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TECHNOLOGY FOR DESIGN ENGINEERING

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HELP!

How to bring in outside engineering expertise

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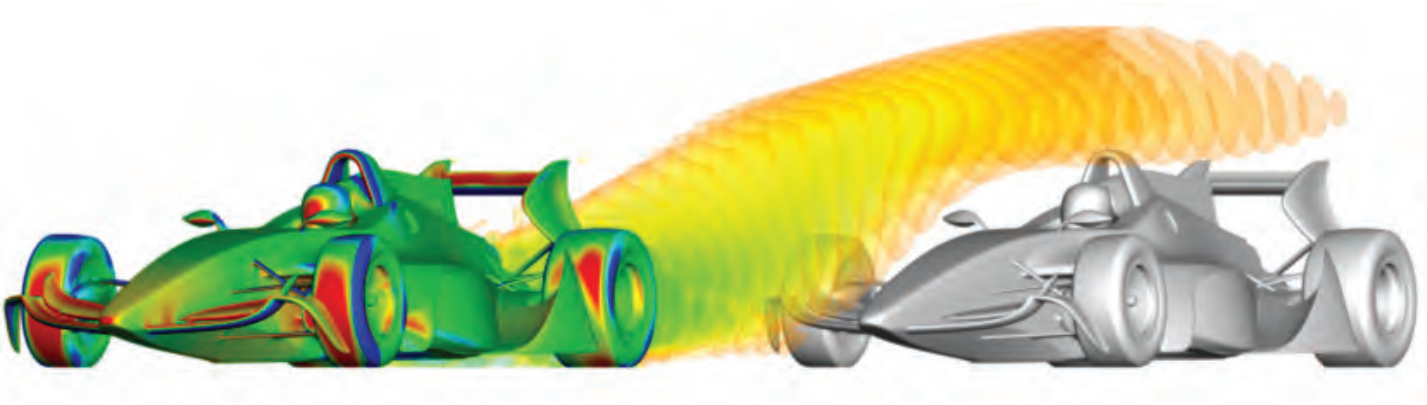

by Jamie J. Gooch

Engineering Help Wanted

The "Great Recession" that the economy is still recovering from saw corporate hiring freezes, downsizing and cost-cutting initiatives that placed additional responsibilities and stress on design engineers.

It forced those fortunate enough to keep their jobs to do more with less, and in less time as product development cycles shrunk. For many design engineers, that meant expanding their expertise outside of their chosen disciplines and learning new, sometimes complicated, technologies while working longer hours to meet shorter deadlines.

If some economic soothsayers are right, the worst is over and companies are beginning to hire again. But finding engineers to hire may present a challenge. The lack of qualified science, technology, engineering and mathematics job candidates has been heralded to near hysterical levels. President Obama even made a point to call out engineers in his recent State of the Union address.

Hiring in outside expertise is a safety valve that releases pressure on overworked engineers.

"Real reform means fixing the legal immigration system to cut waiting periods, reduce bureaucracy and attract the highly skilled entrepreneurs and engineers that will help create jobs and grow our economy," he said. He was addressing, in part, the so-called "brain drain" issue where foreign students get educated in the U.S. and then return to their home countries because immigration laws make it difficult for them to stay here.

Trumpeting the demand for engineering skills from a national stage is a positive sign for a future fix, but design engineers need help now if companies are going to innovate their way out of the recession.

Temporary Fix or New Paradigm?

To cope with the stresses placed on their engineers, many companies have turned to hiring outside expertise to help them with a particularly thorny design issue, a complicated simulation analysis, IT management or the prototyping and testing process. Consultants and service providers are a safety valve that, when implemented successfully, releases the pressure on overworked engineers. They offer a number of benefits if properly integrated into a design process:

1. Specific expertise when it's needed without the expense when such expertise is no longer required.
2. No upfront investment in new hardware or for software licenses you may not need that often.
3. The ability to fill knowledge gaps while you get up to speed on a new technology or process.
4. The opportunity to learn from someone with an outside perspective who is familiar with best practices.
5. The ability to offload less technical, but time-consuming aspects of your work so that you can concentrate on more important tasks.

Thanks in part to the Internet, which makes it easy to work from anywhere, and in part to the recession, which turned untold numbers of laid off professionals into freelance service providers, the increased use of the service model is here to stay. Many company executives like paying for work as needed during busy periods and saving that cost during down times, while many contractors enjoy the flexibility of scheduling work around other priorities, and choosing their clients.

One More Skill to Learn

If not managed correctly, working with outside expertise can quickly switch from saving time and money to wasting them. Engineers who work with outside service providers often become de facto managers—a role they may not be prepared to take on.

The need for engineers to manage outside resources takes us back to the beginning: overworked engineers being forced to learn new disciplines. However, learning to work with outside expertise is a skill that can pay dividends in time savings.

Just keep in mind that contractors—especially if they're working off site—need clear guidelines, expectations and deadlines communicated to them. Ongoing progress reports are key. Their work should be reviewed and critiqued just as a full-time employee's is.

Use this issue of *Desktop Engineering* to identify when to consider hiring outside design, simulation, and IT expertise, or prototyping and testing service providers. We've interviewed various experts who explain the potential benefits of using consultants and service providers. It's a bit of a departure from our regular coverage of hardware and software tools, but we think it's a trend worth investigating. Let us know if and how you've used consulting and service providers by taking our survey at deskeng.com/survey. DE

Jamie Gooch *is the managing editor of* Desktop Engineering. *Contact him at de-editors@deskeng.com.*

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Focus on Service Providers

Many design engineers are being asked to expand their skill sets into new disciplines that have long been the purview of specialists. They are expected to master new technologies, integrate them into their workflows, and still do the important job they've always done. Adding to this already stressful situation is increased pressure to design innovative products under increasingly tight deadlines and budgets. But help is available. Service providers and expert consultants can provide expertise in every step of the design process, from concept to testing. This issue of *Desktop Engineering* focuses on helping you choose the right outside assistance.

ON THE COVER: Overworked engineers can turn to outside contractors and service providers for help. *Image courtesy of iStockphoto.*

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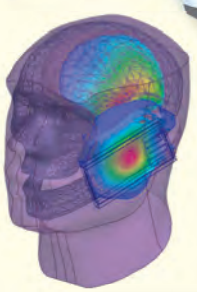

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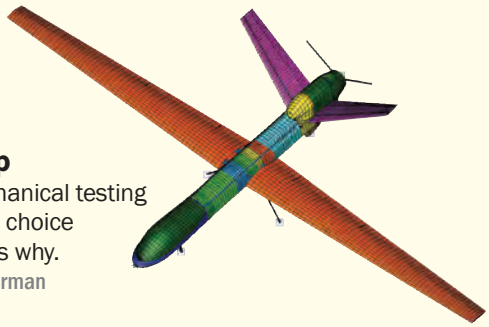

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EDITORIAL
Steve Robbins | Editorial Director
Jamie J. Gooch | Managing Editor
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Heather Pi˜ inger | Copy Editor

CONTRIBUTING EDITORS
Tony Abbey, Brian Albright, Mark Clarkson, David S. Cohn, Barbara Goode, Mike Hudspeth, John Newman, Susan Smith, Beth Stackpole, Peter Varhol, Pamela J. Waterman

PUBLISHER
Thomas Conlon

ADVERTISING SALES
603-563-1631 • Fax 603-563-8192

Erich Herbert | Sales Executive (x263)
Jeanne DuVal | Account Manager (x274)

ART & PRODUCTION
Darlene Sweeney | Director (x257)

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Steve Robbins | Chief Executive Officer
Thomas Conlon | President

ADVERTISING, BUSINESS, & EDITORIAL OFFICES
***Desktop Engineering*® magazine**
Level 5 Communications, Inc.
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E-mail: den@omeda.com

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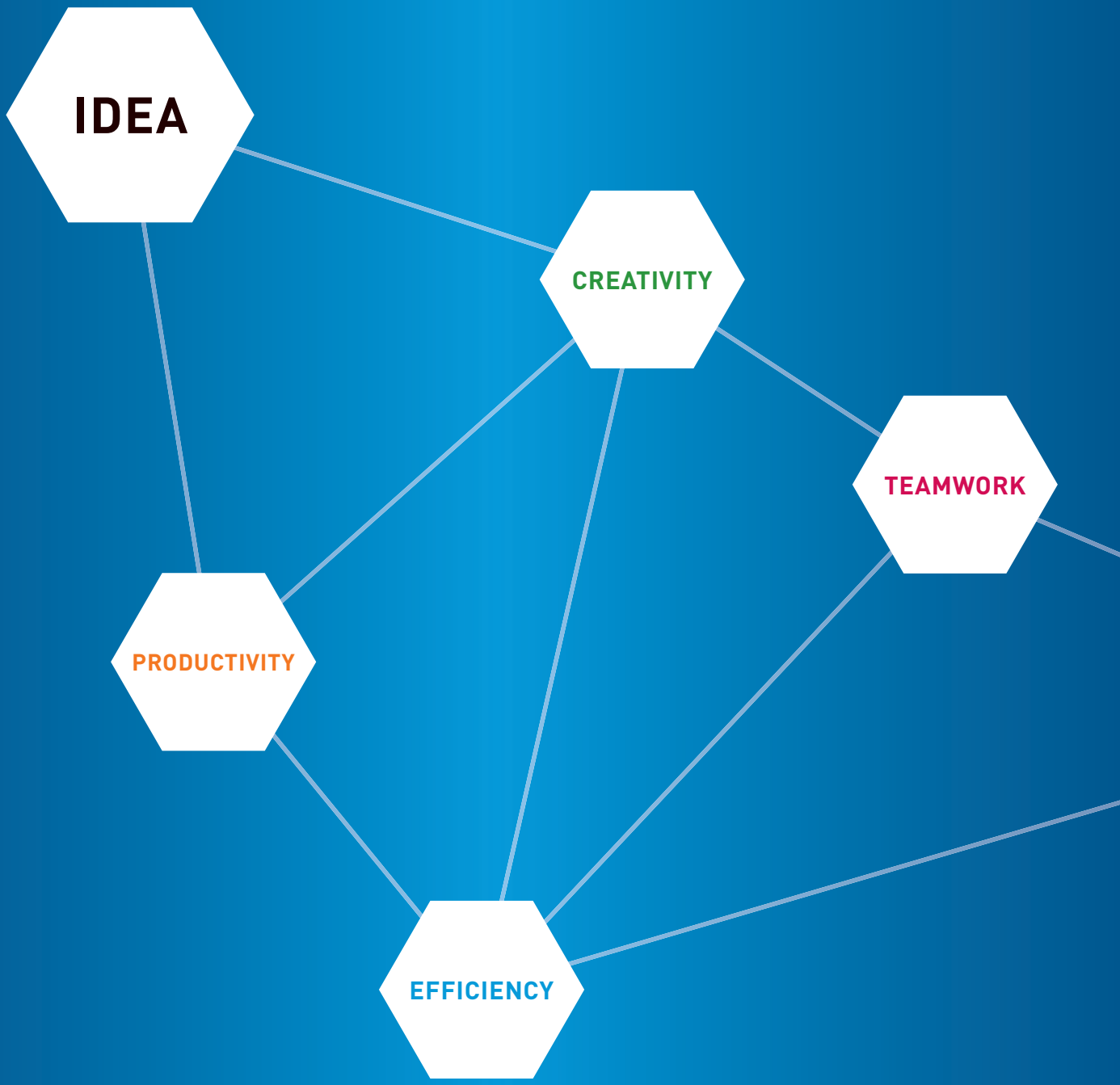


CyDesign on Cloud: Pay as You Go, but Not SaaS

People who are involved in DARPA's FANG (fast adaptable next-generation ground) vehicle design program may not realize they're interacting with a component supplied by a startup based in Palo Alto, CA. Embedded inside META, the web-hosted software accessible to all FANG participants free of charge, is the technology from CyDesign, a company founded by Serdar Uckun.

DARPA's FANG project is a cloud-hosted project, in a manner of speaking: Participants who've signed up for the project access META—the official software tools for modeling, simulation and collaboration—from a standard web browser. Similarly, CyDesign's commercial software, CyDesign Studio, will be delivered over the Internet.

"For us, cloud is not a gimmick, not a marketing tool," says Tom Stegmann, vice president of business development. "It enables us to do things like massively parallel processing of simulation."

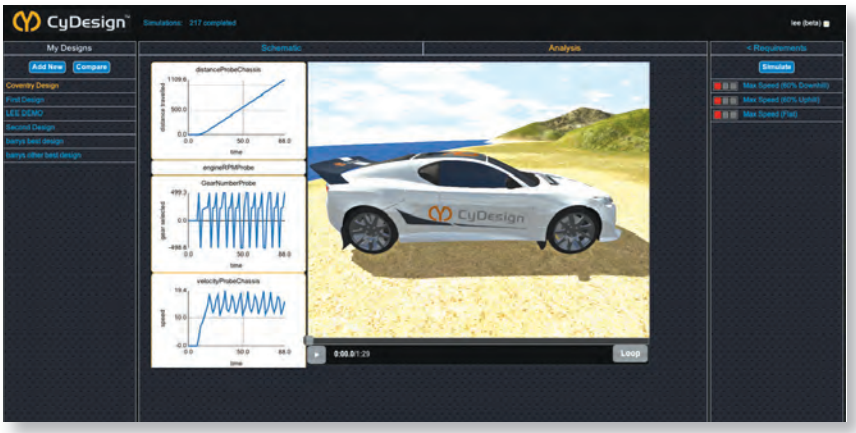
Stegmann and his colleagues envision customers using CyDesign's scalable cloud-hosted back-end processors to test tens, hundreds or thousands of design variations.

"Simulation doesn't give you a definitive answer," Stegmann says. "The trick is to run a lot. In the results, you see a curve that tells you which ones are good solutions. If you're off that line, it's probably a bad solution."

CyDesign Studio is set up so that your program requirements (for example, the desired miles per hour or fuel economy of a vehicle) will be part of the input parameters you use during your simulation, Stegmann explains. The simulation technology in the product is based on the Modelica simulation engine, also powering commercial products from Dassault Systèmes, Maplesoft and others.

But don't call CyDesign software as a service (SaaS). Stegmann prefers "pay as you go" as a better way to describe the licensing model. You'll pay based on usage. It's not a pay-per-module licensing or monthly licensing; it's closer to a comprehensive buffet table where you're charged for the volume you consume, or a utility contract where you're billed for the wattage you used. The billing calculation formula (which CyDesign isn't discussing publicly) will be based partly CPU cycles, storage and connect time.

—K. Wong



In CyDesign Studio, a web-hosted analysis software program from CyDesign, the user can play back simulations and see the resulting data gathered by test probes. The visualization also includes a video playback-rendered 3D environment.

