inside a browser and is mobile-friendly. *Image courtesy of SOLIDWORKS.*

In the Pro/ENGINEER era, PTC was closely associated with large automotive and aerospace manufacturers — but not so much in the Creo era. Edmonds revealed that, last year, roughly 50% of PTC's revenues came from the small- and mid-sized customers, making this segment impossible to ignore. "In our Creo and Mathcad businesses, there are accounts with just a single seat or two. We're developing a program to address startups and small design shops with one to three employees," says Edmonds. "It's to help them get off the ground without a substantial investment."

PTC isn't ready to reveal details about its startup program yet, but Edmonds says: "True startups may even be able to get access to our software at no cost until they start to get business and become established."

X Marks the Spot

Check any manufacturing job posting and you'll most likely come across SOLIDWORKS listed as a skill requirement. The widely adopted mechanical CAD package, part of Dassault Systèmes' portfolio, was previously only available as a perpetual license, but early this year, at the

SOLIDWORKS World user conference, the company announced plans to make SOLIDWORKS available for short-term rental under quarterly and annual licenses.

Furthermore, the company introduced a series of X-branded products: Xdesign for modeling and Xdrive for cloud-hosted storage, for a start. "Xdesign is a new, browser based, full SaaS, product design offering based on Dassault Systèmes' 3DEXPERIENCE Platform. Not everybody wants, or can do product design in the same way. Xdesign addresses the needs of those users who choose to work online and in a browser," says Milos Zupanski, director of Product Portfolio Management at SOLIDWORKS.

The new product Xdesign includes what SOLIDWORKS CEO Gian Paolo Bassi described at the conference as "a baby version of topology optimization." Zupanski explains: "Instead of starting with an empty space, Xdesign suggests what products should look like."

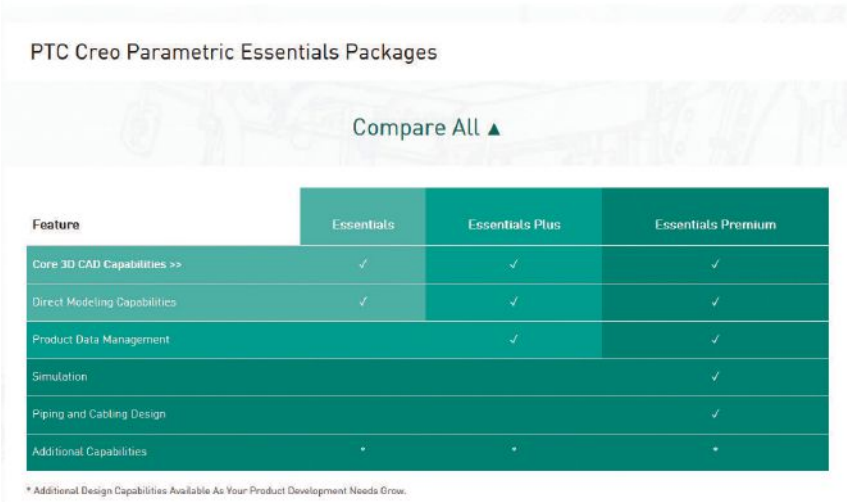
The company hasn't revealed Xdesign's price. The product could be an easier, lighter alternative for hobbyists and makers who don't need everything in a full-featured parametric CAD program and find its learning curve too steep.

Multi-Tiered CAD

Six years ago in 2010, PTC's all-in-one CAD package Pro/ENGINEER underwent a drastic transformation. The company broke up a single product into PTC Creo-branded modules. What used to be families of features inside Pro/ENGINEER became their own discrete products, such as PTC Creo Parametric, PTC Creo Direct, PTC Creo MCAD View, PTC Creo ECAD View, PTC Creo Schematics, PTC Creo Sketch, and more. Back then PTC — like many others in the CAD segment — was skeptical of subscription CAD; nevertheless the modular approach turned out to be a prelude to its wholehearted embrace of the subscription model later on.

Late last year, PTC announced it was putting its entire product portfolio on subscription. With this sweeping move, the company debuted three different levels: Essential, Essential Plus and Essential Premium. All three include the core 3D modeling and direct editing functions. But other advanced features like product data management, simulation, and piping and cable design are pegged to the two higher levels: Essential Plus and Essential Premium.

PTC doesn't publish its subscrip-



PTC multitiered chart: PTC's new Creo Essentials subscription chart shown here reflects how CAD software is broken into different levels for easier consumption under the subscription model. ***Image courtesy of PTC.***

The Evolution of Design

As the appeal of mass-market, one-size-fits-all products yields to consumers' desire for more specialized or even personalized products, design is following suit. Design has become an intrinsic part of the functionality of many products — from automobiles to consumer electronics — than it was in the past.

As the look and feel of products take center stage, people in different disciplines are becoming more design literate. It isn't just for design engineering anymore, which is another reason traditional CAD vendors are making their products easier to use. The potential market for design software customers is already much larger than it was just a decade ago.

Realizing the trend is likely to continue, CAD vendors are making sure the next generation is comfortable with their software by making it available for free or at a significantly reduced cost to students and educators. All of the largest CAD vendors have reduced student licensing programs so more people will be armed with design software know-how, no matter what field they pursue.

tion prices, but according to Edmonds, it is "a fraction of the price of a perpetual license, and it's in line with the software industry's subscription pricing." He adds: "Our customers' transition to subscription is going even faster than we've planned for."

PTC's multi-tiered system is similar to Siemens PLM Software's offer of Solid Edge under subscription, introduced much earlier in 2013. Under Solid Edge subscriptions, those who need only basic 2D and 3D may choose Design and Drafting ($100 per month); those who work with surfaces, sheet metal, weldments and frames may choose Foundation ($230 per month); those who need rendering and part-level structural analysis may subscribe to Classic ($290 per month); and those who want assembly-level analysis, electric cable design, piping and tubing design as well as other advanced features may subscribe to Premium ($420 per month).

With a head start in subscription, Autodesk, too, offers its primary mechanical CAD product Inventor with different clusters of features. Inventor LT ($50 per month) gives you the most basic 3D modeling. Inventor LT Suite ($55 per month) gives you AutoCAD LT and Inventor LT. Standard Inventor ($235 per month) gives you core 3D modeling. Inventor Professional ($385) gives you simulation in addition to 3D modeling. As you move up the ladder to Product Design Suite ($290 per month), you also get electrical design, simulation, tooling and project management.

Onshape, founded by a team of former SOLIDWORKS executives, offers its browser-based CAD software for free to those who keep their number of private project files and data storage below the maximum allotted. Most professional users, however, will likely subscribe to Professional Edition ($100 per month) with unlimited storage. The company also offers Enterprise Edition (price unpublished), which comes with administrative tools and analytics.

"It's a lot cheaper to make people aware of Onshape that way [with the free offer]. Otherwise, I'd have to send an application engineer to go to a prospective customer's site to give a tutorial, then have them sign a document that says they can only use the software for a set amount of time," said Dave Corcoran, Onshape's VP of R&D. "We forego those costs. The free version is our marketing engine; the fee from the paid version supports the free version."

Onshape itself doesn't offer simulation or rendering functions, but its partners do. These partners also offer free versions of their plug-ins. (For more on Onshape, read our coverage of the democratization of high-performance computing on page 28.)

The subscription option to scale up to get access to the more advanced functions like simulation and electrical design, and the option to scale down when the project no longer demands them, may entice new users who have previously stayed away. Siemens PLM Software and Autodesk offer subscriptions as short as a single month, along with quarterly and annual options. PTC's subscription currently requires

at least a one-year commitment, but Edmonds suggested more short-term options are coming in the future.

AutoCAD Rivals in 2D

In the last decade, a series of primarily 2D CAD products emerged to challenge Autodesk AutoCAD's dominance. They include IMSI/Design's DoubleCAD XT (free), Dassault Systèmes' DraftSight (free), and Siemens PLM Software's Solid Edge 2D Drafting (free).

For those who feel comfortable working with CAD files on mobile devices, the free and low-cost options are even greater. Autodesk also offers AutoCAD 360 (formerly AutoCAD WS) as a free mobile app for creating, viewing, and editing 2D DWG files.

The Changing Definition of Low-Cost CAD

Previously, many serious engineers scoffed at the notion of low-cost CAD, generally considered amateurish modeling programs with little or no support. Free consumer-friendly modelers like TinkerCAD, on the other hand, have only the most basic building blocks to create simple shapes, making them attractive to educators but less than ideal to product designers. The software you get with subscription, however, is a different breed. They're the industry-standard professional 3D modeling programs, but broken up and repackaged to make it them more accessible and consumable.

With some starter editions, you get fewer features, but that's welcome news for those who don't need anything beside the basics. You might argue subscription pricing is not truly "low cost" because over time the subscriber pays more for the software. However, for startups with cash flow challenges, the option to pay smaller subscription fees incrementally may be a better alternative to the initial investment required to purchase the software outright.

Pressure from rivals may also drive the price down further. China-based ZWSoft's ZWCAD Classic is listed at online CAD software vendor Novedge's catalog for $569. Pricing for Germany-headquartered Graebert's ARES CAD package begins at $250 for annual licenses or $795 perpetual licenses.

In 2010, Texas-based Alibre dropped the price of its parametric CAD package Alibre to $97. At a time when comparable 3D modeling programs were sold for $2,000 to $5,000, Alibre's sub-$100 price thumbed its nose at the industry norm. Alibre has since been acquired by 3D Systems and the software was morphed into Geomagic Design. At online design software retailer Novedge, Geomagic Design with one year of maintenance is currently listed at $2,279.

Nevertheless, a quick glance at the current CAD subscription prices will tell you that instant access to a robust 3D mechanical modeling program for less than $100 per month is not out of ordinary. It is, in fact, the new normal. DE

Kenneth Wong *is* Desktop Engineering's *resident blogger and senior editor. Email him at kennethwong@deskeng.com or share your thoughts on this article at deskeng.com/facebook.*

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➜ **Dassault Systèmes SOLIDWORKS Corp.:** SOLIDWORKS.com

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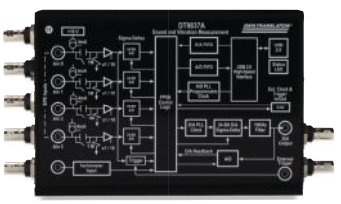

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Q&A: Visual Systems Design

BY JIM ROMEO

Graphical programming employs images and symbols to allow users to communicate complex systems visually, without coding. It can be used to test design parameters and find changes that will improve the overall design outcome.

To explore this topic, *DE* spoke to Jeff Phillips, section manager for Software Platform Marketing at National Instruments; Michael Carone, senior product marketing manager for Simulink at MathWorks; and Jeff Smith, software marketing manager at Keysight Technologies. The conversation centered around graphic programming trends for design engineering applications.

DE: **How would you describe graphical programming and its utility for automated testing? What are its key advantages and attributes?**

Jeff Phillips, National Instruments: A picture is worth a thousand words. At its core, graphical programming is a development paradigm that leverages the human capacity for understanding complex information in the form of a drawing as opposed to words. Graphical programming actually aligns very well with the way engineers visualize systems, in general, and test systems, in particular.

Engineers can focus on the components of a system and their connectivity, and represent that directly in a graphical language, rather than wasting time trying to determine the proper abstractions to use from a more traditional programming language. The artificial complexity of traditional programming often exceeds the inherent complexity of the task to accomplish.

Michael Carone, MathWorks: An advantage of graphical programming is the application of this technique to find design errors earlier in the development processes. Most design errors are introduced in the original specification, but aren't found until very late during the integration testing phase on actual hardware.

In this environment, engineers are able to analyze their designs in a simulation environment, perform various what-if analyses, run tests in simulation on their desktop computer, identify incomplete or missing specification requirements and determine the overall robustness of the design.

Once the design has been confirmed to work in simulation, you can use code generation tools to automatically generate code from the simulation model. In summary, the benefits include: prototyping via desktop simulation; automatic code generation for embedded deployment; and early test and verification of embedded systems before hardware has been built or code has been written.

DE: **So, what exactly is the difference between traditional programming and graphical programming?**

Phillips: There are two fundamental differences. Traditional programming is text-based and sequential, while graphical programming is pictorial and parallel. Text-based languages use words, symbols and esoteric syntax to construct programs, while graphical languages use icons, boxes and lines to construct programs. It is much simpler to see the relationships among the components of a program graphically vs. textually. Traditional languages are modeled on the von Neumann computer architecture, which executes sequentially, so using them to create correct parallel programs is notoriously difficult. Graphical languages, on the other hand, are inherently parallel so they are much better suited to program parallel programs on modern multicore processors.