Sneak Peek of NVIDIA GTC

At SolidWorks World 2013, NVIDIA occupied a corner in the partner pavilion, where it showcased a variety of workstations with its dual graphics-processing unit (GPU) Maximus architecture. Previously, NVIDIA's Tesla GPUs were deployed only in high-performance computing (HPC) servers, dedicated to massive computing tasks. Most notably, Tesla K20 GPUs are under the hood of the supercomputer Titan at Oak Ridge National Laboratory. But the Maximus architecture made it possible for workstation users to enlist the Tesla GPU's processing power on personal desktop systems—a theme that will be explored at the NVIDIA GTC Conference taking place March 18-21 in San Jose, CA. (*Editor's Note:* DE *is a GTC media sponsor.*)

In Maximus-class systems (available in HP Z, Dell Precision, and Lenovo ThinkStation series), the workstation's multicore CPU is augmented with not one, but two GPUs: a Quadro GPU and a Tesla GPU. According to NVIDIA's technology road map, the Maximus architecture will eventually support a configuration with one Quadro and two Tesla GPUs, all in the same machine.

The power in this setup allows workstations to do what they weren't able to do before: Run CAD in a fully interactive, ray-traced mode and a compute-heavy simulation program like ANSYS, Dassault SIMULIA, or MSC Marc—at the same time, on the same machine.

The GTC speaker lineup includes:

- Matthew Gueller, senior surface designer, Harley-Davidson Motor Co.;
- Peter Fassbender, head of the Design Center, Fiat Latin America; and
- Galen Faidley, engineering project team leader, Virtual Product Development Group, Caterpillar Inc.

—K. Wong

SolidWorks World 2013: Mechanical Conceptual Debut

Conceptual, social, instinctive and connected. That's how Fielder Hiss, SolidWorks' vice president of product development, summed up the new SolidWorks Mechanical Conceptual product. The presentation was part of the opening keynote at SolidWorks World 2013.

"This is what you've told us: 31% of all project time is spent on concepts. That's a lot of time," said Hiss. "On average, there are six iterations in that conceptual phase. Three out of four engineers are engaged in that process."

These and other findings about the company's core customers, Hiss suggested, were the reasons behind the development of Mechanical Conceptual, a new product based on parent company Dassault Systèmes' 3DExperience philosophy.

At SolidWorks World 2013, Fielder Hiss, SolidWorks VP of product development, introduced SolidWorks Mechanical Conceptual. The new product will be "conceptual, social, instinctive and connected," he says.

The demonstration revealed a software program with 2D sketching, 3D geometry building and simple dynamic simulation functions. The underlying modeling engine can facilitate direct, history and parametric modeling in a single environment, Hiss explained.

Because the conceptual phase in modern product development revolves around "social innovation," the new product will incorporate social media-like collaboration features, according to Hiss: "What we're doing is removing the noise in social media, and letting all the benefits of it to be applied to engineering." Multiple concept management, mobile apps, and tablet support round out the feature set in Mechanical Conceptual.

An Underserved Market

Mechanical CAD software developers have long courted the conceptual design segment, but the legacy of CAD, rooted in detailed production drawings and manufacturing-grade geometry, prevented market-leading programs from effectively addressing the early product development phase. It left an opening for consumer-friendly Google SketchUp, newcomer SpaceClaim, and a few others to capture a portion of the market.

In the last four or five years, leading CAD developers like Autodesk, PTC and Siemens PLM Software began to pursue the conceptual phase with renewed vigor, using direct-editing programs that are easier to learn and use than typical parametric CAD software. Thus, Autodesk Inventor Fusion, PTC Creo/Direct, Solid Edge with Synchronous Technology, and others emerged. Now SolidWorks joined the battle with Mechanical Conceptual.

Local Client Augmented by Cloud

Internally, SolidWorks R&D staff debated over the right architecture for the new software. In the end, they settled on a thick client (a hefty program that runs on your desktop or laptop), connected to a cloud-hosted data center. "When I say 'Connected,' I don't say 'Cloud,'" SolidWorks CEO Bertrand Sicot clarified. He was well aware that SolidWorks' rival Autodesk, by contrast, is betting heavily on the cloud. (*Editor's Note: For more, read "Autodesk Rounds Out 360 Portfolio With Cloud-Based CAD" by Beth Stackpole, Nov. 28, 2012.*)

"[Development of] SolidWorks Mechanical Conceptual will not be at the expense of, I shall repeat, will not be at the expense of SolidWorks," Sicot said with emphasis.

The company plans to distribute the new product through the reseller channel. At press time, it hasn't set the price for Mechanical Conceptual, but Sicot gave a clear indication: "It's going to be within the range of SolidWorks."

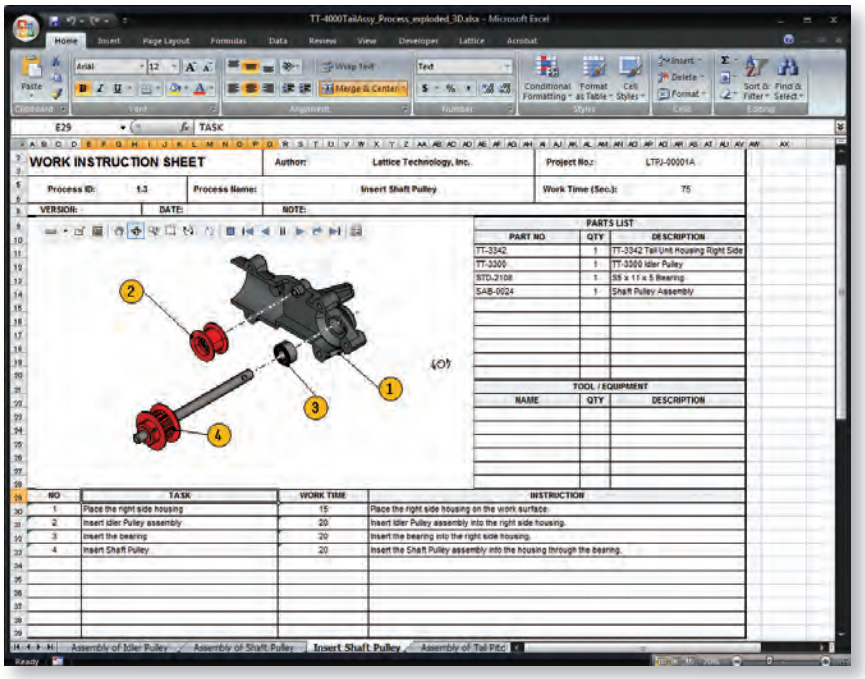
—K. Wong

by Kenneth Wong & Beth Stackpole

Interactive 3D Product Visualization Meets Excel

How many times have you heard engineers and other manufacturing users say they just won't give up on Excel? Despite the onslaught of new design tools, product data management systems, and engineering collaboration platforms, there remains a healthy fan club of users who cling to Microsoft Excel and related manual, paper-based processes as part of their regular workflows around engineering change orders, organizing parts lists, and creating work instructions, among other critical tasks.

In recognition of Excel's enduring appeal, Lattice Technology has released Lattice3D Reporter v6, a software plug-in that lets manufacturing personnel—not just CAD-toting engineers—quickly and easily embed ultra-lightweight, but highly accurate, interactive versions of 3D CAD models and related parts information as part of any standard Microsoft Excel file. The 3D embedded information might be one or multiple bills of materials (BOMs), work instructions, assembly animations, or 3D interactive snapshots. With the free Lattice3D Reporter Viewer plug-in, users can review and interrogate the interactive 3D models and the associated information in the familiar Excel environment.



Lattice3D Reporter v6, a software plug-in from Lattice Technology, lets you include ultra-lightweight, accurate, interactive versions of 3D CAD models and related parts information as part of any standard Microsoft Excel file.

Establishing Associativity

Bill Barnes, general manager for Lattice Technology's Americas and European divisions (the parent company is based in Japan), says the choice of integrating with Excel comes from the reality that the spreadsheet is a ubiquitous tool for sharing BOM and product-related information. "Excel is a tool everyone uses, whether they are sharing BOM information or putting a sequence of parts together in an assembly document," he explains.

Traditionally, people have used manual, paper-based methods for sharing this data, often collaborating using static documents. Lattice3D Reporter v6 and the Reporter Viewer establish associativity between the fully functioning 3D models and a parts list, enabling users to identify parts much faster, perform cross-sections to examine the model, and providing the ability to pan, rotate and zoom on large and complex assemblies for the purpose of creating and exploring interactive parts lists or interactive assembly documents, Barnes says.

"We're bringing 3D and animation to a set of manufacturing engineers who are still using paper-based or electronic 2D documents," he adds. "The interactive 3D models enable a greater understanding of assemblies and parts well before a manufacturing team embarks on building a prototype."

Key to the ability to create the fully functioning 3D models in Excel is Lattice Technology's XVL technology, a lightweight 3D format that is used by companies like Toyota, Lockheed Martin, Boeing and dozens of others to communicate product information through the manufacturing supply chain. XVL compresses data to an average of 0.5% its original size—and does so with high accuracy, Barnes says. That's a characteristic that distinguishes it from other visualization and viewing technologies, particularly those offered by CAD and product lifecycle management (PLM) vendors, he says.

The toolset also enables 3D data to be readily integrated into existing enterprise resource planning (ERP), PLM and other IT systems. Lattice3D Reporter is an Excel plug-in that is available for purchase as a floating or node-locked license. The corresponding Lattice3D Reporter Viewer Excel plug-in is available as a free download from the Lattice website.

—B. Stackpole

Xi3 Shows Off New Microserver Cluster

Small form factor is a bit of an understatement when it comes to Xi3's computers. The basic unit is about the size of a grapefruit. The tri-board architecture makes it easier to upgrade or repair, and (according to the company) also makes it possible to extend the life of the device by several years, compared to regular PCs.

At the Consumer Electronics Show, the company also showed off a theoretical server cluster, using several Xi3 microSERV3Rs fit into a custom cart that can be transported anywhere. It provides thousands of CPU and graphics processing unit (GPU) cores, and operates on less than 1KW of power.

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UCLA Develops More Efficient Memory

Researchers at the University of California, Los Angeles' (UCLA's) Henry Samuel School of Engineering and Applied Science have been developing a new type of memory that requires less energy than current technology. According to the research team, the recently developed magnetoelectric random access memory (MeRAM) is up to 1,000 times more energy-efficient than other types of memory—while retaining the high density, read speeds and other characteristics of current-generation memory.

UCLA's team has improved magnet memory by using voltage to write data directly, rather than forcing electrons through wires, which requires more power and also generates heat. MeRAM can also store data with five times' greater density, which could lead to savings in the dollar-per-bit ratio.

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Robot Baby Makes Debut

Diego-san is a robot baby developed at University of California, San Diego's Machine Perception Lab to study the cognitive development of children.

David Hanson and Hanson Robotics built the robot's head (which includes 27 moving parts to create eerily human-like expressions). High-definition cameras allow the robot to "see" human gestures and expressions, and then use artificial intelligence (modeled on human babies) to learn and respond intuitively.

Researchers are also working on 2D face tracking, head tracking, human-robot interactions, and computer modeling of cognitive processes.

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The Return of the Airship

Expect to see more action around airships, or blimps, when it comes to cargo and transportation applications. Aeros hopes to revolutionize the market with its Aeroscraft (aka The Pelican), designed under a Pentagon contract. The 230-ft. prototype has an internal ballast control system that allows it to offload cargo without using ballast. Built with a rigid structure, it can control lift at all stages with its vertical takeoff and landing (VTOL) capabilities, and carry maximum payload while in hover.

Another company, Ohio Airships, also has plans for a blimp-like cargo ship called the Dynalifter. It combines helium lift with wings and canards, and can take off and land like an airplane. It can also ascend and descend without venting expensive helium.

According to the company, the Dynalifter can accommodate between 45,000 and 300,000 lbs. of cargo in its detachable cargo pods. Because it's not lighter than air, it would be easier to land, as well as load and unload on the ground.

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Two-Man Electric Multicopter in the Works

e-volo, a German company that last year launched the first manned flight of its VC1 electronically powered, vertical takeoff multicopter, is now preparing a two-man version of its Volocopter: the VC2000.

German officials plan to create a new aviation category to allow the craft to fly in the country's airspace, and the company hopes to begin test flights by mid-year.

The VC1 Volocopter achieves its ascending force and stability from the 16 propellers on the vehicle. It has an empty weight of about 176 lbs., including batteries. It does not require any mechanical pitch control.

The two-seater version is being developed as a hybrid electrical craft with a range extender (a combustion motor).

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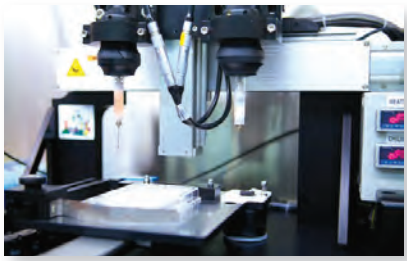
Autodesk Stakes Claim to Bioprinting Frontier



Autodesk Research, and specifically a 14-person team known as the Bio/Nano/Programmable Matter group, has announced a partnership with Organovo Holdings Inc., a manufacturer of three-dimensional human tissues for medical research and therapeutic applications, to create what both claim will be the first 3D design software for bioprinting.

Organovo's 3D bioprinting technology is used to create living human tissues that are made entirely of living human cells. The resulting structures, which are output on Organovo's NovoGen MMX bioprinter, are able to function like native human tissues. Company officials are touting their research and early prototypes as central to advancing medical research, drug discovery and development—and eventually, surgical therapies and transplantation.

Keith Murphy, chairman and CEO of Organovo sees the Autodesk collaboration as a way to potentially open up bioprinting for a broader group of users.

MORE ➜ More: rapidreadytech.com/?p=3212

Concept Laser Announces Mlab Cusing R 3D Printer

Concept Laser's Mlab Cusing line specializes in building small, complex objects from metal. The target audience for the line includes the dental industry and the field of medical implants. The new system adds titanium and titanium alloys to the list of materials, along with gold, silver alloys, bronze, cobalt-chromium alloys and stainless steel.

Concept Laser has also patented a method of interacting with materials, that it calls the "glovebox module": "The glovebox module is docked onto the machine for the loading and unloading process," according to the company. "The build module can simply be pulled out into the glovebox, thanks to the drawer principle. The glovebox is then flooded with argon to inert the chamber, essential for safe titanium processing. The operator accesses the build chamber through the glovebox gloves in order to carry out the loading process or to remove components. After the end of the process, the build module is moved back into the machine."

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3D Printing Extends the Reach of ABS Child

Additive manufacturing (AM) is making life easier for people in all sorts of ways. One example can be found in a 5-year-old boy from South Africa named Liam who was born with ambiotic band syndrome (ABS). He has no fingers on his right hand, and his parents could afford a prosthetic that would make life easier for him. Then they met Richard Van.

Van has some missing fingers of his own. Since losing them during a machining accident, he has been working on creating affordable prosthetics. During his research, Van came across a video by Ivan Owen, a power line communication (PLC) programmer/automation technician, living in Washington. He had built a mechanical hand that copied the motions of a user. Van asked Owen to work with him to create prosthetics and—despite their 10,000-mile separation—they began to collaborate.

MORE ➜ rapidreadytech.com/?p=3367

Nokia Embraces 3D Printing Future

The Windows 8 Lumia 820 phone from Nokia was designed with a removable shell and a "3D Printing Development Kit" (3DK) that gives owners the power to design their own smartphone case.

"In the future, I envision wildly more modular and customizable phones," predicts John Kneeland, a Nokia Community & Developer marketing manager. "Perhaps in addition to our own beautifully designed phones, we could sell some kind of phone template, and entrepreneurs the world over could build a local business on building phones precisely tailored to the needs of their local community.

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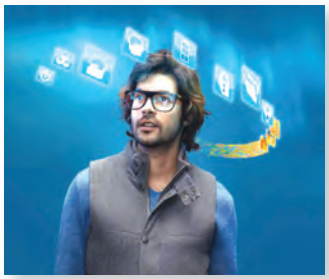
Hardware and Software: Make Them New Together



Maximize your investment in new so˜ ware with a good old-fashioned hardware boost.

BY DOUG BARNEY

There's a funny thing about software: often new applications are larger and slower than their predecessors. We call it bloatware. It frequently leads to a new release just breaking even with the previous one in terms of performance.

But while software gets bigger, hardware keeps getting better. If you want to make the most of your new or upgraded technical application, you should look at a new workstation as well. Look at this way: If new hardware can increase the number of results you explore by 1.5X, then the time to recover your hardware upgrade investment is less than 1 week (a salary of 86K*1.5/48 weeks = $2,687/week).

Should you upgrade your hardware? Absolutely!

CATi, a Dassault Systèmes SolidWorks Corp. reseller, showed the relationship between state-of-the-art hardware and software performance during a recent series of rigorous tests performed by a partner. By upgrading all key aspects of a workstation, you can gain enormous performance boosts, more than 5 times! And the best way to boost all these machine aspects is with a new workstation.

Let's look at the specific ways a new workstation can make the most of your new software. But one word of advice—build a balanced system—do not over invest in one area at the cost of the another or you will be disappointed in your user experience.

New Software Craves CPU

The CPU is the core of any workstation. Faster clock speeds and more cores equals more performance. And if your new workstation has the second slot filled with another multicore processor, the gains are even bigger.

SolidWorks' tests began with a baseline machine with a single Intel Xeon processor with 2 cores. Performance increased a tidy 12% just by going from 2 to 4 cores, and SolidWorks is a largely single-threaded program.

RAM the Perfect Compliment

Even non-technical users know the power of more RAM. SolidWorks found that going from 8 to 24GB of RAM increased performance by 54% as there is more processing happening in memory and less disk swapping.

Galloping GPU: Ideal for a Few Applications

Some applications are GPU aware. Depending on your application, a co-processing GPU card can accelerate your opportunity to play more "what ifs" with your new software investment.

Caveat emptor: If your workflow relies on one technical application, and it is tuned for a GPU, then a GPU investment may be optimal. But do not be fooled by all the claims and make sure your app really delivers at least a three to five times increase in *total* time execution. Many numbers published today focus on solver times: an inadequate and incomplete measure. You may actually find a second CPU offers equal performance and greater flexibility across a wider range of applications.

Superior Storage and SSDs

Storage, like CPUs, get faster and offer ever more capacity at lower and lower prices. Your new workstation will undoubtedly have more room for designs than its predecessor. Also, consider solid state drives (SSD), which are great as secondary drives and for caching, and are superfast and super reliable.

If you work with large projects, mating new software with an SSD can pay for itself through large increases in throughput.

The Big Why

SolidWorks partner testing showed that "investing in an Intel Xeon processor-based workstation with more RAM, robust processors and faster hard drives will increase SolidWorks productivity so much that it typically pays for itself in less than six months via accelerated design iteration," according to a *Desktop Engineering* white paper: "Maximize SolidWorks' Performance."

Chance to Choose the Perfect Box

Eying a software upgrade? Match it with a hardware upgrade and see how much more productive you can really be. DE

Doug Barney *is a computer journalist with nearly 30 years of experience.*

INFO → Intel Corp: intel.com/go/workstation

At Your Service

Companies enlist third-party engineering expertise to keep costs in check and accelerate the time to market.

By Beth St ack Pole

When you're designing the next generation of a product, there's an unquestionable requirement for all engineering disciplines and skill sets to be on deck. But what happens when you're a small, modestly funded upstart with an extremely limited on-board engineering talent pool?

If you are Edison2—or any of a growing number of startups and even larger manufacturing companies—the answer lies not in growing internal staff exponentially, but rather, in partnering with outside consultants, engineering services firms, vendors or product development specialists as a way to tap into collective domain expertise in a more cost-efficient and productive manner.

In the case of Edison2, which took home the top $5 million prize in the 2010 Progressive Insurance Automotive X-Prize competition for its Very Light Car (VLC), the company is now knee-deep in development on the follow-up VLC 4.0. This is a completely new model that employs some of the same architecture and fuel efficiency features of its predecessor, but it is being designed with an eye toward commercial production. Thus, it must address standard regulatory requirements as well as safety, comfort and handling features.

Leveraging Product Data Management (PDM) tools and concurrent engineering practices, Inertia Engineering & Design facilitated the design of this industrial vacuum trailer for a client in less than eight weeks—nearly half the timeframe required by traditional product development methods.

Given the scope of the work involved, Edison2 made a conscious decision to enlist a third-party partner in the development effort—in this case, Altair ProductDesign—rather than taking the time to build out its internal expertise or invest in costly simulation software. So says Brad Jaeger, vice president of engineering and operations at Edison2.

"We have a big-picture problem to solve, and we need engineers that can understand the problem holistically and design what amounts to a proof of concept," he explains. With simulation capabilities and optimization at the forefront of this next-generation product development effort, Jaeger says it made far more sense to tap into Altair ProductDesign's deep bench of simulation talent, as well to leverage Altair's knowledge of applying its own simulation tool, HyperWorks, to a range of cross-industry engineering problems.

"We can take their expertise and knowledge, and the tools that are available to them, and get a much quicker turnaround in terms of getting results from simulation," Jaeger says. "It's also a much better price point, from our perspective."

Jaeger points out that there is no need for Edison2, which has 12 employees (only three of whom are engineers), to purchase any software or hardware. Nor does Edison2 need to invest the time it would take for an individual engineer to get up to speed.

"It's hard to dedicate a few months for one engineer to get up to speed with the [simulation] software, then actually start cranking out results," he adds. "This lets us avoid that ramp-up time and cost."

Specialty Requirements Drive Demand

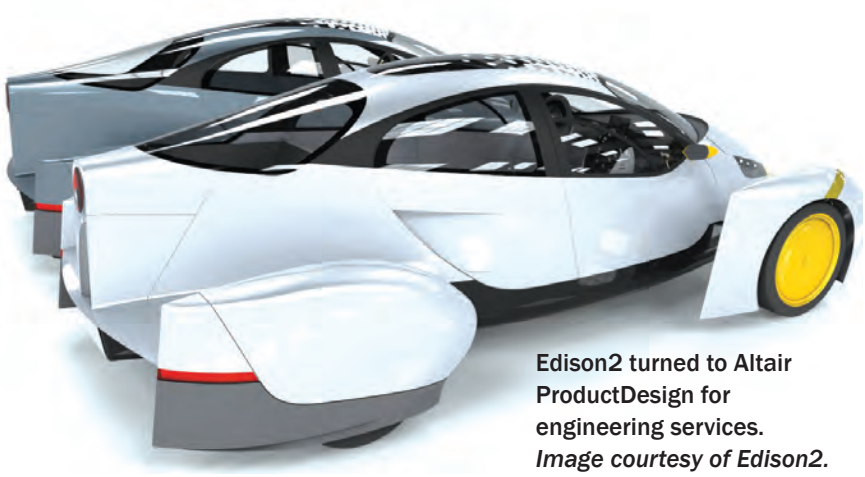
Many companies, big and small, across all industries are finding themselves in a similar boat. Continuing economic pressures means reduced resources for many shops, and like Edison2, it can be cheaper for a firm to tap outside engineering reserves on an as-needed basis—or even as a long-term engagement compared with building out their internal engineering bench.

Scarcity of specialized engineering talent is another factor driving companies to look for outside help: "The United States isn't graduating enough engineers, and there are a lot of jobs that can't be filled because the expertise isn't there," notes Ken Amann, executive consultant with CIMdata, a PLM consultancy and research firm. "It also makes it difficult for companies to keep and maintain some of the skill sets they need."

Specifically, increasing demand for simulation and optimization services, coupled with intelligence around the use of new materials, particularly composites, are specialty areas that are in hot demand. Another big gap in most companies' internal engineering knowledge-base is deep experience in software and electronics development—both critical aspects of today's increasingly multidisciplinary products, whether they be jumbo jetliners or mainstream consumer appliances.

"One of the reasons for accelerated demand is the increased product complexity, especially that surrounding software and electronics, which is outside the domain of the expertise in most companies," notes Joe Barkai, research vice president at IDC Manufacturing Insights, a market research firm. "Companies have issues maintaining enough talent with the expertise at the right cost structure."

Boston Engineering, which provides everything from new product development to test and measurement to manufacturing automation



Edison2 turned to Altair ProductDesign for engineering services. *Image courtesy of Edison2.*

services, says the complexities of designing mechatronics products has helped fuel demand for its services, according to Mark Smithers, the company's vice president and COO. Unlike some engineering services firms, which focus on mechanical, electrical or software services (or even some combination thereof), Boston Engineering takes a systems approach to engineering. Smithers says the company infuses that discipline in both its processes and its strategies, which greatly aids in the design and development of complex mechatronics products.

As simulation and optimization play a larger role in product development, particularly early on in the cycle, companies are looking to augment their in-house resources with experts familiar with specific CAE tools, and with consultants who understand how to apply physics to solve the engineering problem at hand.

Carlo Poloni, CEO of ESTECO, the maker of the modeFRONTIER multidisciplinary simulation and optimization software, says he is definitely seeing an uptick in demand for consulting services from companies who want to take full advantage of the product, and see optimization as delivering a competitive edge.

"The design of new competitive products require sophisticated engineering considerations [and software tools] that frequently are not even present in the corporation developing the product," he continues. "For this reason, high-level engineering consulting is required, as the product development cycle cannot wait for internal knowledge to grow. It is frequently far more efficient to ask experts to address the engineering problem and build an automated analysis process when the issue is a reoccurring one. It's both time-to-market and solution quality that lead companies to cultivate outside partners."

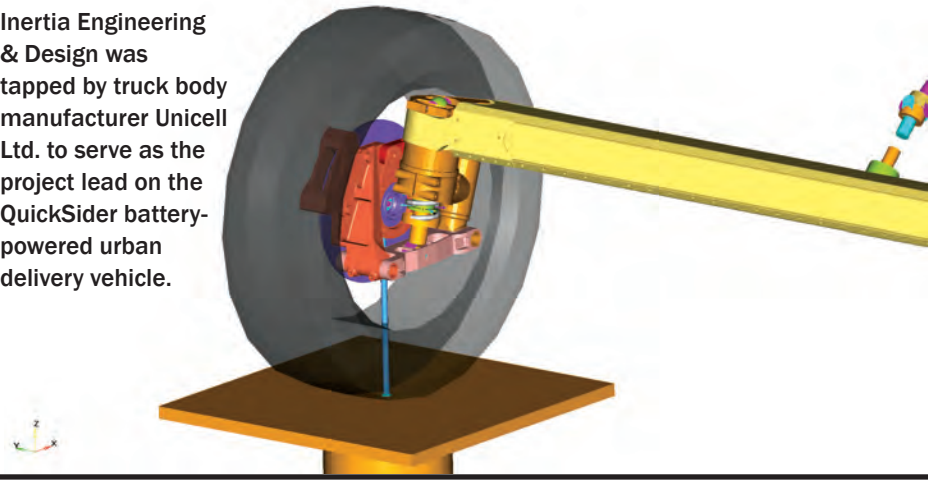
Help applying simulation and optimization software to both the suspension and safety aspects of the VLC 4.0 is part of what drove Edison2 to work with Altair ProductDesign, Jaeger says. It's also behind an increasing number of engagements for Inertia Engineering + Design Inc., a product development and engineering services company—which is growing, on average, about 30% year-over-year, according to President Ray Minato.

IE+E's depth of knowledge around simulation and materials, coupled with its well codified development processes, makes it well positioned to provide soup-to-nuts development services, Minato says. Such services range from vetting product requirements all the way through concept design, testing and even oversight for manufacturing and production.

"It just makes sense to take a whole view of a situation," Minato explains. "When you're doing just a portion of it, there are inefficiencies, and things might get lost."

Making Relationships Work

Whether the engagement is a long-term outsourcing relationship or a pay-by-pound simulation project, IE+D adheres to number of common processes—and leverages a variety of collaboration tools to ensure the partnership is a success. In addition to employing SolidWorks product data management (PDM) as its backbone for storing and collaborating on all project-related design data, the company has honed quality processes and engineering workflows over the years that drive engineering efficiencies and keep all of the project stakeholders on the same page, Minato says.



Inertia Engineering & Design was tapped by truck body manufacturer Unicell Ltd. to serve as the project lead on the QuickSider battery-powered urban delivery vehicle.

New collaborative design capabilities, generic collaboration platforms, videoconferencing tools like Skype and WebEx, and even a new generation of social design tools are all helping facilitate the requisite levels of communication that ensure profitable outsourcing partnerships. This is especially helpful when the arrangement is conducted primarily off-site. Minato notes that the biggest challenge lies in managing expectations, which is where robust tools and formal communications processes come into play.

"The approach we take is to tell our clients the story of what we're doing—not just the technical details, but what we know, what we don't know, the pros and cons of ideas, the recommended solutions," he explains. Design reviews are provided on at least a weekly basis, and "at the end of the project, a client might have 40 to 50 PowerPoint files with all the learning in there so they can understand it.

"By including them in the process, they are involved in the decision-making, and we are seeking agreement at every step, always reiterating the risks," he explains.