Carone: Traditional programming is text based. You write code — that is your program. With graphical programming, your design is represented by blocks and lines. Blocks typically represent mathematical and logical algorithms; lines represent data. One of the main benefits of graphical programming is that it is easier to understand for the person who wrote the original program, and for their colleagues as well. This is especially true for specialized software, such as embedded control or signal processing systems. In those areas of engineering, the college classes and textbooks use block diagrams to represent algorithms and to explain concepts.

DE: **What's unique about graphical programming that can expedite automated testing for design and testing?**

Phillips: Graphical programming can more easily support the testing of multiple devices in parallel, greatly reducing test time and cost for high-volume manufacturing. For complex devices, graphical programming makes it easier to test multiple features at the same time, for example, concurrently testing RF (radio frequency) communication and brightness uniformity of a display.

Jeff Smith, Keysight Technologies: Engineers need the fastest path to their results. Time is limited as it is, so spending half of a day programming instruments or setting up data acquisition software isn't the best use of time for many design-focused engineers. Heavyweight programming isn't

Graphical programming can help engineers implement a more automated testing process. ***Image courtesy of Keysight Technologies.***

always needed for design characterization tasks that will change or evolve over the normal course of a new design. As such, some users have gravitated toward graphical programming languages because learning this can be faster than learning a traditional text-based language.

However, as graphical languages have become more flexible to support more uses, they have also become more complex, increasing the learning curve and burden of test design. This has led to a cottage industry of training classes and certifications for graphical languages that don't necessarily translate to other areas of the industry.

DE: **What are some key features and developments to watch for in graphical programming?**

Phillips: One of the key recent developments in the market has been the proliferation of multicore processors and FPGAs (field programming gate arrays). These are highly parallel processing elements and ideally programmed by graphical languages. They are also becoming more complex by integrating communications and I/O.

Graphical languages are superbly suited to representing I/O and communications paths as well as precise timing relationships so there will continue to be advances in these dimensions. The capabilities of graphical user interfaces (GUIs) have expanded dramatically in the recent past and it will be natural for graphical languages to exploit more elements of modern GUIs in the service of making domain experts more productive.

Carone: One of the key developments in graphical programming is to incorporate the advantages of traditional textual programming inside of a graphical model. For example, Simulink now enables users to type in the name of a block in order to add it into the model instead of having to find that block within a library browser. Furthermore, in Simulink, algorithms from MATLAB, C or other text-based languages can be added directly into the model.

Web browsers are also inspiring some of the enhancements to the graphical programming environment. These include view marks to save particular views of a model, similar to using bookmarks to easily go back to a website, and tabs to switch back and forth between different levels of hierarchy within the model, similar to tabs used to switch back and forth to different websites.

Smith: In response to the market need for a simpler approach to common problems, Keysight Technologies introduced an automation application last year that greatly reduces the programming burden of users who need simple automation with their test instrumentation.

With the Keysight BenchVue Test Flow application for BenchVue Software, engineers can easily create automated sequences with test and measurement equipment. If you understand the basics of a DMM (digital multimeter) or oscilloscope or other common instrumentation, you can drag controls and measurements from dedicated applications in BenchVue to create your own automated sequence with a combination of different instruments. No longer are engineers tied to downloading the right driver or finding the right command syntax for their instrument. With the BenchVue interface, the most common controls are presented for users independent of model number.

For those engineers who need the power and flexibility of a complete programming environment for full automation, Keysight offers tools that augment the development environment of the user's choice. One example is Keysight's Command Expert software that helps bridge the gap from getting the right commands for an instrument to exporting to the development environment of choice. Command Expert walks through the process of finding the right SCPI (standard commands for programmable instruments), helps to fill out the parameters of that command, then arranges the commands into a sequence that can be either used to get the measurement itself or exported to cross discipline programming languages such as MATLAB, C#, Python, LabVIEW and others. DE

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INFO ➜ **Keysight Technologies:** Keysight.com

➜ **MathWorks:** MathWorks.com

➜ **National Instruments:** NI.com

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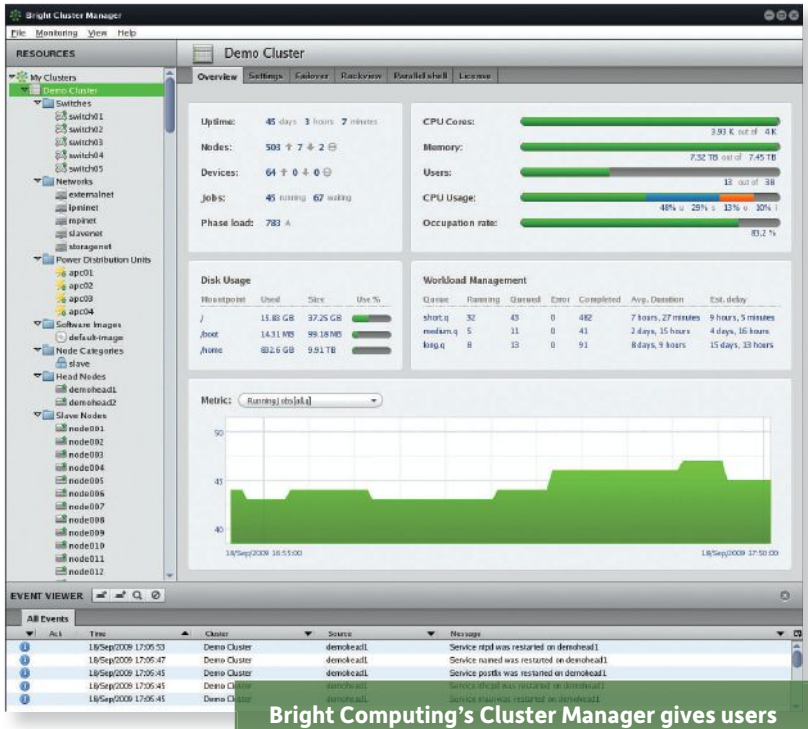
Preparing for the Floodgates to Open

On-demand hardware and pay-per-use licensing are essential in opening new markets for HPC.

BY KENNETH WONG

If Adam O'Hern has something he needs to render urgently, "I can buy a $5,000 machine to do it myself, or I can do it for $3 on Frame," he says.

O'Hern, founder and head of Design at Mechanical Color LLC, specializes in virtual photography. To create iconic images for glossy fashion and lifestyle magazines, a photographer like Annie Leibovitz would set up the scene in a studio with live models. By contrast, a virtual photographer like Adam would set up a CAD model inside 3D software to produce computer-rendered images that are virtually indistinguishable from real photos. In both cases, skill is not the only barrier to entry. Just like Leibovitz has to invest in expensive camera equipment, a virtual photographer, too, needs to acquire and maintain powerful hardware to render. Except, in O'Hern's case, he now has the option to rent the hardware he needs from Frame, a VDI (virtual desktop infrastructure) vendor.



Bright Computing's Cluster Manager gives users the ability to monitor HPC clusters in real time. ***Image courtesy of Bright Computing.***

When asked about his company's size, O'Hern chuckles. "Me — that's my company's size," he says. "When I need scale, I hire contractors." Even though O'Hern is in the Washington D.C. Metro area and his contractors are located elsewhere, they can still share the same machine, after a fashion. The so-called machine is a virtual workstation housed in Frame's cloud server, accessible 24/7. So long as both he and his contractors aren't working on the same project at the same time, Mechanical Color doesn't even need an additional software license. He just needs to share his log-in credentials to the virtual machine with his contractor.

"Five years ago, there was no way I could have operated like I do today," O'Hern reasons. "It's because of tools like Frame that I'm able to be a small shop with low overhead. Otherwise, I would need IT people, regular employees and in-house hardware."

O'Hern and Mechanical Color represent the new blood in engineering. Driven by on-demand computing power and ad-hoc design teams, these small shops compete with the big guys on more equal footing. They were previously an underserved segment, but recent trends indicate hardware and software vendors are finally making the much-needed reforms to cater to them.

Small Shops with Big Jobs

O'Hern counts recognizable household brands among his clients. He and his colleagues may be responsible for the eye-catching advertising and marketing imagery that convinced you to splurge for the latest game console.

"Before I began using Frame, I used AWS (Amazon Web Services), but that meant I had to deal with the IT stuff that goes with it — setting up nodes, setting up remote desktops, specifying IP addresses and so on," recalls O'Hern.

What O'Hern went through was the classic HPC (high-performance computing) adoption pain. Even getting his HPC from the cloud didn't completely eliminate it, because a general purpose on-demand cloud vendor like AWS didn't have a customized product for O'Hern. Frame, on the other hand, offers virtual machines for personal use and teams, and VDI hosting services for larger enterprises.

"With Frame, you can rent the equivalent of a $13,000 workstation for an hour for less than the cost of a Starbucks Latte," says Justin Boitano, VP of Marketing at Frame. That allows O'Hern to pay for more power when he needs it to speed up his jobs — an option he doesn't have with a real machine.

"I'm working on an animation project that I would have previously had to render overnight on my own workstation," O'Hern explains. "But now I just set it up on Frame and keep it running superfast in the cloud. At the same time, I can continue to work on my own desktop, because it's not tied up with the rendering job. Jobs that used to take weeks to finish in series can now be done in parallel in just hours."

O'Hern thinks it's only a matter of time before cloud-hosted HPC becomes the norm. At the present, however, he is acutely aware he must accommodate some clients whose policies prevent him from harvesting the Cloud. "Every client is unique. Some have their own security protocols. That's understandable," he says.

IT-Free Products from an IT-Free Vendor

Onshape, founded by a team of veterans from the CAD software business, came online in early 2015. Previously most CAD vendors argued it was impractical for them to deliver — and for the users to use — a full-fledged 3D mechanical modeling program in a browser (like a social media app or a multiplayer online game). But Onshape defied this notion with its flagship product, a parametric CAD program that runs in the browser, sold as a subscription.

Onshape runs the company in a minimum-IT environment. "We use Gmail, Google Drive, Slack, Jira, GitHub — we use Cloud tools for everything. The tools that we use to manage our cloud tools are also in the cloud," said Dave Corcoran, Onshape's VP of R&D.

"Our entire business runs on AWS," says John Rousseau, Onshape's operations team lead. "For all our collaboration, documentation, development tracking, and product testing, we use cloud-based products."

At the time Onshape was founded in 2012, on-demand computing services were available, but the idea to run an entire company in the cloud did carry certain risks. "Infrastructure as a service (IaaS) has come a long way in the last five years," said Corcoran. "What Amazon provided back then and what it provides now are very different. And the cost keeps coming down."

As a vendor delivering its product from a browser, Onshape has to deal with something desktop CAD vendors don't have to — keeping the product's performance consistent during peak times and lull periods. "There are peak moments during the day; there's a drop at night. We have to scale up and down in response to balance performance and cost for our customers globally," Rousseau explains.

Those peaks and drops also vary across different time zones around the world. "[The demand for service at] 2 p.m. EST is completely different from 2 p.m. PST," Rousseau adds. An in-house cluster with finite computing power would have a difficult time coping with the

varying online traffic. But with an elastic IT setup on AWS, Onshape adjusts its own backend system in the Cloud to respond to the changing workloads.

Bursting at the Seams

Previously HPC was the exclusive domain of large enterprises and university researchers. To harvest the supercomputing capacity of clusters, a business must have a generous budget to acquire the necessary hardware and a robust IT department to manage it.

Bill Wagner, CEO of Bright Computing, identified the three classic hurdles to HPC:

1. Building the cluster.
2. Managing changes in the cluster.
3. Monitoring the cluster health.

All involve a fair amount of time and human resources. Take the cluster health monitor, for instance. "That is a 24/7 job," Wagner says. "You have to keep tabs on how the cluster is performing. Are there nodes that are not performing? Have they gone dead? Do they need to be rebooted?"

On-demand HPC vendors and open source HPC management software reduces the cost barrier, but not necessarily the complexity, Wagner cautioned. Though a commercial HPC software vendor, he doesn't see open source HPC software as a competition. Quite the opposite — he says: "We often find that the clients who have attempted to build and manage a HPC setup using some open source products are our best prospects. Typically, open source HPC is a collection of discrete tools, each solving a piece or providing a specific function. So users are left to cobble these together and manage the interaction among them. They quickly find out how complex it is."

Wagner has been noticing some new trends. One of them, he said, is those who want to augment their existing HPC setup with on-demand products. "We're seeing a pretty sharp increase in piloting and implementing hybrid environments — on-site HPC with the option for cloud bursting on Amazon or Azure," he explains. "With these companies, their hardware is finite, but their workload periodically rises significantly. But they do not want to build an HPC setup to meet the maximum workload. That usually leads them to their first foray into the public cloud."

Bright Computing is also anticipating the rise of a new type of customers — those whose business model is to provide on-demand HPC services to smaller shops and individual users. "We'd like to make it practical for anybody to build a cluster," says Wagner. "One of the capabilities in our product is to create a cluster as a service."

The Shift from High Margin to High Volume

Juan Betts, managing director of Front End Analytics, is witnessing — and helping create — the emergence of app-based simulation. Until now, the use of CAE was confined to experts in large aerospace and automotive firms because general-purpose simulation software requires a high degree of skill to use. Betts and his colleagues specialize in developing simulation templates and apps that can easily be used by those with limited knowledge of general CAE products. Deploying simulation apps for a wider user pool usually involves setting up the backend HPC infrastructure to support it.

"Larger companies have their own IT systems. They just want us to build the apps they need. They tend to deploy the apps behind their own firewalls. But SMBs don't have the hardware or the IT expertise. That's where we see the push toward the cloud," says Betts.

One of the hurdles, Betts revealed, is the prevalent CAE licensing method. "About 80% of the CAE space is dominated by automotive and aerospace companies. In some cases, you have a single engineer using more than $100K worth of software. So you're dealing with business models that cater to a relatively small number. With the SMBs, the number of potential users is much greater, but the per-person cost they're willing to spend is relatively low. The CAE software vendors have not figured out how to deal with that yet," he notes.

SMB use of CAE is also different from their larger counterparts in frequency. Whereas large aerospace and automotive manufacturers have sufficient CAE work to justify a permanent, on-site installation, SMBs use CAE only periodically. Betts said, "Some SMBs say, 'I can't build and maintain an HPC infrastructure for something I just use about two weeks per year.' What they need is an on-demand model. They need the capability to cloud burst."

Betts hopes CAE vendors recognize that, even though the per-user cost SMBs are willing to spend is significantly lower, the total spent by this segment could add up to large revenues due to the larger user pool. He has reasons to be hopeful; he's beginning to see CAE vendors introducing new pay-per-use licensing options.

Opening HPC to Design Engineers

Chapter 9 of *The Design Engineer's High Performance Computing Handbook* takes a detailed look at efforts by Intel, Dell, Altair and many other hardware manufacturers and engineering software vendors to support the Linux Foundation's OpenHPC project.

Participants in the project have pledged to create a stable environment for testing and validation, reduce costs, provide a robust and diverse open source software stack, and develop a flexible framework for configuration. The overarching goal is to make HPC more accessible to more end users.

Download your free copy of the HPC Handbook at hpc.deskeng.com/download.

A Reformation in CAE Licensing

Wim Slagter, ANSYS's director of HPC and Cloud Marketing, and his colleagues have been pondering the pay-per-use model for some time. As this article goes to press, they're getting ready to announce a new option, dubbed ANSYS Elastic Licensing.

"It's like buying a phone card preloaded with a number of hours of Elastic Units. You can use it to pay for any ANSYS products," he says. The new option is an addition to the existing annual licensing, short-term licensing and perpetual licensing models.

ANSYS Elastic Licensing does require an initial investment — that is, the purchase of a minimum quantity of Elastic Units. When the user has depleted the units in the account, they can purchase additional units on demand. Slagter said ANSYS Elastic Licenses will initially be offered in conjunction with on-demand HPC services from cloud-hosting partner providers; therefore, businesses that do not want to invest in their own hardware, or simply want to augment their existing hardware with on-demand computing, may turn to ANSYS HPC partners.

Virtual desktop infrastructure provider Frame enables teams to rent high-performance hardware for intense computing applications. ***Image courtesy of Frame.***

At the Threshold

Front End Analytics' Betts think wider adoption of HPC-driven CAE — the kind that involves automatic exploration of hundreds or thousands of design options — depends on three key elements: on-demand hardware, pay-per-use CAE licensing, and simulation apps. The first already exists in the market. Betts says the CAE industry is slowly moving toward the pay-per-use model. And he and his colleagues are in the thick of the last item: developing simulation apps.

"On-demand storage capacity has found acceptance. I think on-demand computing will become the same," Mechanical Color's O'Hern says. "Right now, for most companies, cloud-hosted data storage is just a normal part of business. I think the same thing will happen to serious computing power."

Bright Computing's Wagner says: "HPC is not only reaching the lower end of the market, it's also finding its way into industries that don't traditional deploy HPC. These new users are discovering that the applications they run are dealing with much more data, and the computation required is much more intense." DE

Kenneth Wong *is* Desktop Engineering's *resident blogger and senior editor. Email him at kennethwong@deskeng.com or share your thoughts on this article at deskeng.com/facebook.*

INFO ➜ **ANSYS:** ANSYS.com

➜ **Bright Computing:** BrightComputing.com

➜ **Frame:** Fra.me

➜ **Front End Analytics:** FEASol.com

➜ **Onshape:** Onshape.com

➜ **Mechanical Color:** MechanicalColor.com

For more information on this topic, visit deskeng.com.

Webcast Continues the HPC Discussion

Tune into the "Supercomputing for the Rest of Us" webcast, moderated by *DE's* Kenneth Wong, as he interviews expert panelists about the democratization of high-performance computing (HPC) on April 12 at 2 p.m. EST.

Panelists for this interactive, roundtable discussion on how more engineers can access HPC resources for simulation, rendering and design work include:

- Alan Chalker, Ph.D., director of technology solutions, Ohio Supercomputer Center (OSC); and director of AweSim, which helps small- to mid-sized manufacturers use simulation-driven design.
- Lee Margetts, Ph.D., chair of NAFEMS' HPC Working Group and director of the open source parallel finite element analysis project ParaFEM.

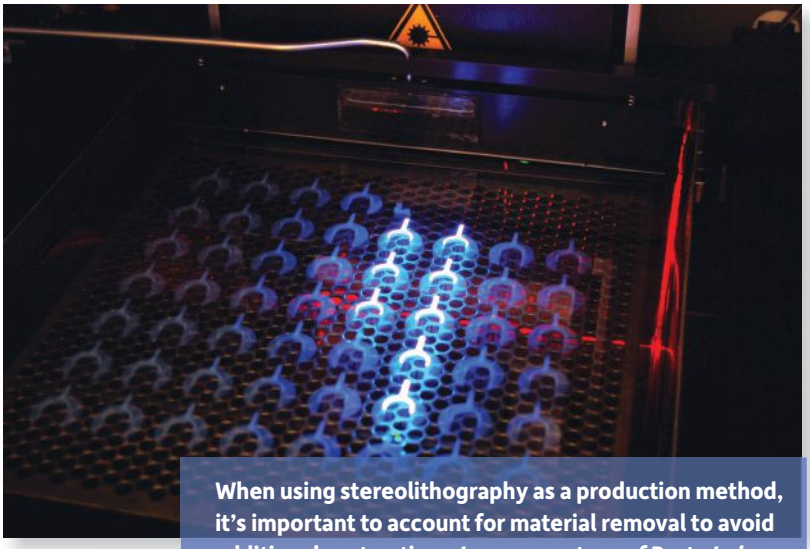
To join us on April 12, register at deskeng.com/de/supercomputing. Not available April 12? Your registration also grants you on-demand access to the webcast.

The Price of 3D Printing

Costing tools and service bureaus can help engineers find the optimal materials and production methods.

BY JESS LULKA

After several decades, 3D printing is now a familiar tool within the engineering community for prototypes and even end-use parts. It has gone from novelty to necessity, so now engineers must figure out how to work within tighter budgets and project deadlines. In response, companies and organizations providing 3D printing services are developing online quoting tools and support to help meet 3D printing costing challenges.



When using stereolithography as a production method, it's important to account for material removal to avoid additional cost or time. ***Image courtesy of Proto Labs.***

Getting Started

Most price quoting tools — which are available from manufacturing companies and third parties — have a similar workflow. Users can upload their CAD file, select the manufacturing method and material, and get an estimate. But more companies are offering additional tools and services to ensure design engineers are getting prototypes that best fit their needs.

With customer-facing pricing tools, "one of the biggest benefits is being able to discover and browse your options," says Tomek Sysak, communications manager at 3Dprintler. Sysak explains that the pricing tools are a good way for beginners to explore some of the base offerings from multiple 3D printing service bureaus and manufacturers. For more experienced users, say those who already own desktop systems, "they [sometimes] don't realize the material options are much wider than the ones that are available at home," he says.

Beyond the individual, companies can implement price-quoting software to streamline customer orders and offer the complete design-to-print workflow. One platform in use by industrial 3D printer manufacturers and service bureaus is RP Platform (formerly 3D Printeo). The company describes its software as a platform that simplifies and automates additive manufacturing processes from CAD file preparation to production, including quotations and customer orders. "There are no two businesses with same approach to cost estimation and pricing, so our platform is highly flexible," says Keyvan Karimi, RP Platform founder and CEO. "We have more than 20 attributes customers can use to create their own pricing logic and pricing formulas without needing any coding skills."

Keeping Costs Down

Depending on an engineer's needs, sometimes it's not possible to reduce the cost of a part. However, there are a couple of considerations that could help make 3D printing cheaper. "Some of the general factors that affect the cost of 3D printing are the technology you're choosing to print on, the material [you're] trying to print on, [as well as] print size and the volume of the part," says Tim Thellin, director of Software and Productivity Tools at Stratasys Direct Manufacturing.

Manually preparing models to make them ready for 3D printing is another huge time sink that can add costs if you rely on a service provider to do it. That's why RP Platform includes a "shrink wrap" feature as part of its offering of additive manufacturing process automation tools, says Karimi. "It can take a CAD model and shrink wrap it to allow us to process complex models at incredible speed," he says.

Adding support structures can also drive up cost, Thellin notes, because they take more time and labor to create within a print. "If users can design their geometries in such a way to reduce the amount of support structures, that can also have an impact on price," he says. Additionally, a lot of technologies do rely on cubic volume to produce prints, so minimizing material use in designs can result in cheaper prints.

Build time should also be a consideration, because it is a

large factor in print cost, says Eric Utley, applications specialist at Proto Labs. "[Build time] is driven by the part volume, build height and resolution," he explains. "It is most cost effective to build all the parts on an order in the same material and resolution so that they can all be built at the same time. Typically adding a part to a[n initial] build is very cheap compared to ordering it later on a second build."

Sometimes to address this issue, Thellin says they'll print a larger part as several smaller pieces for cost effectiveness and efficiency.

Sysak adds that costs can be accrued in the processing and finishing of a prototype, as most general materials do have a fixed printing price. "Afterward, if you want a certain texture or smoothing, usually someone has to go and do that for you. A lot of the time if you choose a simple material and the natural finish for that material, then you'll get the best price," he explains.

Stratasys Direct Manufacturing offers many 3D printing production technologies. Pictured here are some of the company's Fused Deposition Modeling systems. ***Image courtesy of Stratasys.***

Designing for 3D Printing

3D printing also has different design considerations than some traditional manufacturing methods. By accounting for these before any production, engineers can ensure a smoother manufacturing workflow with fewer iterations and reworking.

"The most common mistake I see is not allowing for clearing of excess resin or powder for stereolithography (SLA) or powder-sintered parts," says Utley. "Designers can add voids to reduce material, but there needs to be access holes to clear the excess material. SLA resin is similar in viscosity to olive oil and the sintered powders are similar in consistency to flour. When adding voids, designers should ask themselves if they could reasonably remove the excess material from their parts. We recommend adding access holes to the opposite ends of the voids to allow the excess material to be drained."

Another consideration should be wall thickness. Utley says he often sees designs with walls too thin to form. He recommends doing a sweeping cross section view through a part and look for unintentional thin sections.

To help with some of these design challenges, some companies will also provide quick-use design tools to ensure that models can be 3D printed. Shapeways, a community-oriented 3D printing service provider, has a basic Web-based modeler for design work and Creator apps to expand accessibility.

"We created [the] 3D Tools to allow us to fix things very quickly on Shapeways, so that [designers] don't have to jump off the platform, go back into 3D modeling software, tinker with their model there and re-upload it," says Mansee Muzumdar, PR associate at Shapeways. These options are also good exploratory tools for designers that may not yet know the specifics of their design — such as preferred material or printing process, she adds.