In addition to tools and open and regular communications, experts agree that it's critical to establish clear roles, including who is responsible for what, as well as to formalize contractual agreements to specify ownership of intellectual property. There should be clear levels of protection included, as well as remedies in case of a problem. It's also important for the client to keep skin in the game, so to speak, and not abdicate all engineering responsibilities to an outside party.

"You have to be smart and sophisticated about what you have to own and what you outsource," says IDC's Barkai. "It's striking that right balance between innovation and reuse, and what you keep in-house and what you outsource." DE

Beth Stackpole *is a contributing editor to* DE. *You can reach her at beth@deskeng.com.*

INFO → **Altair HyperWorks:** AltairHyperWorks.com

→ **Altair ProductDesign:** AltairProductDesign.com

→ **Boston Engineering:** Boston-Engineering.com

→ **CIMdata:** CIMdata.com

→ **Edison2:** Edison2.com

→ **ESTECO:** ESTECO.com

→ **IDC Manufacturing Insights:** IDC.com

→ **Inertia Engineering + Design Inc.:** InertiaEngineering.com

→ **SolidWorks:** SolidWorks.com

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Have CFD/FEA/PLM Skills, Will Travel

Freelancers are on the rise in product development.

BY KENNETH WONG

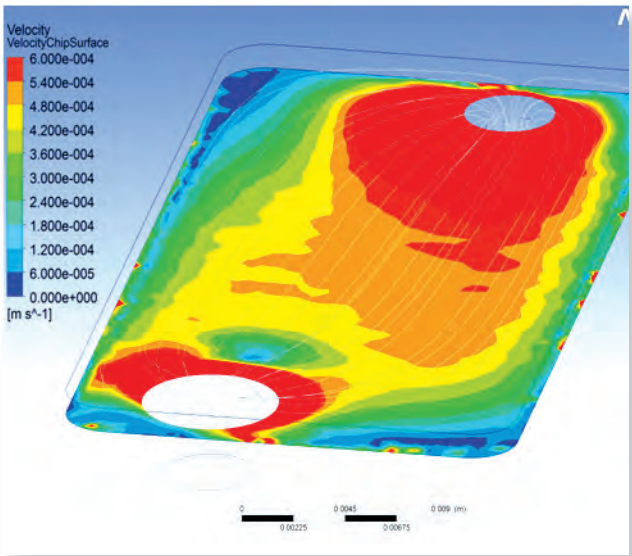
Tom Marinaccio tends to get distress calls from people trying to understand why something has failed, usually with the need to find an answer and fix it in a narrow window of time. He describes a typical call as follows: "[The plant operator] had some ideas what the problem was. The material that forms the thermal protection inside a furnace seemed to be eroding more quickly than expected. They had 10 plants. They operated them the same way. But at that particular one, they were getting warning signs. The outside of the furnace was hotter than it should be. They knew something had gone wrong inside, but didn't know what."

The facility owners knew they needed to shut down to implement a permanent fix, but the downtime must be kept to an absolute minimum. It would be up to Marinaccio and his colleagues to digitally simulate the operations of the troubled furnace, complete with material properties and thermal loads, and then present the most probable answer to the owners.

With sophisticated CAE software, Marinaccio could literally show a cross-section of the furnace to reveal the heat buildup inside. This new understanding gave plant operators confidence in the remedy they had chosen. If necessary, Marinaccio could also simulate the planned fix to predict whether it would work.

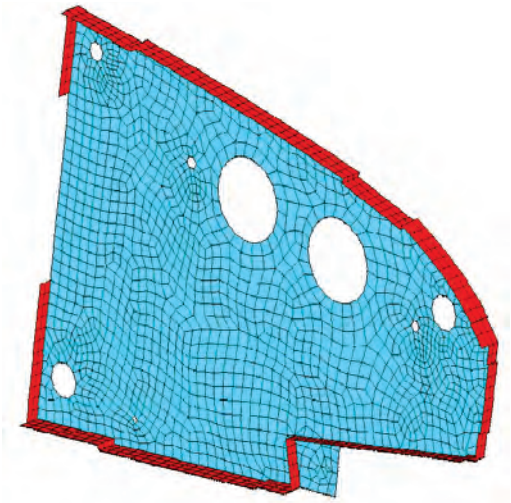
Metin Ozen has received similar calls. He remembers the time Keck Observatory in Maui reached out to him. "It's up at 14,000 ft. At that elevation, the ambient air gets very cold at night," he says. "When they open up the observatory, there's a sudden change in temperature in the mirror. It's made of glass, but supported by structures with another material, so they expand at different rates. We were called in because the mirror started cracking."

Cory Huey tends to get a different variety of Mayday calls—usually from manufacturers who have come to realize they're lagging behind their competition because of aging IT and software infrastructure. They want to undertake a technology upgrade, accompanied by a workflow overhaul, but aren't sure where or how to begin. EAC, Huey's employer, has been involved with more than 400 product lifecycle management (PLM) system implementations, just in the last six years. And that historical knowledge, Huey adds, "can get a customer to the point of success faster than they can on their own."

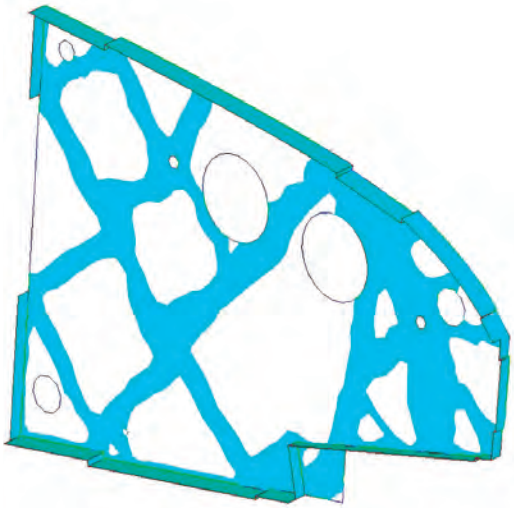


In one of its consulting projects, Ozen analyzes the optimization of a fluid passing through a flow cell where the properties of the fluid are being measured on the sensor surface. To obtain accurate measurements, the fluid should have a uniform velocity.

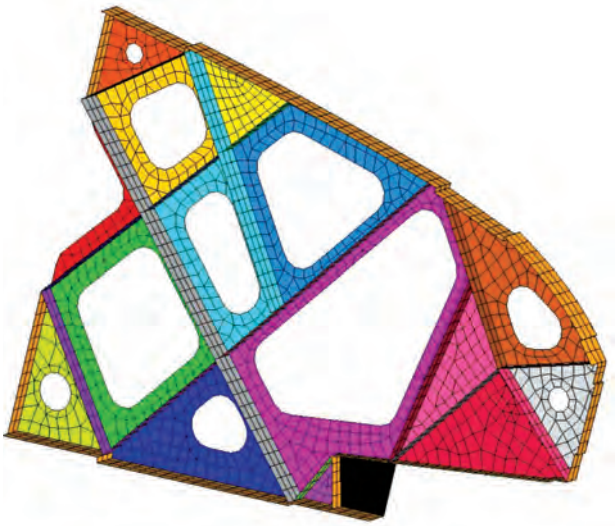
Marinaccio, senior vice president of CD-adapco's worldwide engineering services; Ozen, CEO of Ozen Engineering; and Huey, vice president of services at EAC, belong to a growing pool of hired guns for design and engineering projects. Simulation experts like Marinaccio and Ozen are ideal for projects where you need swift resolution and don't want to deal with acquiring, learning and mastering a particular technology—for example, software-driven fluid or thermal simulation. Quite often, they won't even need to haul their laptop and fly to the troubled site; they just need



The meshed topology of a wing section of Airbus 380, part of a consulting project undertaken by Altair ProjectDesign Group.



The optimal topology, as proposed by Altair's OptiStruct.



The final design p oposed by Altair ProductDesign Group, which makes the wing 40% lighter.

the CAD file, operating conditions, and a series of inputs to find the answer. PLM experts like Huey and his colleagues have implementation experience culled from years of continuous improvement of their engagement process. They're your on-demand reinforcement, part of the consultant brigade to help you put out fires, deal with a sudden workload spike, or usher you into a more efficient workflow. For businesses that prefer to keep a lean in-house staff, engaging freelance talents has become a vital part of operations.

Specialized Skills, Software Mastery and Hardware Firepower

Most simulation consultants have a specialty, encompassing a deep understanding of the best practices, government regulations and software tools used in their domains. From past history and repeated consultation, they have developed encyclopedic knowledge of specific areas, such as sustainability, thermal conductivity, air flow, fluid flow, weight reduction, etc.

"Our specialty is solder-joint reliability," Ozen says. "In many modern devices [cellphones, tablets, etc.], the solder joints go through many cyclic motions. They are usually the weakest connection in electrical components. When you drop them, the solder joints are the first ones that usually fail."

Lately, Ozen has expanded its services into electromigration analysis, a prevalent phenomenon in cell phones, CPUs and LED units. "It's a different failure mechanism. Materials tend to evaporate, dissipate. This happens because of the high current in tiny electronic devices," he explains.

Ozen uses ANSYS Multiphysics (MP) and ANSYS Mechanical to simulate thermal stresses and coupled physics phenomena (like electro-migration or electrostatic on structures). "Some clients do have the software in-house, but don't have the knowhow to set up the simulation problem correctly," Ozen says. "So we would go in, show them how to set it up, solve it, hand the engineer a report—essentially train them to do an advanced simulation in-house. Then there are other clients, like a startup, that don't have the money to invest in the software; they just want a problem solved."

Consultants also make a point to augment their software arsenal with appropriate hardware. Part of the benefits a consultant offers is its ability to run compute-intense programs on its own systems without tying up the client's resources. Last year, Ozen added a high-performance computing (HPC) server with 48 processors, custom-built by Fine Tec Computer. Ozen also acquired a HP Z820 workstation equipped with NVIDIA Maximus technology, comprised of two GPUs (Quadro and Tesla units). Because ANSYS software is written to run parallel computing jobs on multicore CPUs and GPUs, newer hardware dramatically speeds up processing time: "We

can now solve in a day or two projects that used to take one or two weeks," Ozen says.

It's quite common for simulation and analysis software developers to have a small army of consultants, as they have not just the software expertise but also the IT infrastructure (specifically, HPC servers) to speedily process complex CAE tasks. CD-adapco is known for its flagship software STAR-CCM+, an engineering physics simulation software suite. The company also has about 100 dedicated consultants, completely separate from the software R&D division. They account for roughly 15% to 20% of CD-adapco's revenues, according to Marinaccio.

CD-adapco consultants recognize a comprehensive analysis would invariably involve more packages, including those from competitors. "If you're looking at fluid flow, heat transfer, stress, fatigue, dynamics, battery and casting, this could involve software we [CD-adapco] may or may not have," he observes. "In these cases, we work the problem by using STAR-CCM+ for part of the project, and SIMULIA Abaqus [a Dassault Systèmes product] for structural mechanics."

Divide and Conquer

MSC Software, another simulation software developer gearing up for its 50th anniversary, has about 155 consultants on staff and another 200-plus freelance consultants that they utilize for engineering work. They work in concert with the R&D team, but they are a separate group, accounting for roughly 10% of the company's revenues, according to Tony Davenport, MSC's senior marketing manager. "Our services team knows our software inside and out; coupled with a half-century of engineer experience, we provide our customers with amazing, efficient engineering solutions every day," Davenport states.

Dr. Martin English, manager of design and development, Hadley Group Technology, was a client of MSC Software's consulting services. He notes, "Access to the vast and varied knowledge base of MSC Software's engineers proved essential in fast-tracking our understanding of our specific application from the onset, bypassing weeks of analysis time spent trying to arrive at the same solution ourselves. The value of such an approach should not be underestimated."

Davenport notes that the service team is broken into two groups. "The general services group pretty much takes on every type of mechanical simulation—computational fluid dynamics (CFD), structure, dynamics, kinematics, motion, materials, acoustics, and so on," he explains. "Then there's another group that focuses on data and process. They respond primarily to customers who are new to analysis that

may want to develop efficient engineering methods, or may want to improve an existing method."

With acquisitions of e-Xstream Engineering in September 2012 and Free Field Technologies in September 2011, MSC gained expertise also in material science and acoustic simulation. The new products and experts joining the company allowed MSC to offer consulting services related to composite materials, plastics and noise reduction in automotive, aerospace and consumer product design.

Fresh Ideas from the Outside

Although best known for its engineering simulation software, Altair also maintains a ProductDesign division, comprising roughly 700 engineers. They operate separately from the developers involved in crafting and programing the next releases of Altair software products; however, what consultants learn on the job tends to serve as inspiration for new features and functions added to the software.

Mike Heskitt, COO of Altair's ProductDesign division, reveals that his unit accounts for roughly 25% of the company's revenues. Over time, the division's engineers gained a reputation for being able to drastically cut down weight and mass in products. The core of their approach is Altair OptiStruct software, which can propose a lighter design that can withstand the required load and stress.

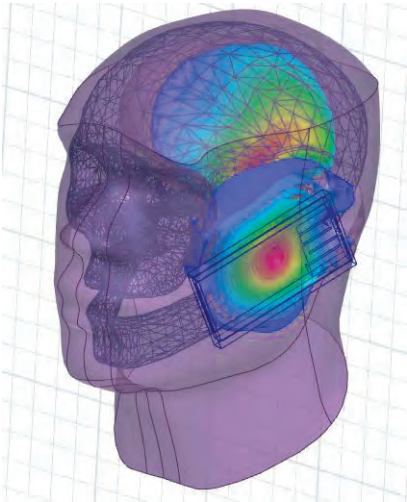
Altair knew it was taking a risk when it accepted an assignment from Airbus to redesign its wing section to make it lighter. In attempting to reduce fuel consumption and carbon dioxide emission, the aerospace and automotive industries usually look to reducing weight as one of the most effective strategies. Altair has extensive experience in automotive, but the Airbus 380 program was among its early forays into aerospace. Could they apply the same weight-reduction and topology optimization principles from automotive to aerospace and achieve the same results?

The project was "pretty severely behind schedule," Heskitt recalls. "This was a risk for Altair, because we weren't sure we could do it in [Airbus's] timeframe [of 12 weeks]." As it turned out, they could: Altair delivered its design on time, with a 40% reduction in the wing's weight.

But the proposed topology, with 13 ribs, was so radically different from what the aerospace industry was familiar with that it first met with skepticism.

"The design we delivered was a very nontraditional airframe," Heskitt says. "At the time, they didn't have the technology that would make them look at solutions in that direction."

If engineers had taken the traditional approach of padding more materials to stiffen areas expected to buckle, he explains, they would not have stumbled on the topology proposed by OptiStruct. The software examines simulation results, then proposes the optimal topology that can counteract the stress distribution—a more sophisticated approach to design.