Working With Service Providers

Even though online quoting can be useful to start the production process, there can still be a learning curve for engineers not familiar with 3D printing materials or technologies. This is where service providers or more consumer-oriented companies can help smooth out the process.

"There are a lot of online capabilities for doing instant quotes, [but working with service providers] is a value when you're not quite sure what you want. If we better understand what your application is, what you're going to do with the part and the quantity, we'll be able to help drive the customer to the right technology and material," Thellin says.

Service providers can also reduce product development time, design risk and production snafus. "By utilizing a service provider, product developers can focus on their designs and not worry about the upkeep of 3D printing equipment," Utley says.

Working with service providers can also lessen the learning curve associated with 3D printing. "A lot of people choose 3D printing because they have a design that you really can't do any other way," says Muzumdar. "However, 3D modeling and design [can have] a pretty steep learning curve. By connecting people to designers who use Shapeways, we're able to help them get their ideas off the ground."

Today's pricing tools and service companies are helping engineers gain more access to a decades-old technology. In doing so, firms can leverage 3D printing to create better models and parts to ensure their designs will withstand real-world conditions. DE

Jess Lulka *is associate editor of* DE. *Send e-mail about this article to DE-Editors@deskeng.com.*

INFO ➜ **3Dprintler:** 3Dprintler.com

➜ **Proto Labs:** ProtoLabs.com

➜ **RP Platform:** RPPlatform.com

➜ **Shapeways:** Shapeways.com

➜ **Stratasys Direct Manufacturing:** StratasysDirect.com

For more information on this topic, visit deskeng.com.

A New **Powerhouse**

The Dell Precision 7710 delivers great performance in a sleek package.

BY DAVID COHN

Dell has always delivered excellent mobile workstations. For example, for the past two years, we have raved about the Dell Precision M3800 (deskeng.com/de/?p=26848). But that thin, lightweight system could be a bit underpowered when faced with more demanding engineering applications.

Enter its new big brother: the Dell Precision 7710. Billed as Dell's most powerful mobile workstation ever, the 7710 is the logical replacement for the M6800. But where that older system had a squared-off design, the new Precision 7710 is rounded and sleek, belying the power within.

The redesigned chassis measures 16.42x11.08x1.36 in. and weighs 7.9 lbs. as tested. A large but thin 240-watt external power supply (7.8x3.8x1.0 in.) adds another 2.1 lbs., bringing the total weight to 10 lbs. While that's still quite a load, it is nearly 4 lbs. lighter than the Eurocom Sky X9W we recently tested (deskeng.com/de/?p=28987).

Raising the lid reveals a 17.3-in. wide view anti-glare backlit LED and a 103-key keyboard with separate numeric keypad. The base configuration comes with a 1920x1080 IPS (in-plane switching) display, but our evaluation unit had a gorgeous UHD IGZO (indium gallium zinc oxide) panel with a native 3840x2160 UHD resolution and a maximum brightness of 400 nits, adding $170. A 1280x720 webcam and microphone array, centered above the display, come standard. A non-backlit keyboard is also standard; the backlit version in our evaluation unit is a $35 option.

A round power button is located in the upper-right corner above the keyboard and a touchpad with three dedicated buttons is centered below the spacebar. There is also a blue pointing stick nestled between the G, H and B keys with its own three buttons directly below the spacebar. A fingerprint reader sits to the lower right and a contactless smartcard reader to the lower left of the keyboard. Battery status, hard drive activity and power status lights as well as the two stereo speakers are aligned along the front edge of the case.

A New Generation

Where the M6800 came with 4th generation Intel processors, the new Precision 7710 offers a choice of 6th generation CPUs. The base model has a 2.3GHz Intel Core i5 processor. Our evaluation unit had a 2.9GHz quad-core Intel Xeon E3-1535M v5 CPU. This Skylake chip features 14nm lithography, 8MB Smart Cache, a 45 watt thermal design power (TDP) rating, a maximum turbo speed of 3.8GHz and adds $529 to the price.

The 17.3-inch Dell Precision 7710 delivers great performance in a sleek new design. ***Image courtesy of Dell.***

Although the CPU includes integrated Intel HD Graphics P530, Dell also offers five different video cards. An AMD FirePro W5170M is included in the base configuration, but our Precision 7710 came with a top-of-the-line NVIDIA Quadro M5000M with 8GB of dedicated GDDR5 memory. This 100-watt GPU (graphics processing unit) provides 1536 CUDA (compute unified device architecture) cores, a 256-bit interface, a bandwidth of 160GB per second, and adds $1,190 to the total cost.

There are also lots of memory options. The base configuration comes with 8GB of non-ECC memory, installed as a single DDR4-2133MHz DIMM (dual in-line memory module). Our evaluation unit came with 32GB of non-ECC memory, installed as four 8GB modules (adding $279). You can opt for up to 32GB of ECC memory or 64GB of non-ECC memory.

Storage options also abound. In addition to the 500GB 2.5-in. 7200rpm SATA drive offered in the base model, the Precision 7710 can accommodate an additional PCIe solid-state drive (SSD) or up to three PCIe SSDs in lieu of a 2.5-inch HD. Standard hard drives of up to 2TB are available as well as SSDs ranging from 256GB to 1TB. Our configuration included just the standard Samsung 500GB hard drive. With multiple drives, the system supports RAID 0, 1 and 5. As is becoming increasingly common, there is no optical drive; you will have to provide your own. Dell sells a slim USB DVD+/-RW drive for $50, but similar drives are available for as little as $25.

The Precision 7710 has a decent selection of ports arrayed around its exterior. The right side provides a Smart Card slot, a headphone/microphone combo jack, three USB 3.0 ports with

Mobile Workstations Compared

	Dell Precision 7710 17.3-inch, 2.9GHz Intel Xeon E3-1535M quad-core CPU, NVIDIA Quadro M5000M, 32GB RAM	Eurocom Sky X9 17.3-inch, 4.3GHz Intel Core i7-6700K quad-core CPU, NVIDIA Quadro M5000M, 64GB RAM	Dell Precision M3800 G2 15.6-inch, 2.3GHz Intel Core i7-4712HQ quad-core CPU, NVIDIA Quadro K1100M, 16GB RAM	HP ZBook 14 G2 14-inch, 2.6GHz Intel Core i7-5600U dual-core CPU, AMD FirePro M4150 & Intel HD Graphics 5500, 16GB RAM	BOXX GoBOXX G1980 15.6 inch, 2.8GHz Intel Core i7-4980HQ quad-core CPU, NVIDIA Quadro K1100M, 16GB RAM	Eurocom P5 Pro 15.6-inch 4GHz Intel Core i7-4790K quad-core CPU, NVIDIA Quadro K510, 32GB RAM
Price as tested	$3,890	$6,781	$2,109	$2,115	$3,365	$4,489
Date tested	1/23/16	1/23/16	5/25/15	2/20/15	2/4/15	2/4/15
Operating System	Windows 10	Windows 10	Windows 8.1	Windows 8.1	Windows 8.1	Windows 8.1
SPECviewperf 12 (higher is better)						
catia-04	75.57	102.23	15.16	15.09	21.26	64.64
creo-01	55.78	84.55	15.36	16.57	20.28	48.70
energy-01	9.00	10.52	0.34	0.06	0.32	2.61
maya-04	43.43	75.56	13.85	9.09	18.20	48.84
medical-01	31.21	40.75	4.30	2.70	5.71	23.93
showcase-01	48.07	45.87	8.55	7.58	10.35	27.86
snx-02	63.33	87.30	15.30	20.06	22.10	58.41
sw-03	82.02	121.63	25.41	29.21	34.53	97.38
SPECapc SOLIDWORKS 2015 (higher is better)						
Graphics Composite	3.88	6.07	1.85	1.75	n/a	n/a
Shaded Graphics Sub-Composite	2.40	4.36	1.70	1.30	n/a	n/a
Shaded w/Edges Graphics Sub-Composite	3.21	5.58	2.27	1.32	n/a	n/a
Shaded using RealView Sub-Composite	2.85	5.07	1.57	1.16	n/a	n/a
Shaded w/Edges using RealView Sub-Composite	4.93	8.36	2.76	1.88	n/a	n/a
Shaded using RealView and Shadows Sub-Composite	2.94	5.17	1.38	1.39	n/a	n/a
Shaded with Edges using RealView and Shadows Graphics Sub-Composite	4.85	8.11	2.29	1.61	n/a	n/a
Shaded using RealView and Shadows and Ambient Occlusion Graphics Sub-Composite	5.70	6.81	1.12	2.90	n/a	n/a
Shaded with Edges using RealView and Shadows and Ambient Occlusion Graphics Sub-Composite	8.74	10.28	1.74	3.40	n/a	n/a
Wireframe Graphics Sub-Composite	2.99	3.76	2.36	2.27	n/a	n/a
CPU Composite	2.56	3.03	2.41	3.14	n/a	n/a
SPECwpc v2.0 (higher is better)						
Media and Entertainment	2.57	3.38	1.22	0.87	n/a	n/a
Product Development	2.73	3.16	1.08	1.05	n/a	n/a
Life Sciences	3.18	3.91	1.12	0.90	n/a	n/a
Financial Services	1.19	1.40	0.96	0.53	n/a	n/a
Energy	2.66	3.13	1.09	0.66	n/a	n/a
General Operations	1.48	1.70	0.82	0.76	n/a	n/a
Time in Seconds						
Autodesk RenderTest (lower is better)	85.60	64.90	79.38	124.28	55.39	56.88
Battery Test (higher is better)	5:30	2:17	5:34	7:28	2:15	2:10

Numbers in blue indicate best recorded results. Numbers in red indicate worst recorded results.

TOP: The Dell Precision 7710 plus its 240-watt power supply weighs a total of 10 lbs. **RIGHT:** Internal access is easy — just slide a latch to remove the battery cover. *Image courtesy of David Cohn.*

PowerShare and a Kensington lock slot. The left side houses an HDMI port, a mini DisplayPort and another USB 3.0 PowerShare port. The rear panel sports only an RJ45 network port, the connection for the external power supply, and two large air vents.

Dual-band Wi-Fi and Bluetooth come standard, but can be eliminated. Mobile broadband is available as an option. Although the base configuration comes with a six-cell 72Whr lithium ion battery with ExpressCharge, Dell included the longer-life 91Whr battery in our package, a $29 add-on. The company also sells a 91Whr long life cycle lithium polymer battery for $79. Changing batteries and 2.5-in. hard drives is simply a matter of sliding a latch to remove the battery cover. Accessing other components requires removing two screws to release the base cover. Thanks to the larger battery, our Precision 7710 ran for 5.5 hours — very impressive for a mobile workstation.

Great Performance at an Attractive Price

In terms of performance, the Dell Precision 7710 proved to be everything you would expect from a 17.3-in. mobile workstation. On the SPECviewperf benchmark, which focuses on graphics, the 7710 scored near the top and beat all other systems equipped with processors designed for mobile systems rather than desktops.

We recently switched to the new SPEC SOLIDWORKS 2015 benchmark, and while this marks just the second time we are publishing results from this new test, we did go back and retest several other systems we recently reviewed. The Dell Precision 7710 performed quite well on this new test.

On the SPECwpc benchmark, the Dell Precision 7710 turned in great results on this very demanding test. Only the Autodesk rendering results, which averaged 85.6 seconds, lagged the field. On this multi-threaded test, systems with faster CPUs and more CPU cores have a definite edge.

Throughout our tests, the Dell Precision 7710 ran cool and quiet, barely ever becoming audible over the ambient noise in our test lab. Users can choose to have Windows 7, 8.1 or 10 preloaded. Our system came with Windows 10 Professional 64-bit. Dell backs the system with a three-year hardware service warranty with onsite/in-home service after remote diagnosis. That coverage can be extended to up to five years and augmented with extended battery service for years two and three of the system life, and accidental damage protection. Dell also sells several docking stations/port replicators, with a Thunderbolt Dock not yet released as of this writing.

As configured, our Dell Precision 7710 currently sells for $3,980 — a competitive price compared to similarly equipped systems. All things considered, the Dell Precision 7710 is a winner and a great choice of any engineer on the go, offering an appealing combination of style, performance and extended battery life at a price that won't break the bank. DE

David Cohn *is the technical publishing manager at 4D Technologies. He also does consulting and technical writing from his home in Bellingham, WA, and has been benchmarking PCs since 1984. He's a contributing editor to DE and the author of more than a dozen books. You can contact him via -email at david@dscohn.com or visit his Website at dscohn.com.*

INFO ➜ Dell: Dell.com

Dell Precision 7710

- **Price:** $3,890 as tested ($1,699 base price)
- **Size:** 16.42x11.08x1.36 in. (WxDxH) notebook
- **Weight:** 7.9 pounds plus 2.1-pound power supply
- **CPU:** 2.9GHz Intel Xeon E3-1535M v5 w/8MB Smart Cache
- **Memory:** 32GB (64GB max)
- **Graphics:** NVIDIA Quadro M5000M w/8GB GDDR5 memory
- **LCD:** 17.3-in. UHD 3840x2160 wide view anti-glare backlit IGZO
- **Hard Disk:** 512GB 7200rpm 2.5-in. HD
- **Floppy:** None
- **Optical:** None
- **Audio:** Built-in speakers, headphone/microphone jack, built-in microphone array
- **Network:** Intel Dual-Band Wireless-AC 8260 WiFi 4.1 plus Bluetooth, one RJ45 jack
- **Modem:** None
- **Other:** Four USB 3.0 with PowerShare, mini DisplayPort, HDMI, headphone/microphone combo jack, SmartCard reader, integrated 1MP webcam
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DE
Technology for Optimal Design Engineering

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GPU Virtualization *Accelerates* Engineering Efficiency

Advances in GPU acceleration are providing engineers the flexibility for remote CAD collaboration as well as efficiencies throughout the design workflow.

BY BETH STACKPOLE

Nissan engineers across Europe, Japan and North America will be collaborating on new car models and sharing CAD files much more easily and cost effectively thanks to a next-generation vehicle design platform architected around virtualization.

Nissan's new platform is built around a virtual desktop infrastructure (VDI) that leverages virtualization and advanced graphics processing in the data center to allow far-flung engineering teams to access the latest CAD tools and 3D models from a centralized server with the same visual experience and performance previously reserved for high-end workstations. Applying virtualization technologies to the design process will streamline a number of workflows for Nissan, from ensuring that global engineering teams are working off the same CAD models to giving individuals the flexibility to get their work done virtually, on any device, including tablets and mobile phones. At the same time, Nissan officials say the VDI-based next-generation vehicle design platform will reduce hefty IT costs, making it easier to stay up-to-date with CAD updates, and consolidating and improving the management of a complex IT infrastructure.

"By keeping the compute and graphics within the data center, the customer gains improved security, easier administration of small sites and faster access to the data residing on the server or local storage system," explains Matthew Simpson, vice president, Product Driven Services, at Siemens PLM Software, whose NX CAD software has been certified to run on the new Nissan vehicle design platform.

Nissan is among a growing number of automotive OEMs (original equipment manufacturers) and other manufacturers finally ready to take the plunge with VDI to make engineering workflows more efficient and to capitalize on some of the infrastructure benefits around virtualization. While mainstream business functions like storage and enterprise applications like ERP (enterprise resource planning) have been migrating to a virtualized model for

With NVIDIA GRID, Bell Helicopter is allowing users to access engineering applications and design data with full performance and display fidelity from any location on any device running the Citrix client. ***Image courtesy of Bell Helicopter/Textron.***

The NVIDIA GRID VDI solution is fully tested and supported by a number of leading ISVs (independent software vendors) ensuring that users get the same graphics performance in a virtualized environment. ***Image courtesy of NVIDIA.***

The AMD FirePro S-series takes a hardware approach to GPU virtualization, making it more difficult for hackers to break in, AMD officials say. ***Image courtesy of AMD.***

some time, graphics-intensive workloads like simulation and CAD have stayed put on high-end workstations mainly due to issues related to performance.

Traditional VDI has been missing two pieces for handling 3D CAD and simulation files efficiently: Storage infrastructure for moving around extremely large, graphics-intensive data effectively and graphics acceleration for workstation-class performance. In the past, customers running CAD applications like NX in a virtual environment ran into visual quality issues, performance bottlenecks and frequent system crashes, says Bob Brandenstein, Siemens' director of Technology Management. An engineer might be able to bring up a complex part in this environment, but it would take minutes to rotate it, detracting from interactivity, he says.

"In the past, virtual machines didn't have remote graphics so when you ran our software remotely on a virtual machine, there was very poor performance that wasn't acceptable for an engineering workflow," says Brandenstein, adding that Siemens is now certifying NX to run in engineering VDI environments like NVIDIA GRID. "All of that has changed with companies like Citrix, NVIDA and others announcing accelerated graphics for remote displays."

Out with the Old, in with the New Workflows

The changes couldn't come at a better time. Just as mainstream business users have been clamoring for mobility solutions that allow them to work and collaborate from wherever they are on a range of devices, engineers have also been looking for the freedom of being untethered from the desktop.

"The old way of working isn't working any more," notes Will Wade, NVIDIA's director of Product Management for GRID virtual GPU (graphics processing unit) technology. "Engineers don't sit around in their cubicles trying to be creative. They want to be in the world that they're designing, and the office isn't always the office anymore. Engineers aren't always next to a high-powered workstation."

There are other limitations to the traditional local workstation model when it comes to engineering collaboration. Linear design flows, where one engineer passes off a design to the next, can create a lot of rework and project reconciliation since teams are often working on different versions of designs. Moreover, because it takes so long to send large 3D models back and forth between global design teams, engineers spend too much time waiting or alternatively, only download smaller pieces of the model as a time-savings workaround, Wade explains.

Engineering VDI solutions help organizations address many of those shortcomings while eliminating the limitations of traditional VDI. NVIDIA GRID, for example, is helping organizations achieve 75% improved project time resulting from real-time collaboration while delivering 50% faster access to files and applications and 65% improved productivity due to the ability to allow engineers to work remotely with secured access, he claims.

An engineering VDI also allows companies to easily bring consultants or suppliers into the design workflow without having to fly people around to participate in design reviews. Instead of having to allocate a high-powered

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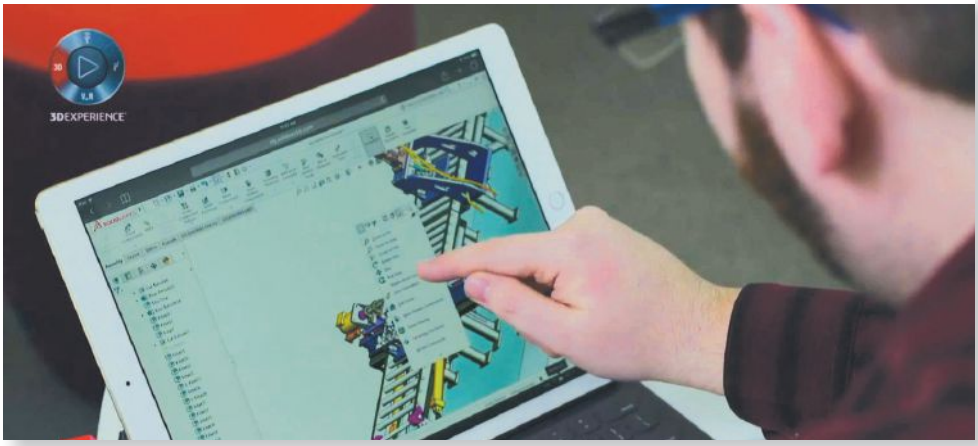

SOLIDWORKS is testing the waters with virtualization by leveraging Frame's technology to deliver a trial version of SOLIDWORKS from the cloud that will run on any device. ***Image courtesy of Frame.***

and expensive workstation for each engineer on the project, engineering VDI lets organizations maximize their compute power by allocating virtualized resources to individuals when they need it. "In the old way of doing things, you go with a workstation and had to live with it good or bad," says Brandenstein. "In the new environment, you allocate hardware and VMs based on the need of the user and what they're doing at a particular time."

At Bell Helicopter, a division of Textron, moving to VDI is all about creating a new collaborative workflow that helps synchronize data across disparate engineering environments, says Friederich Devoir, manager of IT Infrastructure. Traditionally, the global teams at Bell Helicopter struggled to share large CAD files in any kind of efficient manner because changes to a design might take hours to replicate to systems across the globe. For years, the company worked around the issue, but when Devoir came onboard, he was familiar with NVIDIA's GRID solution and helped make the case that VDI technology was ready for primetime.

Since implementing NVIDIA's GRID GPU acceleration technology in its data centers, Bell Helicopter's virtual engineering desktops now ensure faster model loading times, more flexibility for accommodating remote work, and a higher level of security for its engineering IP (intellectual property) because sensitive CAD data is no longer spread around company-issued laptops. Cycle time for design changes has also been cut in half, says Devoir.

Product Watch

NVIDIA's GRID approach lets organizations take any graphics-intensive application running on a physical desktop and virtualize it in the data center for efficient remote access. The solution comes in three editions: NVIDIA GRID Virtual PC, aimed at knowledge workers running applications like Microsoft Office or PLM (product lifecycle management) that could benefit from a GPU; NVIDIA GRID Virtual Workstation, suited for mainstream designers using tools like SOLIDWORKS, CATIA or NX; and an extended workstation version ideal for high-end designers using the most powerful content creation applications.

Compared to NVIDIA GRID, which it classifies as a software-based virtualized GPU, AMD is taking a hardware-based approach to the problem with its just-announced FirePro S-Series GPUs with Multiuser GPU (MxGPU) technology. The new server GPUs support up to 16 simultaneous users on a single card, which features 8GB of GDDR5 memory and promises to deliver workstation-class experiences in a VDI environment, claims Tonny Wong, AMD's product manager for virtualization products.

"We are taking the same guts of a workstation and putting it back in the data center in a server," he says. "The beauty of our hardware-based solution is that once you set up a virtual machine and load your OS of choice, a native graphics driver, and a [certified] version of SOLIDWORKS or NX, it's like the exact same version you'd run on a regular workstation."

In addition to performance, Wong touts the security advantages of a hardware approach vs. doing the GPU virtualization in software. "The software adds an extra layer that could give hackers an opportunity to gain unauthorized access — with hardware, everything is built into the silicon so … that ups the ante from a security aspect," he notes.

An alternative to NVIDIA and AMD's GPU virtualization tools is Frame, a platform for installing and managing any Windows application in the cloud for remote access. Unlike VDI in the data center, Frame's cloud-based delivery doesn't require IT staff to configure storage, servers, network switches, hypervisors and the like or to manage the data center infrastructure once it's up and running. "We allow users to provision and create a virtual workstation in minutes, bring over their [design software] licenses and get started," says Jeff Brown, Frame's chief operating officer.

Dassault Systems' SOLIDWORKS is also hopping on the Frame bandwagon. The company is testing the waters with virtualization and remote access CAD with SOLIDWORKS Online, a fully-featured trial version of the 2016 release that can be accessed through a Web browser on any device. "We're

taking baby steps with this to make sure the solution is robust enough for commercial use," says Stephen Endersby, SOLIDWORKS' director of Product Portfolio Management.

Embracing Virtual Workstations

Traditional workstation manufacturers and integrators have taken notice of the virtual counterparts to their traditional offerings. Rather than being reticent to disrupt the status quo of a workstation under every desk, they are embracing the new workflow paradigm.

"It's really about providing a choice," says Rishi Manocha, head of Virtual Workstations Marketing for Dell. "If it makes sense to go to cloud, we want to be at forefront."

To that end, Dell has released the Dell Precision Appliance for Wyse. It can be accessed by up to three employees — each using a dedicated GPU — or up to eight users can share GPUs via NVIDIA vGPU technology. Dell also offers thin clients that allow users to access the virtual workstations, as well as software it says makes it easy to setup. Customers can also tap into Dell's Virtual Workstation Centers for Excellence to test virtual configurations using their own software environment.

HP's virtual workstation offering, the DL380z, is designed for compute- and graphics-intensive engineering, CAD, oil and gas exploration, digital media and government industries, according to the company. A single HP DL380z can use dual NVIDIA GRID K2 graphics cards and NVIDIA GRID GPU (graphic processing unit) virtualization to support up to eight users.

"As IT needs change, customers are looking to HP for a virtualized workstation solution to support centralized/secure data access, high-availability applications and demanding graphics workloads," said Jim Zafarana, vice president and general manager, Commercial Solutions Business Unit, HP, in a press statement. "The HP DL380z will provide a true workstation experience that offers end-to-end security and industry-leading ILO (Integrated Lights Out) centralized management in an industry-standard 2U form factor."