In another consulting project, Ozen was asked to simulate induced specific absorption rate (SAR) levels for a typical cell phone on the human face, skull and brain. SAR is defi ed by the FCC as being "a measure of the amount of radio frequency energy absorbed by the body when using a mobile phone."

Airbus became convinced of the integrity of Altair's proposal when the design passed through its test program. With the new wing ribs, each Airbus aircraft is approximately 1,100 lbs. lighter. Today, Airbus maintains an optimization center in partnership with Altair.

Process Reengineering

As a PTC software reseller, EAC has access to the latest product development and data management technologies. But EAC's Huey is no longer surprised when he meets clients using 20-year-old software, dating back to Bill Clinton's presidency. Such aging technologies are stumbling blocks in deploying the most advanced design and engineering methods into the client's assemblies, or efficiently tracking the revisions and versions of external references embedded within the models, he noted.

As PTC Windchill became standard PLM product for its customers, PTC phased out an older product, Pro/PDM, in 2001. As recently as last year, Huey encountered several clients still plodding along Pro/PDM's decade-old setup. Somehow, he suspects, they won't be the last ones he encounters.

"[These customers] were managing current-day projects with current-day design complexities in Pro/PDM," he says. "When you're working with a technology that old, there are severe limitations on what you can do with your design environment, because the data management system may not understand the design techniques you are trying to utilize."

When asked why they insist on putting up with such inefficiencies, Huey's clients often reply, "It was working for us at the time," or "Our processes were developed around that [old data management system]."

Sometimes Huey's staff gets calls from those who wish to add additional functionality to their current PLM environment, data indexing or model publishing. Sometimes he gets calls to help facilitate a software replacement or to develop better data transfer between PLM systems and enterprise resource planning (ERP)/manufacturing resource planning systems. But most often, Huey gets a call when a business wants to roll out the latest version of their existing PLM software or decides to move from homegrown, directory-driven data management system to a more formal PDM or PLM system.

Huey attributes EAC's success to the company's ability to show tangible, measurable results or improvements. "There's a reason a customer is needing to improve or update their environment," he said. "There should be a return on their investment. We'll work with the customer to define these measures or metrics. After an implementation is complete, we come back and measure the results to ensure the customer is getting the value we promised."

For example, the basic unit of measurement for a successful implementation could be the decrease in the amount of time employees spent searching for information. Another measurement may be the reduction of scrap, or wasted material, an outcome directly linked to better change control, version control, and communications with supply chain.

Successful Consultancy

EAC's Huey admits that some of his consulting projects are hampered by clients who are slow to acquire necessary hardware—multicore workstations for graphics-heavy engineering programs, servers for data warehousing, and so on—to support the implementation. It's not always frugality or budget constraints that prevent clients from moving to a more modern data-management environment. Sometimes it's their unwillingness to make drastic changes to a familiar workflow and process.

Being outsiders, consultants can bring a fresh perspective to the problem a business is trying to solve. As shown in Altair's case, they sometimes introduce innovative ideas, inspired by a different industry with which they have had the chance to study and work.

"Companies that are willing to look outside, are willing to see what other people are doing and to adopt what they can benefit from—we have the best engagement with

these types of companies," says Altair's Heskitt. "We may see something in automotive that's interesting, and propose that to an aerospace company to try out. But some closed-minded companies won't see that as a value; they may only see risk."

CD-adapco's Marinaccio says he believes bidirectional transparency between the client and consultant is part of his team's success formula. "We work in virtual hallways," he quips. "As we get close to a deadline, we may be exchanging emails 20 times a day. We don't guard our methods. Some consultants worry that if they tell the client how they do things, then they won't be needed anymore. From our point of view, that's a bad way to work. If they want to do something themselves, we'll help them do that, because we'll end up with a software sale. We're very open to customers' questions about what we're doing."

The rise of consultants in design and engineering projects has to do with the highly specialized skills freelancers can bring. For most manufacturers, CFD simulation, sustainability, electromagnetic fields, or systems integration is not their core business. Developing in-house talent to address occasional needs doesn't seem like a pragmatic approach. For such situations, an on-demand talent pool is a more attractive alternative. But what begins as a one-time or temporary engagement may lead to a mutually benefitting relationship—turning consultant and client into partners to jointly pursue new ventures together. 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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→ **Hadley Group Technology:** HadleyGroup.com

→ **HP:** HP.com

→ **MSC Software:** MSCSoftware.com

→ **NVIDIA:** NVIDIA.com

→ **Ozen Engineering:** OzenInc.com

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FEA for Managers and Reviewers

Finite element analysis services are becoming more in demand—and more in supply. Here's how to determine your best choice in practitioner.

BY TONY ABBEY

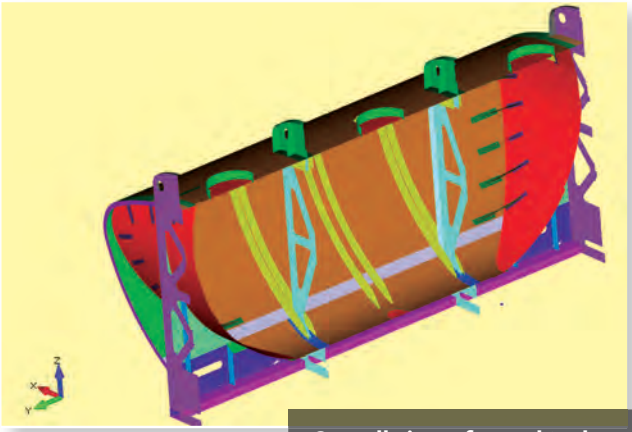
Editor's Note: Tony Abbey, in conjunction with NAFEMS and Desktop Engineering, *will discuss this article's points in a free, Q&A-style webinar on March 7. For more information and to register, visit nafems.org/asktony.*

Finite element analysis (FEA) tools are now widely available and relatively cheap. This means an increasing need for analysis resource across the industry, as well as a growth in consultancy firms.

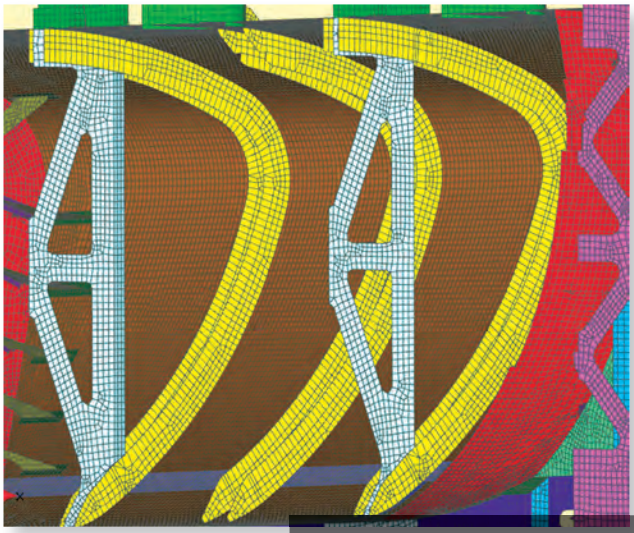
The cost of investing in people increases, and "career" analyst numbers are falling. The result is a shortage of engineers familiar with FEA in industry, and increased outsourcing. There are fewer staff to manage effective initial task assessment and resource allocation, or to carry out the analysis review.

The whole question of process management and quality assurance (QA) with FEA is a big topic, so in this article we'll focus on two themes: startup and review.

- Managers: Let's discuss the need to buy time up front to focus on the key questions, so that the team can start work effectively. We need to know the scope, objectives and the deliverables.
- Reviewers: How do you sign off an analysis report? You will need evidence of good basic checking, demonstration of good practice, and confidence in the analysis and its results.



Overall view of a road tanker used in an FEA analysis.



Internal details of a road tanker.

Planning the Project

We need to understand the stages involved in an analysis project. A common assumption is that analysis starts with the meshing, with the analyst quickly jumping to the computer. It is an overwhelming temptation—comforting for managers to see engineers busy, and engineers to be seen as being busy! But we need to avoid this, and buy time to plan properly.

The first stage is the problem definition. We scope the physical problem and the client's expectations, to decide on the simulation approach we take. All these are the high-level decisions.

On the NAFEMS Introductory FEA courses, we build a process sheet interactively. Over the years, many useful ideas have evolved, and some are presented below.

Preparations and Actions before an Analysis

1 Define your objective. Determine whether this is forensic analysis, a fresh design or a redesign.

- If it's a new product, with no previous analysis or test history to compare against, we have to assess assumptions and methodology carefully. We may liaise with design and manufacture, and stage through preliminary and final design.
- Analysis of a failed component requires as much data as possible on the failure. A surprising amount of physical data and anecdotal evidence is lost that could have underpinned analysis assumptions and conclusions.
- If we're certifying a product, we need to know the standard and where to source it.
- If we're determining what safety level factors are required, keep in mind that man-rated or mission-critical will need higher safety factors for design and more rigorous analysis.
- If the analysis is to support a scrap or re-use decision, we need to understand the cost implications.

2 Get familiar with the structure to be analyzed and its purpose. We need to look at the background of the structure, to understand the failure mode, in-service conditions and associated tests.

3 Consider the scope of the analysis. We should understand loading applied to a structure and internal load. This takes skill to establish free-body diagrams, etc., and use initial hand calculations to check feasibility. If the team doesn't have these skills, it's a good idea to plan to develop them. This is vital: We can't treat the structure and its analysis as a black box solution in FEA. A reviewer looks to see whether you understand the structural behavior, in the report and in any presentation.

4 Consider how to represent real-world loading within available analysis simulation tools. Avoid point loading inputs; they don't exist in the real world and will cause analysis problems. Pressure on available geometry faces may be too approximate. Augment the geometry to map the real footprint.

Overall internal stresses in tanks and frames.

5 Consider the constraints. Simulation includes fully built-in and simply supported methods. In reality, neither exists—so we introduce boundary conditions in other ways. Testing and documenting of assumptions should be clear in the report and to the reviewer.

6 Source and check geometry data. CAD data source and format should be defined. Product lifecycle management (PLM) may handle this, or we may need to get coherent data from the client. Keep in mind that we need time to assess the stability, applicability and accuracy of data. This is a key step for which we should be prepared.

7 Source material data and design standards. We need to make sure we source early with authoritative values. If we standardize on data sources so they are readily available on-site via PLM or other systems, then so much the better. If we're involved in a design or redesign, we need to have a good understanding of acceptable materials, section types, gauges, approved welds, bolts, etc.

8 Define the resources available for the analysis. This includes available manpower, associated skills and range of experience. It includes resources we can tap into for advice and guidance—within the company, trade organization or software hotline. Available computing resource is important. You may be competing, so check with other departments. This includes computing power, storage, etc. Tuning analyses against computer resources, to give good predictions on feasible size and scope of FEA models, is essential.

9 Know to what you are entitled. What is your available software, including appropriate modules and licenses? Calling a software vendor last minute is not going to enable much discount. Budget, time scale, and priority are huge factors. Sadly, this gets overlooked on most courses.

Modeling Methods

There are many modeling method choices, including analysis type, linear, nonlinear, dynamics, fatigue, etc. An assessment of the physics involved in the real structure and how we simulate it is required. The reasoning must be reflected in the report, and clearly understood by a reviewer. This builds confidence—and any false steps or revisions can be more easily and constructively addressed.

Different idealization levels have been covered in previous articles, including 1D, 2D or 3D simulation and choosing mesh refinement. In summary, though, we want sufficient elements to represent the structure well. Too many elements imply performance and resource issues. Again, assumptions and validation model details should be in the report.

Defining the Deliverables

This could be a detailed report that needs an overview for reviewers to quickly grasp what we have done and how.

When reviewing, I recommend requesting a copy of the analysis files to check the validity of the method and results.

I have occasionally been surprised when certification bodies have resisted this idea, as they cannot rerun the analysis. There are two points: the original model creator doesn't know that, and the analysis run can be subcontracted out if required.

Another argument is that the model is intellectual property of the originator. The contract should indicate that independent check runs are valid and legal QA.

I have supplied analyses to major aerospace companies who demand copies, and it really sharpened my game. I have seen reports that make me question what model could produce them. It is something for both sides of the process to think about.

The Single Model Syndrome

Several models can be used to support different aspects of the project, such as an assembly global model, and local models of important details with finer mesh or plane strain 2D simplification. Many analysts build a single model, but we don't need to be thus constrained.

I like having an "under-the-table model." In my early days, project budgets only allowed a single model. This was an all-embracing model, which occasionally wasn't ready for the design review. Sitting in a design review without results can be career limiting.

A simpler model was often developed in parallel, representing the basic structural behavior. It was a lifesaver to present the results from this.

Report Format

Let's review the format and content of the report, from the manager and reviewer perspective. Your FEA program may produce an automatic report, which is a starting point.

- Consider the audience. Whether you go with an informal or formal report depends on the recipient. Is it your peers, the management, the prime contractor, the certification authority? The level of detail and the structure reflect the audience and intent. A detailed report for formal review should include extensive results, tables, assumptions, etc. To avoid overwhelming the reviewer, provide an executive summary with conclusions and key results.
- Show, don't tell. Don't write a report like a magic show, with the climax in the last act. Do the opposite: Show the rabbit in the executive summary, and then explain it. Put the detail and the majority of the results into Appendices.
- Support your work. There must be clear supporting evidence for the analysis methods and the conclusions. Hopefully you will be confident about the analysis, and want to convince

Things to Avoid with FEA

What follows is a short list of things that should not get through to review stage:

- Stress averaging switched on in plots. They may hide real peaks, poor mesh and be un-conservative.
- von Mises stresses only in global views. We want to know what is happening throughout the structure, and at key points what the stress state is (tension, compression, shear, bending, axial, etc.). This takes more than a single plot.
- No overall load balance summary—what went in, what came out.
- No summary of checks carried out on element quality, numerical solution accuracy, etc.
- No detailed breakdown of components, materials or properties with clear diagrammatic roadmaps.
- No detailed set of mesh plots.
- No clear definition of assumptions and modeling techniques.
- No clear statement of analysis objectives and whether they were met.

—T. Abbey

the reviewer. A prior internal peer review is useful—and not just by experts. If a manager knows the basic ideas of good and bad practice, he or she can assess the validity of, and confidence in, the work.

- Build the report as you go. If you don't record details, you may forget. Meld them into the final report. The worst-case scenario is leaving "dummy" material or other data in an analysis. If not updated until report time, results change and a rewrite is needed.

Whether your role is manager, reviewer or analyst, there is a lot to consider in an FEA project. We want to be able to use this powerful technique safely and effectively. I hope this very brief overview has given you some food for thought. For more, attend my March 7 webinar on this subject by registering at nafems.org/asktony. 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 a wide range of e-learning classes. Send e-mail about this article to DE-Editors@deskeng.com.*

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You Better Shop Around

When shopping for a rapid prototyping service bureau, word-of-mouth recommendations are your best guide. Lacking those, how do you find the service bureau that's best for you?

BY MARK CLARKSON

How do you shop for a rapid prototyping service bureau? First and foremost, says Charles Overy of LGM, a Minturn, CO-based provider of visualization and modeling solutions.

"You need to be honest about what you know, what you don't know, what you want to learn, and the timeframe you have to learn it in," he says.

"We can do a simple 3D print if someone brings us an STL file," Overy continues. "But if you've got a SketchUp drawing and you need a model to put in front of your client in two weeks, that's a whole different conversation."

Maybe this isn't your first time around the block. "If you're using SolidWorks," says Overy, "and you know you want STL, and you've had experience with STL printing, and you know that the STL file you're generating is solid, and you're printing it at 1:1 scale, and you don't need help with draft angles … then you can shop on price. If not, and if you don't have time to learn about 3D printing, look for a specialty bureau that works in your area of need in order to fill in some of the blanks."

Specific industry knowledge can save you time and money, Overy says: "You may find that we can save you substantial money over an aggregator or another bureau, simply because we know the specifics of the industry." LGM primarily produces architectural models, but the same can apply to other industries.

Overy suggests looking at a candidate bureau's website, to determine whether its body of work is applicable to your project. If they have the same stock samples as dozens of other sites, you might win on price, but lose on knowledge, support and value-added services.

That last factor is a dealmaker for LGM, Overy notes: "About 50% of our revenues don't come from 3D printing; they come from value-added services related to taking the [customer's] data and getting it ready to 3D print."

Know What You Want

What are you trying to accomplish? Do you really need a metal part, or can you live with a prototype that looks like metal? Does it need to live and work in the real world, or just look pretty at a trade show?

Do you have a design review next week? Then speed is your primary concern. Or maybe you need a prototype that looks and functions just like a real product. In that case, you'll need to go down a different path.

"Sometimes we give a customer a price and they go into sticker shock," says Chuck Alexander of Solid Concepts, a rapid prototyping service provider. "When we dig a little deeper, we find out they don't need a cosmetic, functioning part; they just need something to pass around the table. The more detail you can provide, the easier it is for a service bureau to recommend the right thing."

Dare to Compare

There are a lot of rapid prototyping service bureaus out there. Shop around. "Don't stop at the first place," advises Michael Siemer of IMDS, a medical device outsourcing company. "Talk to at least three different companies."

Just a quick conversation, he says, will usually give you a good feel for whether the company has the experience you need: "Are they trying to help you, or are they just trying to sell you? Some companies just want to make the sale, and you don't typically find that out until you get your parts back."

Siemer says it's also important to find out whether a candidate bureau can back up its recommendation with good technical direction. And local, face-to-face service is key.

"If I had a choice between two different companies and one would save me 10%, but was located in another state, I would pick the local company," he adds. "When I get my part and it's not exactly what I want, I can get help more effectively."

After all, when things go wrong, says Siemer, it's nice to have a "throat to choke."

Realize AM's Limitations

While metal additive manufacturing (AM) is a hot topic, there are more limits with metal AM than plastic, according to Siemer. It's also more expensive.

"People think, 'I can spend $300 on a plastic prototype, maybe metal's just a little more.' It's not just a little more," he says, noting that metal parts and prototypes can easily cost five to 10 times as much as plastic. "Some people believe that because it's 3D printing, it can build whatever you draw. But additive manufacturing has limitations, just as with any manufacturing process. It has a lot more design freedom, but it's not perfect."

Do you need a working part with a 0.010-in. living hinge? It's probably not going to happen, Seimer says: "That's one of the reasons to go to a service bureau, to get basic education about what additive manufacturing can and cannot do."

Size Does Matter

The size of your part is also a factor in choosing a service bureau.

"Something large like a car bumper typically has to be built in multiple pieces and assembled," explains Terry Wohlers of Wohlers Associates, a consulting firm specializing in 3D printing. "These are more complex projects. You want the pieces to lock together, almost like a jigsaw puzzle."

With that in mind, you want a service bureau that has the tools, skills and experience to pull it off. Another factor that is sometimes overlooked is the downstream processes, Wohlers says.

"It's one thing to submit a file and have parts built, but it's a 'whole nuther thing' to process those parts—

not only to knock the supports off or remove the excess powder, but to really clean them up and prepare them for whatever application you require," he adds. "If you want to present those parts at a show, they have to be polished up nicely, and typically painted or coated. Not everyone has those capabilities. Some people just 'strip-and-ship;' they clean the parts up and ship them out."

You might need something a bit more refined, but that can take time, he says. "You can coat these parts so you can't tell how they were manufactured. They look injection molded. They look like finished products," Wohlers says. "But it takes a lot of expertise to get to that level of finish."

No service bureau can do everything, he points out. Processes like chroming might have to be outsourced, which will add more time. But do you really care about the production speed? Maybe you can wait two or three weeks for your prototype. For a rapid prototyping bureau, two weeks isn't fast; it's slow. If you're willing to wait a little longer, it can sometimes save you money.

Quality, Service and Information

Another important consideration is a service bureau's quality control system. "Solid Concepts is a manufacturing company," notes Alexander, "so we treat [rapid prototyping] that way. All of our shops have ISO certifications. In lieu of those certifications, you have to start to dig deeper. How do they control their processes? How do they know they're not contaminating one material with another?"

The key, he says, is to look for a company that's focused on service. "Plenty of people out there will build parts, but are they a service organization? That's something you want to focus on, especially if you're a new user.

"The rapid prototyping industry—especially additive manufacturing—changes pretty quickly," Alexander adds. "If you're a design or manufacturing engineer, it's usually not your job to stay up to date on all this stuff. It is our job."

A Diversity of Processes

The experts agree that ideally, your bureau should be a diverse one.

"Make sure you get the right solution, not just the process they have in-house," says IMDS' Siemer. If you go to a service bureau that only offers STL, for example, it's no surprise that that's probably what they're going to recommend. People sell what they have, so look for a service bureau with a range of manufacturing options.

And don't forget traditional methods, such as computer numerically controlled (CNC), laser jet cutting, water jet cutting or urethane casting techniques.

"The more a service bureau has to offer, the easier it is for you as a customer," Alexander concludes. "You don't have to work with multiple vendors." DE

Contributing Editor **Mark Clarkson** *is* DE's *expert in visualization, computer animation, and graphics. His newest book is Photoshop Elements by Example. Visit him on the web at MarkClarkson.com or send e-mail about this article to DE-Editors@deskeng.com.*

INFO → **Innovative Medical Device Solutions:** IMDS.net

→ **LGM architectural visualization:** LGMModel.com

→ **Solid Concepts:** SolidConcepts.com

→ **SolidWorks:** SolidWorks.com

→ **Trimble SketchUp:** SketchUp.com

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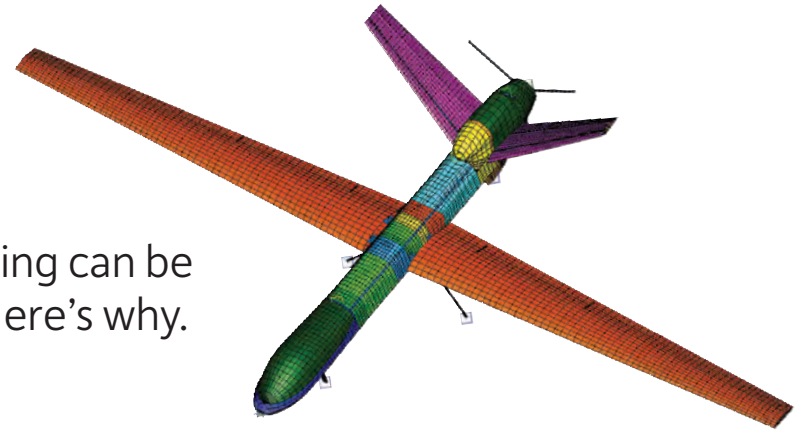
Test Prep



Hiring out mechanical testing can be a be˜ er choice than DIY. Here's why.

BY PAMELA J. WATERMAN

Great engineers are usually Renaissance types—those dynamos who manage to know and do a bit of everything in and out of their field. They listen, they learn, they push limits, but they also recognize when a solution is best left to the experts.

Working with an outside, expert service may be the right course for you to follow, too, when a product or system needs mechanical testing, whether for validation, comparison or certification purposes.

Fortunately, specialty testing companies are here to help, offering equipment, services and years of experience that can accommodate products from tiny medical devices to full-size drone aircraft. *DE* asked a number of testing companies to share their thoughts on making the most out of using their services.

Hip implant test set-up at Accutek Testing Laboratory, based on a specific test procedure in Method ISO 7206 for measuring endurance and fatigue testing of artificial hip implant prostheses. *Image courtesy of Accutek Testing Laboratory.*

Why Use Outside Test Sources?

Erin McCloy, director of marketing at Accutek Testing Laboratory in Fairfield, OH, offers four key reasons why it makes sense to hire out testing:

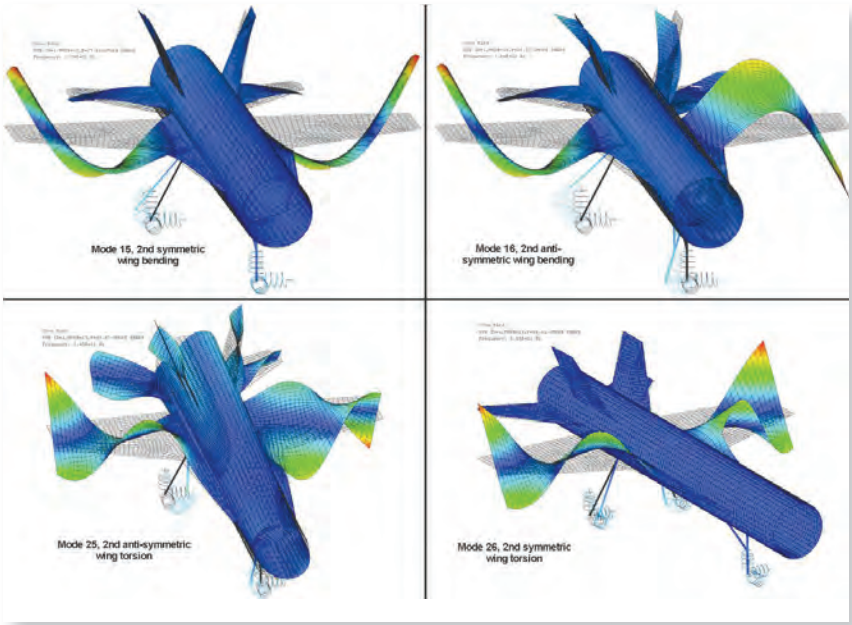
1. They've made the rookie mistakes long ago. She explains that if you're doing a test for the first time and setting up monitoring equipment, you might get well into the program and find, for example, you've chosen the wrong transducer.

2. They let you focus on your core business. If you are a developer of a hip implant, you're good at developing. You know how to manufacture, but learning the science of testing is a completely different animal. "Just like you outsource your shipping to UPS, outsourcing your testing to somebody who is experienced allows you to focus," McCloy explains.

3. They offer an independent, nonbiased, accredited testing option. Accutek, for example, holds a number of accreditations with groups such as ISO

Humvee vehicle in Dayton T. Brown's environmental test chamber for MIL-810 low-temperature testing. *Image courtesy of Dayton T. Brown.*

An antenna undergoing MIL-810 vibration testing at Dayton T. Brown's testing facilities. *Image courtesy of Dayton T. Brown.*



Example of modal test data supplied to a client, based on an "iron bird" test bench model used for R&D and training at ATA Engineering. ***Image courtesy of ATA Engineering.***

and Nadcap (formerly NADCAP, the National Aerospace and Defense Contractors Accreditation Program, a global cooperative accreditation program within the aerospace and automotive industries). These bodies have verified and audited Accutek's protocols, procedures and quality assurance programs. McCloy notes this is especially important for backing up a client's marketing and performance claims.

4. They operate on economies of scale, owning and maintaining multiple sets of test equipment and fixed-cost items. Running tests on, say, 100 samples of a composite part in a timely manner would be a challenge for a design company owning a single test set-up—but would be fast and straightforward at a testing service with duplicate stations.

What Tests Do You Need?

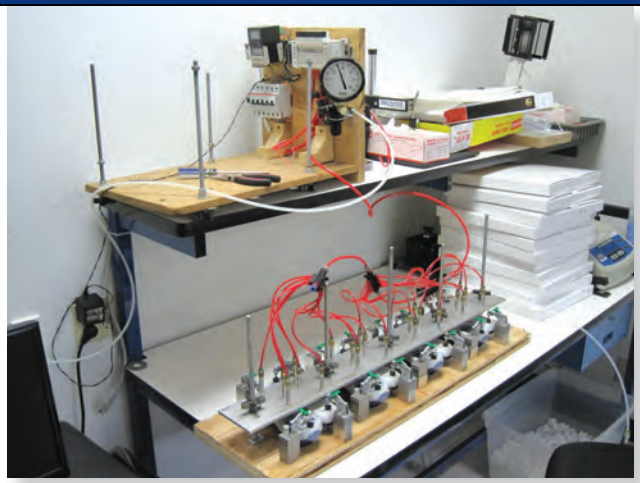
Mechanical tests fall generally into the categories of physical properties, thermal response, and static/dynamic behavior. The most commonly performed include vibration testing (random, sine, shock), drop/impact, temperature/humidity, strain/fatigue and altitude/pressure differential. Within these areas, engineers can choose from thousands of test procedures—some general in concept and some very specific, such as fastener or chain testing, salt-fog corrosion resistance, and sterile-barrier immersion testing (for medical packaging).

Systima Technologies, a Bothell, WA-based testing company, defines these categories in great detail. For example, within vibration, an electrodynamic shaker can provide sine, random and mixed-mode vibrations, as well as classical shock and shock response spectrum (SRS) analysis. Systima's specialties include pyro/mechanical shock and highly accelerated life testing (combining vibration and thermal shock).

Herb Schueneman, president of San Jose, CA-based Westpak, says that most of what his company does consists of mechanical shock and vibration testing, temperature and humidity testing, altitude or pressure differential testing, and outdoor exposure testing, including sunlight, ultraviolet (UV), thermal cycling, etc.

"Most often, a client will come to our facilities to test for compliance with a given specification, condition or requirement," he says. "There are, how-

This horizontal impact test system (HITS), designed by Westpak testing services, studies the effects of auto and truck impacts, rail car coupling and similar horizontal-shock events. *Image courtesy of Westpak.*



Test set-up to determine the reliability of finger-pushed buttons, such as on a remote-control device, at Westpak testing services. Millions of cycles are possible in a short time period. *Image courtesy of Westpak.*

ever, many clients who use our facilities to fix a problem or issue that has arisen. Often this occurs during transportation, but it may also happen in the customer's environment."