BOXX Technologies also offers a virtual workstation solution with its XDI (XTREME Desktop Infrastructure) series that includes a Tera2 PCoIP (PC over Internet Protocol) card from Teradici Corp. to handles pixel stream compression and encryption, remote display support for dual or quad displays, and dual Intel Xeon processors.

While accelerated GPU solutions finally make virtualization a reality for engineering workflows, there is still work to be done to convince companies about the benefits. Upfront cost savings are not in the cards for most virtual workstations implemented to run graphic-intensive processes, but they do provide a long-term return on investment thanks to lower IT management costs. Education will also be key to overcoming engineers' fears of relinquishing control of the workstations at their desk.

"Over the last 10 years, the industry has done a good job convincing people to buy PCs, then shifting from PCs to workstations, and now to a secured data center," says AMD's Wong. "Everything old is now new again." DE

Beth Stackpole *is a contributing editor to* DE. *You can reach her at beth@deskeng.com.* **Jamie Gooch** *contributed to the reporting on this article.*

INFO

- **AMD:** AMD.com
- **Bell Helicopter:** BellHelicopter.com
- **BOXX Technlogies:** BoxxTech.com
- **Dassault Systèmes SOLIDWORKS Corp.:** SOLIDWORKS.com
- **Dell:** Dell.com
- **Frame:** Fra.me
- **Nissan:** Nissan.com
- **NVIDIA:** NVIDIA.com
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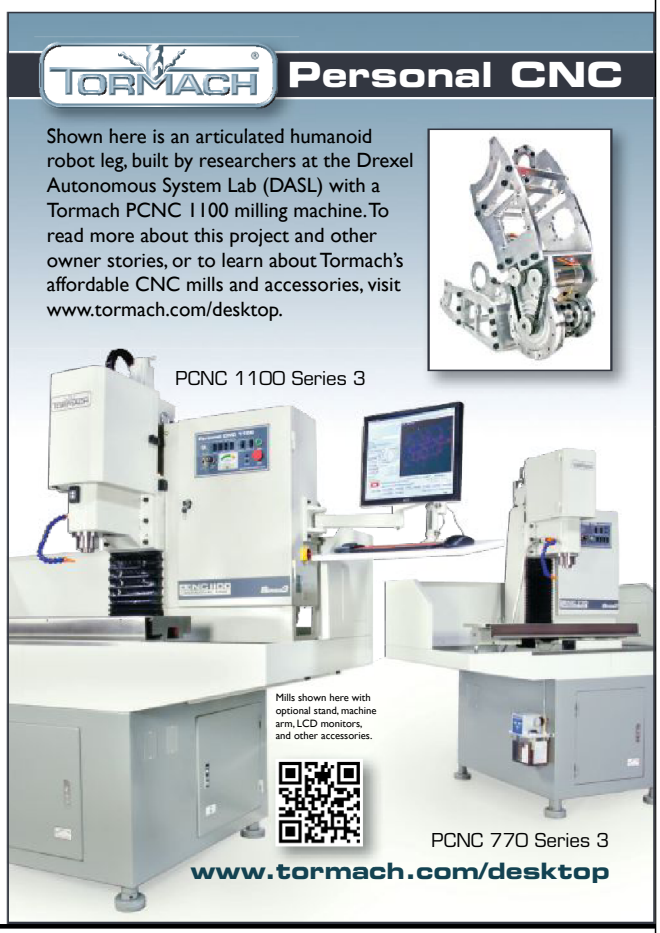


Wrangling ECOs

Electronic document management systems can streamline the engineering change order process.

BY BRIAN ALBRIGHT

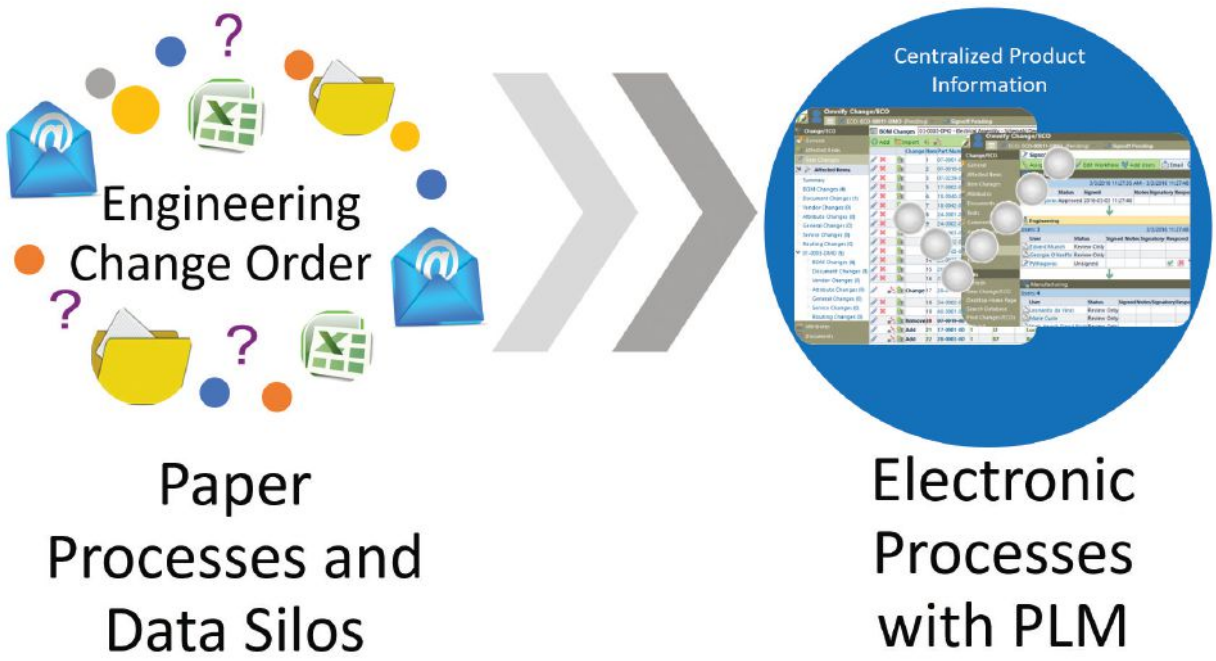
Managing engineering change orders (ECOs) has become more important and complex as more products incorporate complex electronics or Internet of Things (IoT) functionality. Even industrial goods that previously had a relatively simple bill of materials (BOM) or document sets now face much more complicated quality and compliance issues when it comes to engineering changes.

"Change management is a critical and vital part of many businesses, because they have changes coming from a variety of places, including internal staff, manufacturing, sales, or from external customers and suppliers," says Scott Lamond, vice president of Marketing and Business Development at Synergis Software. "How do you streamline a process that is often manual, paper-based, or phone- or e-mail-based, so that it's more efficient and costs less, and takes less time to complete?"

Effectively managing the processing of the ECO, tracking changes and approvals, and updating documents, drawings, and data stores across multiple systems is simply too complex to manage using spreadsheets. In the past, these tasks were spread across multiple systems (i.e., schematics in the CAD solution and parts lists in Microsoft Excel). That led to time-consuming manual processes and errors.

"You might be able to use spreadsheets for simple products and pull that off for a while," says Steve Chalgren, chief strategy officer and executive vice president of Product Management at Arena Solutions. Arena specializes in the high-tech electronics space, where engineers have to manage complex BOMs and multiple change orders. "In the electronics industry, there can easily be hundreds of different ECOs released between two versions of the same product. You have a high rate of change, multiple products and multiple people involved in the product process for revising the design, electrical components and firmware. If any one of those people has the wrong version of the materials, that could stop production or cause a product failure in the field."

Without an automated solution, manual processes cause delays in change order approvals and ultimately delay product releases. "If you don't have a system in place, then you have print outs and you're walking a physical folder from person to person



Automating and digitizing engineering change orders can connect data and provide time savings. ***Image courtesy of Omnify.***

to do sign offs," says Chuck Cimalore, CTO and president of Omnify Software. "In our system, you now have inherently parallel processes so multiple people are viewing and signing off, and suggesting additional changes in one system."

There are a number of different types of solutions that can help manage and automate these processes: product lifecycle management (PLM), document management, electronic content management, product data management (PDM), E-CAE, etc. They all trade in information management, and can help get a handle on files and unstructured content.

"We provide different ways to optimize processes associated with that content," says Greg Milliken, vice president of Marketing at M-Files. "Not only the workflows and processes, but also ensuring that changes are not getting overwritten without proper authorizations."

These solutions use central databases to coordinate the documents and files associated with a project — as well as all of the data. That's important because not all of the information related to a specific project is necessarily housed in a document, per se.

Streamlining the ECO Process

ECOs allow organizations to adjust or debug designs while providing an audit trail of when those changes are made. They typically include technical information about the changes (parts, components, drawings, etc.) as well as explanations, instructions, approvals and lists of departments or staff affected by the change.

Electronic ECOs be linked to drawings, spreadsheets, BOMs and other related files. "Relationships are created between the form and all of the associated documents," Lamond says. "You can find those files via intelligent search features, collect them, and link them to the changes."

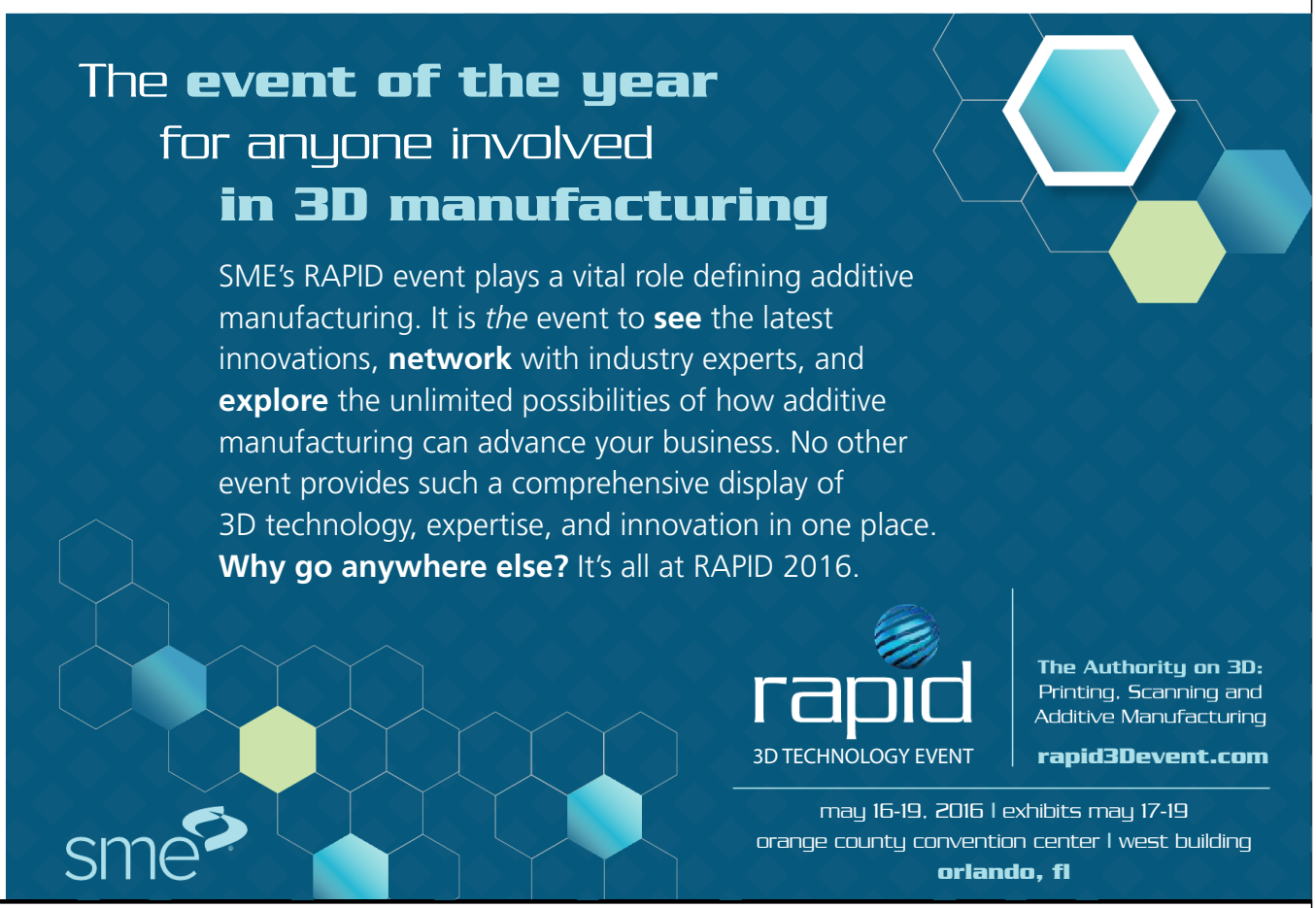
Change orders can be automatically routed to make processes more efficient, and can be accompanied by automated email notifications. The solutions can also be configured to trigger other processes in other solutions. Change approvals can also be accomplished via electronic signatures.

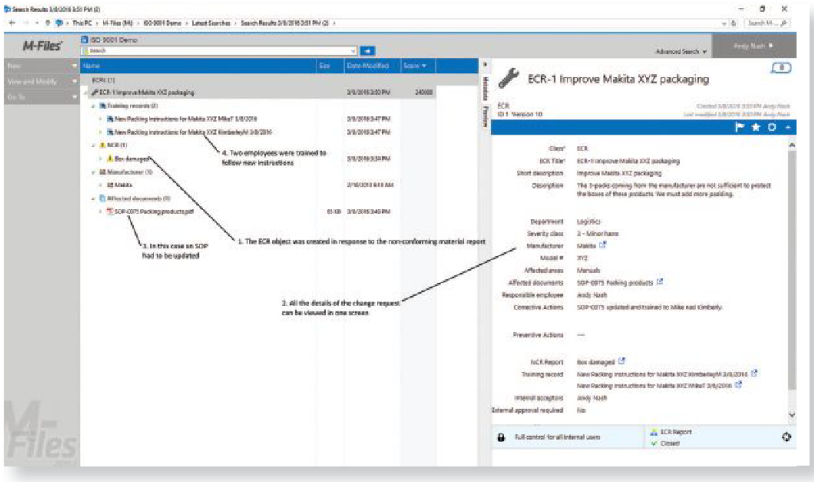
The entire process is also more efficient because there is no longer any paper or printing to manage — change orders can be more quickly created and linked to the necessary files.

"This is really about creating a process that people can follow and will consistently follow in an efficient, ongoing way," Milliken says.

In Synergis Adept, for example, users can set up automated change order processes in the solution. "You also have multi-user markup capabilities, so people can collaborate on these changes as they are routed through the approval process," Lamond says.

In Omnify, as a new element (like a drawing) is added, the system creates a live element that all stakeholders are aware of.





M-Files' enterprise information management system gives greater transparency to any changes throughout the workflow. ***Image courtesy of M-Files.***

As changes are made, a red line environment is automatically established so everyone can see the changes and note the differences between the original and new versions. "The system assigns workflows behind all of these processes, based on each person having their own set of rules and businesses role associated with access," Cimalore says.

Once all approvals have been signed in the system, all of the product records can be updated, including drawings and BOMs. New revisions are reflected in other systems (CAD, Excel documents, etc.), and instructions can be issued to the ERP (enterprise resource planning) system for manufacturing.

Making this work requires more than simple file management. The documents and files have to be tied to other information that exists in multiple systems. Companies have to know who the customer is, what purchasing information the manufacturing group needs to complete the project, which vendors are involved, etc. "There is a lot of crucial information that exists within those systems that allow us to more efficiently mange the process and allow people to discover documents," Milliken says. "That requires metadata-based information management."

According to Milliken, traditional folder-based management is ill-suited to this type of collaborative work because the information in the folders has to appear in multiple places at the same time. "An invoice might be important to me in purchasing, but somebody else in a different role in manufacturing might have an interest in it as well," Milliken says. "You have to classify information by what it is, not where it's stored."

"Living" Document Management

The key benefit of applying PLM or document management technology to the ECO process is that the accompanying files (BOMs, drawings, etc.) can evolve right along with the details of the change order in ways that are accessible and visible to all interested parties.

"In contrast to a static Excel spreadsheet, the solution creates a living, breathing document that continues to tie to the product record," says Kent Killmer, vice president of Marketing at Arena Solutions. "We have an item master and a relational dataset holding all of this together, which the BOM references. You can 'go back in time' to see changes, which is fundamental for liability purposes or warranty work."

Transparency is improved. As engineers collaborate, changes are documented simultaneously across all departments and all related data sources and documents reflect the changes. Any modifications can be compared to previous versions, and the author of the changes (as well as all approvals) can be tracked.

This also makes it easier for different engineering disciplines to work together more efficiently. Rather than a sequential process, in which a change order passes from one group to another to evaluate the repercussions of a change, everyone sees the information at the same time and can collaboratively address any potential unintended consequences or problems.

"You can suggest changes to the software, the electrical systems, or to the hardware, and everyone is looking at it as a whole," Cimalore says. "If you make a change in one area, it affects other disciplines. All of those things are dependent on everyone being able to see the full effect of the product change. Once you have a unified system, you get full collaboration; everybody can see what is going on."

These solutions also document why changes were made. "That history of information and interactions are easily discoverable by key members of the team when someone needs to assess a change order or evaluate costs," Milliken says.

In highly regulated industries, the change order process may need to stand up to close scrutiny and auditing for compliance. Notifications can be put in place so that the right people are automatically alerted when documents or projects have passed important milestones, or are in danger of missing important deadlines.

"As the project itself is advancing, you track and log access and revisions and version management based on those milestone reviews," Milliken says. "Not only are you assuring manufacturing that they are dealing with the right version of the product, you are also building the foundation upon which you can show you are compliant with various regulations and quality standards."

These solutions also make it possible to grant role-based access to stakeholders in different companies (customers or suppliers, for example), so that information can be shared or changes approved without requiring the physical shipment of documents or an in-person meeting.

In the case of M-Files, for example, those rights and roles can change dynamically. "If a change order needs to be reviewed by smaller groups of people, once it is reviewed and approved the rights to the document can change," Milliken says. "That reveals the document to more people."

"Each person has their own set of permissions that determine what they can access, and that can be done on a project level," Cimalore says. "Third-party providers can get access without having to do anything on their end other than click a hyperlink."

Arena provides two different ways to grant access to outside stakeholders. They can log into Arena and be granted object-by-object access based on their user privileges; or they use the Arena Exchange product to provide a snapshot of data. The latter provides a collaboration pane that lets a supplier or customer grant access to multiple people within the organization to collaborate in real time and share files.

"When you go to make a product, there are hundreds of people working on it," Chalgren says. "We built Arena Exchange because if you have a supply chain with 20 suppliers, it's too hard to manage adding them to your systems. Licensing costs can be a barrier, as well provisioning all of those people and maintaining their controls and privileges. This way, they can see the entire BOM and all of the redlines, and look at a snapshot of the enterprise application."

The technological ability to automate the ECO process is established in a number of tools. Ideally the ECO tool should be linked or integrated with ERP, product data management, PLM and other systems. The solution has to be easy to use for employees. If you require them to leave the tools they're used to working in so they can initiate document management, you will either create new inefficiencies or users won't embrace the system.

Companies also have to accurately map their ECO processes to successfully automate them. "The biggest challenge getting customers to understand their own processes and being willing to aggressively adhere to the process," Lamond says. "You really have to take the time to stop and document processes so you can enforce them and automate the workflows."

ECOs are critical for implementing design changes. Automating the ECO process using an electronic solution (whether that is a PLM, document management or other type of system) can streamline reviews and approvals, ensure accurate implementation of changes, provide auditable documentation for compliance purposes — and most importantly — ensure a fast time to market for improved designs. DE

Brian Albright *is a freelance journalist based in Columbus, OH. He is the former managing editor of* Frontline Solutions *magazine, and has been writing about technology topics since the mid-1990s. Send e-mail about this article to DE-Editors@deskeng.com.*

INFO ➜ **Arena Solutions:** ArenaSolutions.com

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Leaving the Paper Trail Behind

BY JAMES L. FINKEL

Implementing EDM (electronic document management) should not be undertaken without extensive prior planning. You have to determine which documents to add and when, what indexes you need or want, what hardware exists, and which hardware and software you must buy. Much of your EDM implementation depends on how you organize your document suite.

The initial step in building an EDM system is to conduct an inventory of your entire document database — this is really a sorting out process. Simply put, you do not need to add all your documents to your EDM database. For example, a typical midsize engineering firm may have on hand some 100,000 drawings, half of which are classified as current and only 10% of that half will be frequently used.

Even if your current structure is unworkable, renaming and scanning all your documents is a tremendous undertaking, so you will want to cull out obsolete files. And once you reorganize for EDM, you lose any logic that your original structure had.

Todd Hays at ACS Telecom, an EDM supplier, argues that the ideal EDM system gets along with your current structure. The importance of this is that it will minimize the learning curve and accommodate the differences between various sites and departments. While not all files in an EDM system will be organized in the same fashion — your drawings may be organized by project, clients, author or job number — "it is essential to construct a system where the current naming and organization can be accommodated," says Hays.

Kari Johnson of EDM product developer Alpharel believes that the most successful EDM implementations are those that have a multiyear, multiphase approach. When Alpharel's project managers help clients set up EDM systems, they first evaluate technology needs, taking a long-term view of requirements. Still, they design the EDM system around the best chance for immediate acceptance by all who must use it.

Tommy Petrogiannis, director of engineering technology at Silanis, warns that it's more difficult and more time-consuming to build an EDM system from scratch than you may imagine. Petrogiannis estimates that it can take anywhere from three months to two years to complete the job. DE

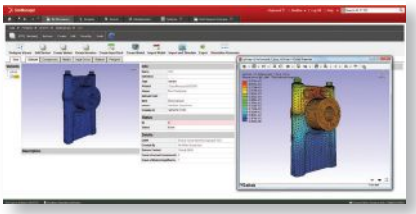
Editor's Note: *This excerpt is taken from the cover story of the March/April 1996 edition of* Desktop Engineering *magazine to show how data and document management has changed since the magazine was launched.*

Editor's Picks

by Anthony J. Lockwood

Each week, Tony Lockwood combs through dozens of new products to bring you the ones he thinks will help you do your job better, smarter and faster. Here are Lockwood's most recent musings about the products that have really grabbed his attention.

MSC Software Announces SimManager 2015



The program is now integrated with the Adams/Car environment.

SimManager 2015 enables simulation data and process management in a centralized, searchable environment. It creates the infrastructure to store, protect and distribute simulation data and methods, which keeps everybody on the same page. It has features like audit trails, automatic job queuing and submission, role-based access control and object-level security. SimManager supports customizable workspace-driven access to data, processes, searches and navigation.

This release has full integration with Adams/Car, ease-of-use features and MSC One licensing options.

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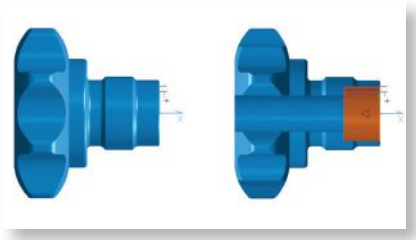
SmartCAM v2016 Launches



Release includes several updates to its Knowledge-Base Machining Library.

SmartCAM v2016 sees a lot of work in its Knowledge-Base Machining (KBM) Library. The KBM Library functionality is intended to make creating new programs easy. It brings together your tool and operation parameter management as well as managed manufacturing data in a single repository. That means users can store then re-use tooling and operation settings.

The program also sees improvements in its mill roughing capabilities, a new View Section command that makes it easier to view and select hidden elements as well as a bunch of new customization functions.

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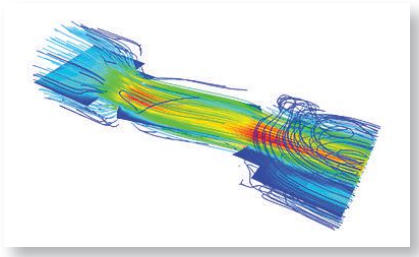
ESI Group Debuts ESI Cloud



The technology provides cloud-based computational fluid dynamics capabilities.

ESI Cloud is a scalable high-performance computing service with three primary components: modeling, collaboration and cloud services. Besides the obvious — like running computers and maintenance — cloud services means security services and analytics. Plus, synchronous and asynchronous collaboration runs throughout ESI Cloud where users want it.

Modeling has two prongs. One: ESI Cloud is a CFD (computational fluid dynamics) solution. Two: it's an on-demand version of ESI's multi-domain VPS (Virtual Performance Solution) system.

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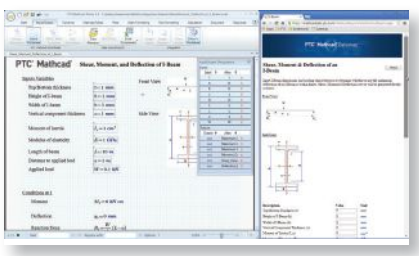
PTC Mathcad Gateway Now Available



Program grants secure access to engineering calculations.