For the latter instances, Westpak will recommend test procedures and protocols that have shown promise in similar situations in the past.

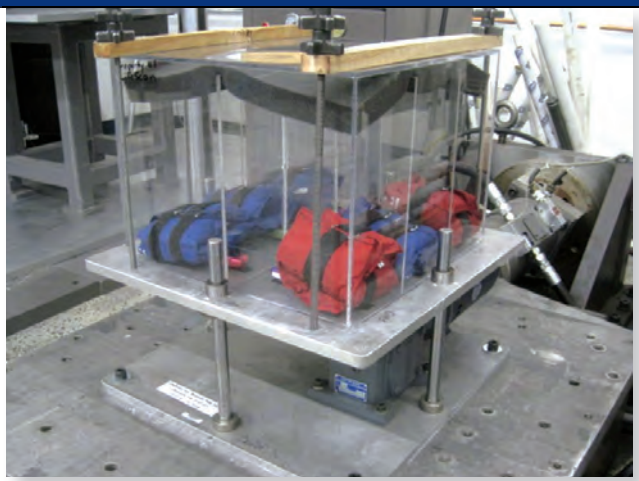
The more you know about testing procedure details, the better (and more efficiently) these tests will fulfill your requirements. At Dayton T. Brown, a New York testing facility, Bill Bradshaw, vice president and chief engineer, points out that settling on the details of test requirements can be time-consuming. "Provide as much information about the test and the test item as possible," he advises. "For example, even if it is a straightforward temperature test, does the item weigh 5 or 5,000 lbs.? Must the item be powered during or after the test? What are the power requirements? What are the cooling requirements?"

Other important questions include: Will you be onsite for the testing to operate/move the item in-between tests if necessary? Is the order of test important? Have all stakeholders approved the test plan? Defining these details up front will save time and money, ensuring it is done right the first time.

Interesting References for Mechanical Testing

- Westpak has authored detailed white papers on such topics as "Product Fragility Analysis Made Easy" and "Cushion Engineering, Design and Testing": Westpak.com
- Dayton T. Brown offers a large set of e-brochures that highlight specific application industries, such as Commercial & Military Aircraft Structural Services: DTBTest.com/eLibrary.aspx
- An in-depth paper on a method for evaluating relative shock severity is "Shock Response Spectrum (SRS) Analysis": Signalysis.com/pdf/srs.pdf

—P. Waterman



Vibration test unit built by Westpak testing services to learn of the effects jogging has on personal devices such as cell phones, recording devices, blood glucose meters and similar devices. *Image courtesy of Westpak.*

Sterile barrier immersion-test conducted on an inner packaging system of medical devices, at Westpak testing services. *Image courtesy of Westpak*

Pricing and Deliverables

Some tests are engineering-intensive but quick to run, while others may go for days or months. Pricing at most testing facilities is time-based, although quantity and type of equipment can come into play.

Dave Hunt, vice president of business development at ATA Engineering, says his company bases its price on the number of labor-hours, plus the test equipment required to perform the test. Noting another good reason to work with experts, Hunt says, "We can almost always accurately estimate the time required to perform a test, and from that, offer a fixed price contract. Customers appreciate that vs. an open-ended 'pay-as-you-go' contract where the total cost is undetermined."

Getting his facility involved early helps save overall cost and schedule, explains Hunt, because his staff can often suggest ways to optimize the test and define a clear objective.

Typical result deliverables include a detailed written report that covers all aspects of the test, including test objectives and approach, measurement locations, test equipment and calibrations, test setup and performance, data analysis and results. Formats range from universal files to spreadsheets, and can include commercial codes such as MATLAB.

"We also provide raw as well as processed test data in a mutually agreed-to format that allows customers to perform their own post-processing," Hunt says. "Even more than that, ATA provides conclusions and insight to the 'why' of the test results."

Trends and Specialties

Testing for specific industries such as medical implants is becoming more in demand, as is testing on composite materials (the hottest thing, according to Accutek) and combined-environment testing. An example of the latter is one that combines wind-induced vibration with temperature oscillation for such units as solar modules.

"There has been a jump in private space-related work that has caused mechanical test levels to become more extreme," adds Nathaniel McDonald, lab manager at Systima Technologies. "Many of the test levels we see today

Chambers for conducting product tests over rapid temperature and humidity changes, at Westpak testing services. *Image courtesy of Westpak.*

This large shipping container is undergoing a transit vibration test at Westpak testing services. *Image courtesy of Westpak.*

push well beyond the standards we saw for automotive and aerospace. We are working hard to keep up with these new test extremes."

Designers will continue to move between computer simulations and hands-on testing to evaluate and guide product design. ATA's Hunt sees the value of a closed-loop approach, saying, "Early testing in the design process can yield great benefits later in the development process by improving the ability to validate modeling assumptions, leading to improved computer simulations. The need for testing will never go away; as new materials and manufacturing processes are developed, the number and types of tests will also evolve—to define those tests that provide the best value to the overall development process."

Hunt points out that reducing overall test time will continue to be a goal of many companies: "Better yet, successful companies will be able to identify those tests that provide the most value to their processes, and implement them in a cost-effective manner."

Getting the Most out of Testing

Having a single person responsible from the sale through the process can be a plus when working with a testing service.

"The single biggest cost of conducting testing at the Westpak laboratories is not the equipment, not the labor and not the overhead," asserts Schueneman. Rather, he says it's "simply the coordination of the test, including making sure that the samples arrive on time and in good condition, that the test procedures are properly understood—especially any variations required—and that all communication between the client and the testing laboratory is complete, including the contract (purchase authorization). This coordination winds up taking more time and effort than all the other individual components in most single tests. "

As Accutek's McCloy concludes, "Testing is a unique industry compared to a lot of other products and services out there." Perhaps it's time to explore how your company can bring the strengths of outside testing to the front-end of your design process. 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.*

5 Benefits of Outsourced Mechanical Testing

- Experience, gained from repetitive and ongoing test procedures. Nowadays, larger companies are pushing qualification testing to their suppliers, who may not be familiar with the processes.
- Efficiency, based on frequent use of the equipment and adherence to good laboratory procedures.
- Quality, thanks to ongoing training and certification.
- Accuracy, because properly calibrated equipment and instrumentation help guarantee reliable data.
- Timeliness, because the equipment base and staffing level probably permits a faster turn-around and guaranteed priority; some tests can be staffed and run 24/7.

—P. Waterman

INFO → **Accutek Testing Laboratory:** AccutekTesting.com

→ **ATA Engineering:** ATA-E.com

→ **Dayton T. Brown:** DTBTest.com

→ **Systima Technologies:** SystimaETL.com

→ **Westpak:** Westpak.com

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Seeking Help: When Should You Hire an IT Consultant?

Just because engineers know technology doesn't mean they should be tasked with managing IT.

BY FRANK J. OHLHORST

If there is one constant associated with the majority of engineering firms, it's their reliance on technology. While technology can take many forms, the ubiquitous workstation and associated networking technologies prove to be the pinnacle of productivity for any engineering firm. What's more, these devices often prove to be the primary tool on which an engineer must rely, especially those in the fields of design and simulation.

Engineers have come to count on the latest technology to deliver the productivity that they need to accomplish critical projects on schedule. Nevertheless, many engineers may not be experiencing the full benefits offered by that technology—and are wasting precious time trying to get things to work in the most productive way. Simply put, when a tool such as workstation or computer network is not deployed properly, productivity suffers. And in the high-stakes world of engineering, time is most definitely money.

There comes a time when an engineering firm should turn to professional help, at least in the form of a properly qualified IT consultant. However, determining when to seek external guidance can be hard to recognize, especially when engineers have become used to solving IT problems on their own and forging ahead by using any means possible.

At first blush, the "damn the torpedoes" approach seems to be the fastest path to regaining productivity. But nothing could be further from the truth. There are multiple situations where it can take many hours to solve an IT problem, only because someone is hampered by a lack of experience or knowledge. Sometimes that problem was created because of an improper deployment or configuration of the technology, or the problem was a result of making changes to an existing system. Either way, productivity suffers, frustrations rise and tempers flare, leading to a situation that is far less than ideal. Encountering a situation as such only exemplifies the need to bring in a professional to solve thorny IT issues, to make sure that systems are deployed properly, configurations are done correctly and data is kept secure.

Many firms have different reasons for deciding to bring in an IT consultant, and those reasons can range from strategic, such as a major change in a firm's technological road map, to practical, such as a physical reduction of in-house support staff. Either way, it all comes down to a

point in time where existing staffers have moved beyond their comfort zone of dealing with IT products.

One of the primary benefits of hiring a consultant is that he or she can really help office staff navigate new initiatives while providing hands-on help and advice. Another benefit is that consultants can help prevent staff from making tactical mistakes, ones that could affect IT operations and create downtime. What's more, consultants bring in a third-party perspective, which can add fresh information and insights into critical IT decisions.

Smooth Integration

Bringing a consultant on board is no easy task, especially when an organization is leveraging leading-edge technology and highly sophisticated software, as most engineering firms are known to do. Nevertheless, those concerns should not be translated into a reason to not seek external help. On the contrary, vetting a consultant and taking a project-based approach to garnering professional services only helps to cement what may turn out to be a long-term consulting relationship—one that turns that IT consultant into a trusted technical advisor.

One of the first things to realize is that hiring an IT consultant for a mission-critical task or project that drives core business sometimes is more cost- and time-efficient than hiring a full-time employee, whom you may have to train, work with and guide. Specialized IT pros can be brought in to work on critical, deadline-driven tasks or perform maintenance, audits and of course, consult on technology plans. That makes it imperative to find the right IT consultant for the job. It can be a tricky and potentially risky endeavor, but there are steps that can be taken to ensure the job gets done, while minimizing risks to the company.

Do Your Homework

The first steps involve lots of careful research, asking relevant, detailed and tough questions of both the staff

Quick Tips for IT Help

When deciding whether to contract an outside IT professional on a per-project or an ongoing basis, consider these points:

- How much of your productivity is lost due to improperly configured networks and downed workstations?
- Could your time be better spent on tasks related directly to product design and simulation than on IT projects?
- Are your IT systems falling behind due to a limited knowledge of new technologies?

and the potential consultants. The goal is to locate a consultant who can best mesh with the team. Finding that person can start with talking to business peers and asking whom they use for IT support and why.

Another critical element to consider is exactly which services are needed. Is the IT consultant needed for a particular project, for example, or for overall training, maintenance and support? Such questions will help to determine the type of consulting relationship that needs to be developed, and can play heavily into determining what reasonable fees can be defined. If the need is based upon a project, then that project should be fully defined early, with expectations outlined and results measured.

For example, a network upgrade or deployment of new workstations can be treated as a project-driven event: Outline the expectations, estimate the hours, plan the deadlines and determine the deliverables. Ongoing support can be treated in much the same fashion, with a contract defined that outlines the type of support to be delivered, the costs associated with it and what metrics will be used to measure success.

When selecting a potential candidate, engineering firms will benefit from performing the same basic due diligence required for any business decision. That may involve checking with local business and technology groups, and doing detailed informational searches using Google, LinkedIn, and even Facebook. It is also important to get references from prospective consultants, especially when they've done similar projects for others.

Also consider validating those references, even if it means contacting those references and examining the projects that the consultant has accomplished for those companies. Because an IT consultant may become a critical resource for the business, and may be exposed to company secrets or proprietary information, engineering firms should consider conducting background checks on candidates, and validate that candidates have wide experience to perform the tasks needed. Engineering firms should not have to pay for a consultant who is going to learn about technology on the job.

Ask Questions

Another consideration is availability. Is the consultant local? Will he or she guarantee response times? For what hours do you need support? Can the consultant escalate problems to vendors? These questions can help define expectations—and also take into account the cost of downtime, something that is frequently overlooked.

Other questions to keep in mind when hiring a consultant include qualifications, certifications and education. On a more personal level, it is also a good idea to discern through an interview whether the individual has the motivation, communications skills, management experience and perceptual skills to do the job.

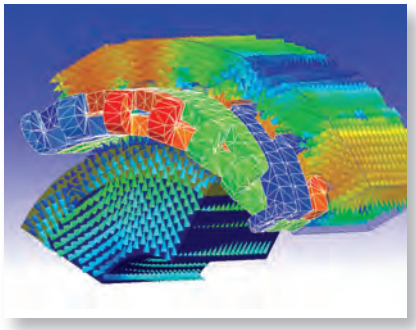
All of the above will help you find the correct candidate for IT support, while minimizing the risk to the business. DE

Frank Ohlhorst *is chief analyst and freelance writer at Olhorst.net. Send e-mail about this article to DE-Editors@deskeng.com.*

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.



Multiphysics Highlights ANSYS 14.5 Release

Technology enhancements reportedly deliver engineering productivity and innovation through improved multiphysics analyses and high-performance computing.

ANSYS has released version 14.5 of its engineering simulation solutions. The amount of updates, improvements, and introductions across an engineering simulation ecosystem as vast as ANSYS defies quantification in a brief message like this.

The overall theme of ANSYS 14.5 is that since you are creating more complex and smarter products, you need to be more innovative and more efficient. The solution is that you need more multiple physics analysis capabilities and you need to harness HPC power to do it efficiently and cost-effectively.

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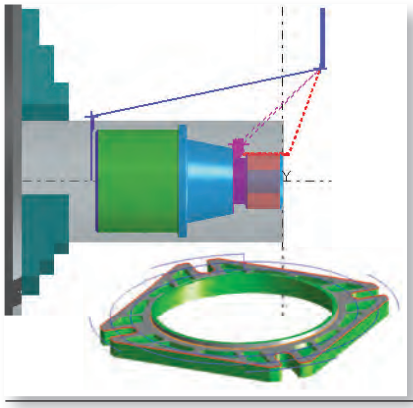

Turning Improvements Focus in SmartCAM V19.5 Release

Threading and grooving improvements, new parting process, and usability upgrades also featured.

SmartCNC has released SmartCAM version 19.5. I'll focus on one of the many cool things that SmartCAM does for you. It's called Toolpath Modeling.

SmartCAM handles all toolpath elements, whether created manually or by its automated toolpath creation tools, like they are geometry. This means you can manipulate toolpaths like you would a model's geometry elements. You can create, edit, and delete toolpaths. You can change CAD geometry into toolpath geometry. You can reorder or re-sequence a toolpath, and then some.