PTC Mathcad Gateway is a math calculation server that provides secure Web access to engineering calculations without letting IP (intellectual property) out of the bag. From their preferred smartphone, tablet or workstation, users get on the server and enter data into calculation forms that use worksheets developed with PTC Mathcad Prime engineering calculation software.

It also uses pre-existing infrastructure from hardware to security models and authentication methods, which adds another blanket of security users are comfortable with and simplifies administration.

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Designing on Time

Autodesk Digital Prototyping helps Swiss watchmaker Ulysse Nardin meet production and cost goals.

In 1846, Ulysse Nardin founded what is now one of the world's premier makers of fine mechanical watches. With more than 400 moving parts, Swiss watches, such as those made by Ulysse Nardin, have long been marvels of design and artistry. But in today's competitive marketplace, even companies like Ulysse Nardin must accelerate time to market while controlling costs. To make its product development process more efficient, the company implemented the Autodesk solution for Digital Prototyping using Autodesk Inventor, Autodesk Productstream and Autodesk Showcase software. Using Digital Prototyping, Ulysse Nardin has been able to:

- Cut product development cycles in half.
- Produce one physical prototype instead of three.
- Save as much as $30,000 per new watch by producing fewer prototypes.
- Create photorealistic images of watches for marketing before production.

Prior to turning to Digital Prototyping, Ulysse Nardin spent about four years designing the internal mechanisms for each new watch it created. The process was lengthy due to design complexity, small design teams, and the number of physical prototypes required. Ulysse Nardin had to create ever more innovative watches — faster.

"Innovations take time and care to perfect," notes Pierre Gygax, Ulysse Nardin's executive vice president of Production. "For example, with our perpetual calendar watches, you can adjust the date as you cross time zones with the push of a single button. The gears and springs inside do the rest. With 2D tools, designs took a long time and then we still had to do three to five rounds of physical prototypes to achieve the high level of quality our customers expect."

The Solution

Ulysse Nardin accelerated its product development cycles using Autodesk Inventor software to cost-effectively take advantage of a Digital Prototyping workflow. As the foundation of the Autodesk solution for Digital Prototyping, Inventor software allows Ulysse Nardin's mechanical designers to create an accurate digital prototype of a new timepiece.

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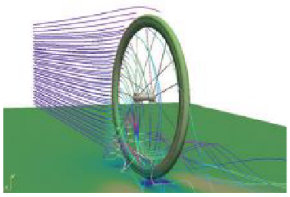
Simulation Enhances Cycling

Tokyowheel relies on SimScale to run analyses on their specialized racing wheels.

Founded in 2010 and based in Japan, Tokyowheel is a highly specialized company that engineers technical carbon fiber racing wheels for competitive cyclists. Their carbon wheels for road, triathlon and cyclocross bikes provide significant performance improvements through decreased aerodynamic drag of the wheel shape, and the decreased mass of the lightweight carbon fiber construction.

As the first company in the industry to offer free shipping worldwide, and delivery free from customs tax, Tokyowheel is the leader in international direct-to-consumer sales of performance bicycle wheels.



Engineering aerodynamic wheels nowadays requires CAE. Historical methods produced competitive results, but were time-consuming and required significant resources. CAE can provide similar results in less time and with a significantly smaller investment.

Computational fluid dynamics (CFD), in particular, is expensive, with annual subscriptions often costing tens of thousands of dollars. The SimScale platform provided Tokyowheel with a solution to high costs.

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By Tami Pippert, *Keysight Technologies Inc.*

USB Type-C: Simplicity and Complexity All in One

We all have several variations of USB cables we use in our daily lives to connect and power devices: Type-A, -B, Micro, Mini and more. Anyone who uses computers and peripherals knows USB standard A/B connectors must be plugged in in a single direction. Compared with these existing types of USB cables, Type-C cables offer the usability advantage of being both symmetrical and reversible. USB Type-C is a breakthrough standard designed to meet the demand for ever smaller and thinner computers and devices, higher-speed data and more power and flexibility. It provides:

- dynamic power and transmission of USB 2.0 with other protocols;
- the ability to be an interface for new and future devices;
- backward compatibility; and
- ease-of-use as a result of reversibility.

The protocol simplifies consumer usage but presents new challenges for engineers.

Designing for USB Type-C

Consumers using USB Type-C enabled products will find them to be much more capable and simple to use. Engineers, however, have a lot more complexity to manage during design and test, especially when considering the many different scenarios of functionality Type-C offers.

Design and test engineers face a number of challenges as they work to upgrade and integrate USB Type-C into products, while ensuring interoperability and achieving test compliance.

Previous versions with 4- or 8-pin power, ground and data connection will move to 24 pins with multiple power, ground, Tx/Rx lines, control lines and more. Also, compliance test standards have increased and are more complex due to higher data transmission speeds, more power and additional functionality.

The USB Type-C cable and connector not only provides backward USB compatibility, but also increased functionality for power management and data transmission. USB Type-C power delivery provides up to 20 volts, 5 amps and 100 watts for dynamic power and charging of different devices. The transmit/receive (Tx/Rx) pairs can be used for USB or "guest protocols" such as DisplayPort, MHL or Thunderbolt data transfer.

Type-C data transfer rates are up to 20Gbps (Thunderbolt) with the ability to achieve 40Gbps in the future. These new capabilities create a greater challenge for engineers working to ensure the interoperability of their USB channel and devices by performing USB-IF standard conformance tests.

Start Early

Dealing with this new complexity starts with knowing how your Type-C device will function as early as possible in the design process. Physical layer design simulation helps ensure a valid layout with optimal performance, test compliance for new device designs and prevent possible re-designs. To avoid costly hardware prototyping cycles and to identify problems early, it is best to perform simulation of the design for compliance testing.

Simulation and design validation for Type-C device performance involves characterization of clock and data signals for the transmitter, receiver and the channel for various stress signals and helps ensure interoperability.

Once you have a physical prototype, the Type-C specification introduces new test and validation implications. Successful testing requires accurate and standard compliant test instruments, software and fixtures. It begins with USB power delivery. The single CC (configuration channel) line negotiates which alternate modes you're running, how power will flow and provider/consumer relationships. Then, for whichever technology (USB, DisplayPort, Thunderbolt, etc.) being used, the ability to quickly and accurately measure and validate key aspects of the transmitted eye will be critical for a transmitter test. Flexible signal generation and bit error detection are key for receiver test validation.

For those involved in cable assemblies, it's critical to quickly address signal integrity issues that can negatively affect system performance as bit rates increase, while accelerating interconnect testing and characterization. You'll now need to consider high-speed interconnect analysis, including impedance, S-parameters and eye diagrams.

The USB Type-C connector will add simplicity in our day-to-day lives and complexity for the engineers implementing it. Your goal with Type-C will be to get from debug to characterization to compliance to done as quickly as possible. DE

Tami Pippert *is marketing programs manager of High-Speed Digital Solutions at Keysight Technologies (keysight.com). Send e-mail about this commentary to DE-Editors@deskeng.com.*

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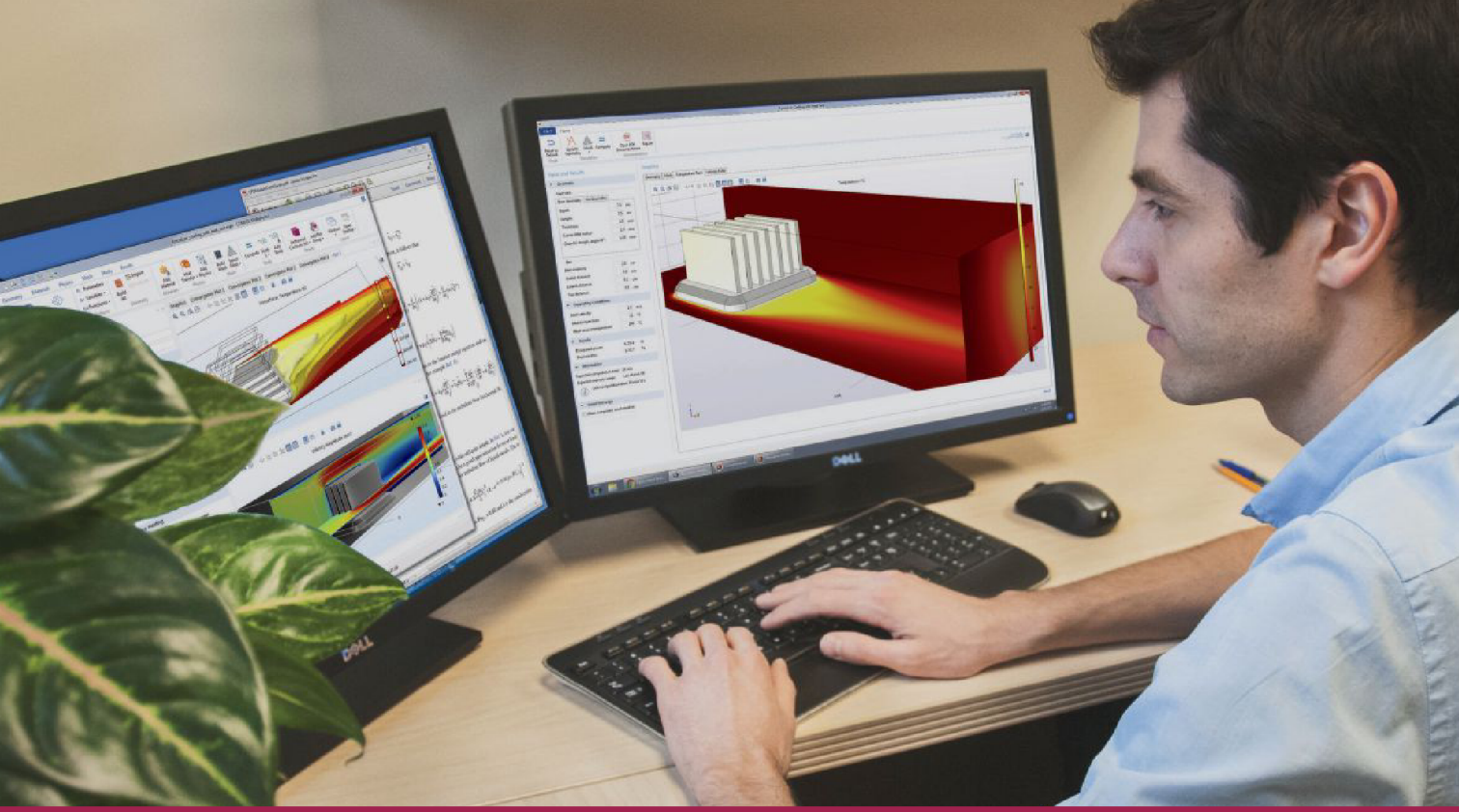

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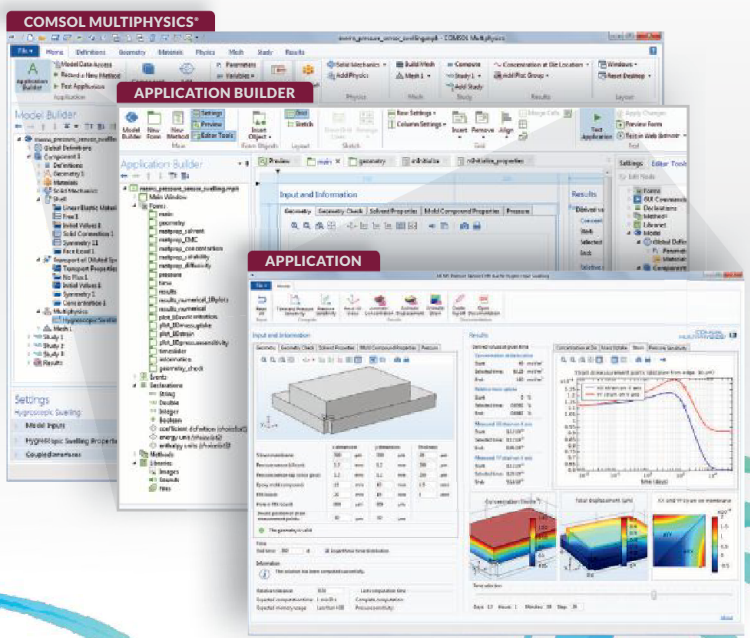

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