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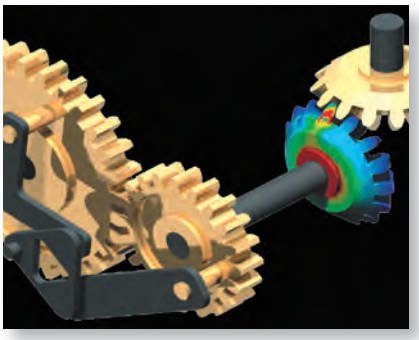

Integrate Motion and Stress Analyses

SimWise v8.5 offers new associative interface for Solid Edge; 64-bit edition available.

SimWise is an umbrella moniker for three packages: SimWise Motion, SimWise FEA, and SimWise 4D. SimWise is CAD-independent, meaning it can work with geometric design data from most any major CAD system as well as the usual neutral file suspects. The newest edition, version 8.5, also offers associativity with Solid Edge, which adds that mechanical CAD system to SimWise's list of tight associativity capabilities that already included Inventor and SolidWorks. It has a formula language and function builder as well as an automation interface for programing with C++, Java, and so on.

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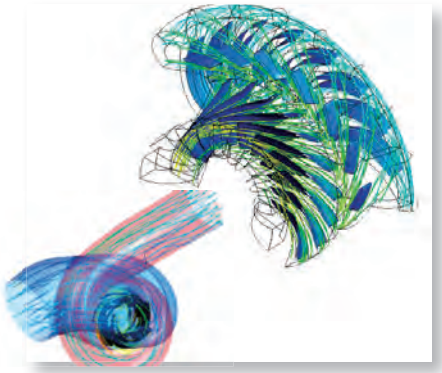

Turbomachinery Suite Models Volute Pumps and Casings

ADT ships version 5.2 of TURBOdesign 3D aerodynamic and hydrodynamic design suite.

ADT – Advanced Design Technology – and its US distributor TDT (TURBOdesign Technology) have released version 5.2 of the TURBOdesign suite of aerodynamic and hydrodynamic software for designing turbomachinery blades such as pumps, compressors, fans, turbines, and torque converters.

The big news with this release is the new TURBOdesign Volute module for designing volute pumps and casings. The gist of this module is that you can specify variable inlet flow angles and velocities circumferentially, enabling you to design a volute for non-uniform inflows.

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Upstream Scrutiny Drives Downstream Savings at Dynisco

The analytical instrument manufacturer uses benchmarking and smart design to lower its products' total cost of ownership.

Dynisco, a Franklin, MA-based subsidiary of Roper Industries, is a maker of extrusion measurement and control equipment for the plastics industry.

The company grades its products—

which include pressure and temperature sensors, control systems and analytical instruments—based on total cost of ownership (TCO). TCO is a holistic discipline that begins with a cost assessment of the piece parts each product contains. From there, Dynisco works to ascertain the product's total landed cost, which can include capital spent on freight, insurance, fuel charges and customs duties. But only when the picture expands to yet another level, with items such as cost of poor quality, inventory carrying costs, reverse logistics, and risk factors from wage inflation to IP protection, does Dynisco consider the cost picture complete.

"The TCO model is a time-and-point snapshot that helps us decide where to build and launch a product," says John Biagioni, vice president of supply chain and operations at Dynisco.

Design can have a significant impact on a product's TCO.

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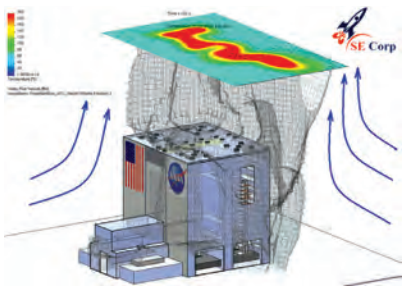
The Sky's the Limit

SE Corp. helps NASA evaluate safety hazards with SolidWorks Flow Simulation.

After working as an engineer for nearly two decades, Sean Stapf founded SE Corp. in 2008. Making his analysis consulting business a success required hard work, as well as access to highly capable design, analysis and engineering applications.

The type of work that Stapf targeted—advanced simulations in CAD and computational fluid dynamics (CFD)—demanded robust, cost-effective engineering tools. Fortunately, Stapf's engineering history had exposed him to commercial analysis systems.

"I was familiar with all of the world-class FEA (finite element analysis) packages, having used them throughout my career," Stapf recalls. "However, for my consulting company, I conducted a cost-benefit analysis. I needed analysis power and speed at the most attractive price."



Stapf chose SolidWorks Simulation Premium software as SE Corp.'s analysis package because of its CAD integration, extensive set of capabilities, and fast solvers. "I selected SolidWorks Simulation Premium and SolidWorks Flow Simulation software because they provide structural, thermal, and computational fluid dynamics (CFD) analysis tools within the SolidWorks parametric modeling environment," Stapf says.

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The Right Stuff

Noesim automates its CAE process using Siemens PLM Software technology—and helps customers make smarter design decisions early in the development process.

Noesim was established in 2005 to consolidate the engineering and management know-how its founders acquired by working with major Italian companies. The company's objective is to make its expertise available to organizations that strive for success through innovation and competitiveness.

Based in Cesate, Italy, a few miles from Milan, the core focus of this design and engineering company is the aerospace industry. Noesim has also extended its services to companies in other industries that require CAE expertise and simulation tools in the design and validation stages of a project.

From the very start, Noesim built its business on a sound foundation, providing engineering consulting services to the aerospace industry.

"We have been working in aerospace for many years, and we know the requirements of companies in this industry very well," says Guglielmo Barbiani, one of Noesim's co-founders. "For example, there are non-official habits and standards, such as the use of Nastran as the de facto standard CAE solver. We also needed a CAE tool that could interface with all the different CAD packages adopted by our customers."

To create an efficient and competitive organization, Noesim develops internal standards and procedures that are independent of their customers' processes. Noesim engineers acquire competence using software tools that help them deal with multi-disciplinary tasks. They have expertise not only in static and dynamic structural analysis, for example, but also in composite materials, kinematics, fluid dynamics and heat transfer.

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Tools of the Month

New Products for Engineers

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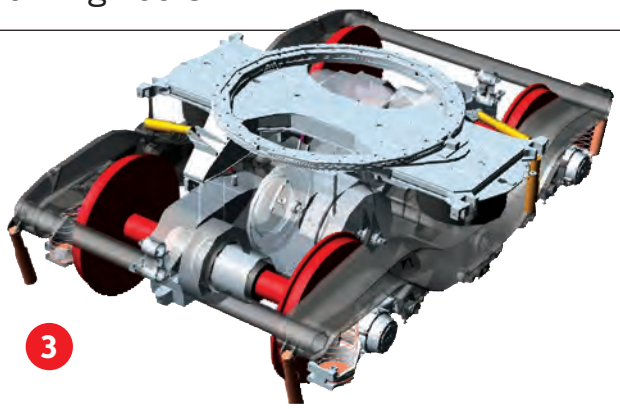

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1 Contex Launches PageDrop Cloud-based Solution

Contex (Contex.com) has released PageDrop, a cloud-based application to process wide-format scans. PageDrop lets users (with any smartphone or Web-enabled tablet) transfer Contex-scanned images to a variety of destinations, including Dropbox, HP ePrint, and e-mail. Users scan a QR code that is unique to each Contex scanner, and then select a destination for the scanned image. PageDrop is a free service, now available for the Contex IQ 2490 wide format scanner.

Siemens Updates Fibersim

Enhancements in the latest release of Siemens PLM Software's (siemens.com/plm) Fibersim software can help industries that use composite materials in their products reduce design and analysis time by up to 80% and shorten some design for manufacturing processes by up to 50%, the company says. Fibersim 13 adds new functionality for bi-directional exchange of computer-aided engineering (CAE) and CAD data that helps eliminate data re-entry. The new capability directly integrates analysis data into the design environment, enabling automatic design updates based on analysis results. It also provides new design-for-manufacturing processes that support optimization for parts designed to match the manufacturing definition and then trimmed to the engineering definition.

2 Imagination Tech Ships Ray Tracing Accelerator Boards

Imagination Technologies (imgtec.com) is now shipping its Caustic Series2 PC boards, the R2500 and R2100, which accelerate PowerVR OpenRL applications including the Caustic Visualizer viewport plug-ins for Autodesk Maya and 3ds Max, and the Neon viewport in Rhinoceros 5 from Robert McNeel and Associates. The Caustic Series2 is a family of high-performance ray tracing accelerator PC boards. The Caustic R2500 OpenRL PC board is targeted at the latest high-end workstations. The Caustic R2100 board is intended for upgrading a wider range of mid-range and higher workstations. The boards include 4GB and 16GB of memory, respectively, which is used to store scene geometry and the ray tracing acceleration structure.

LightWave 11.5 Now Available

The LightWave 3D Group's (lightwave3d.com) LightWave 11.5 3D modeling, animation and rendering software is available to all registered LightWave 11 customers via the LightWave 3D website. Some of the new features include the Genoma character rigging system with modular presets, predator and prey Flocking capabilities, per-object Instancing control, and soft-body Bullet Dynamics with support for FiberFX. Also included are Interchange Tools supporting Adobe After Effects cameras and Pixologic's Zbrush, stereoscopic and depth-of-field motion blur in the Viewport Preview Renderer (VPR).

3 MSC Ships Adams 2013 for Modeling, Visualization

MSC Software's (mscsoftware.com) new Adams 2013 release includes modules for machinery dynamics analysis along with extended automotive features for ride test, leaf spring generation, and powertrain modeling. It is designed to help mechanical engineers more accurately model systems, predict performance, and visualize results, the company says. The solution's HHT integrator was enhanced with a more efficient step size selection. Adams 2013 also provides users with the option to implement the "Adaptive Interpolation" in all integrators to improve the solver speed. The Adams/Machinery solution adds a new bearing module to the existing gear, belt, and chain modules introduced in the 2012 release. Also included are productivity enhancements for automotive and truck engineers, a new leaf spring preprocessor, and a single leaf spring model is fully supported.

3D Systems' Go!MODEL for Creaform Scanner

3D Systems' (3dsystems.com) Go!MODEL 3D reverse engineering and design tool was developed for Creaform's (creaform3d.com) newly released Go!SCAN 3D portable scanner. Using the integrated Go!MODEL and Go!SCAN 3D package, users can capture physical objects and directly model renderings and designs optimized for 3D printing, according to the companies.

4 Agilent Introduces Mixed Signal Oscilloscope

Agilent Technologies (agilent.com) announced the expansion of its Infiniium 9000 X-Series oscilloscope family to include its highest performance mixed-signal oscilloscope (MSO). The expansion adds six new MSO models, as well as 13GHz DSO and DSA models, to the X-Series. The integrated digital channels of the new MSO models can function at 20 GSa/s in an eight-channel configuration,

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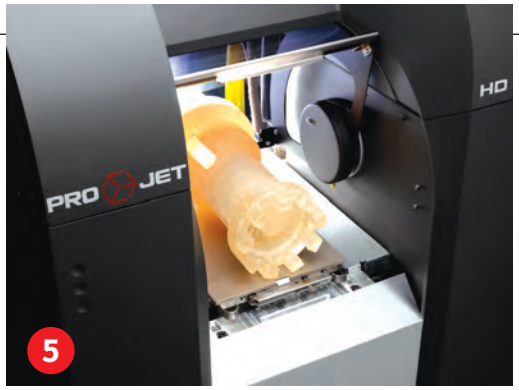

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or at 10 GSa/s in a 16-channel configuration. Agilent now offers MSOs ranging from 70 MHz to 33 GHz of analog bandwidth. The new 13-GHz DSO, DSA and MSO models give engineers access to the Infiniium 90000 X-Series at a lower price.

5 3D Systems Releases New ProJet 3500 3D Printers

3D Systems (3dsystems.com) has announced eight new ProJet 3500 professional 3D printers. The new series incorporates the company's recently introduced ProJet HD MAX and CPX MAX technology platform, including its Multi-Jet Modeling (MJM) print technology, its production-grade printhead, material management, touchscreen controls and remote tablet and smartphone connectivity. ProJet 3500 series printers are compatible with the company's VisiJet print materials.

nCode DesignLife Version 9.0 Released for Simulation

nCode (ncode.com) announced the version 9.0 release of nCode DesignLife. The solution includes new enhancements and technologies for composites, welds, load reconstruction, multi-body dynamics, and data visualization for engineering durability and CAE fatigue analysis. A new animation capability enables users to better understand how a structure is deforming under dynamic loading and how to improve structures to avoid fatigue failures, the company says. The linear superposition can now be used to calculate the total displacement at each instant in time, and this can be viewed as a full 3D model animation.

Simpleware 5.1 Released

The latest release of Simpleware's (simpleware.com) image visualization, analysis and model generation software suite (Version 5.1) introduces the new +NURBS module, as well as new features that will help accelerate the process of segmenting and meshing 3D image data, the company says. Users can choose from an array of statistical settings to generate user-specific statistics displays. The new release also includes volume rendering for masks, large images support (greater than 2GB), and additional COMSOL export functionality.

Altair Releases PBS Professional 12.0

Altair has released PBS Professional 12.0 (pbsworks.com), the latest version of its workload management and job scheduling solution for high-performance computing, with new features that speed scheduling and boost utilization and agility, the company says. PBS Professional 12.0 also includes the second major component of Altair's plug-in infrastructure, allowing users to control, modify, extend and change job lifecycle events in the execution stage. DE

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Commentary

by Greg Milliken

The Cloud: Driving a Hybrid

As dynamic business demands continue to place an unprecedented burden on technology infrastructure, IT managers remain ever-vigilant to ensure sufficient resources are available to support business-critical and heavily used applications. The good news is that IT departments now have compelling options for effectively balancing the need for additional infrastructure and capacity with limited staff and budget resources.

A hybrid cloud environment can combine private or public clouds, as well as on-premises implementations, that are connected to deliver the benefits of multiple deployment models. If an organization requires certain business services be implemented and/or data stored on its premises, but wants hosted solutions to ease the burden on existing IT infrastructure, a hybrid cloud deployment offers an effective approach.

Hybrid Cloud Advantages

According to an IT survey by Unisys in January 2012, of the 45% of respondents who said cloud computing was their top IT priority for the year, 21% indicated they were looking for more operational flexibility, and would be exploring hybrid clouds for that purpose. What follow are the primary drivers leading organizations to consider deploying a hybrid cloud.

A hybrid cloud environment can combine private or public clouds, as well as on-premises implementations.

- **Utilization of existing resources:** The needs of enterprise IT are often dynamic, evolving over time. The hybrid cloud model empowers IT to flexibly augment existing on-premises infrastructure and services with those based in the cloud, without necessarily adding to their own workload. As a result, IT can better leverage existing staff—as well as capital investments such as servers, software, network infrastructure, and so on—while also incorporating assets from the cloud to create a more flexible and cost-effective IT environment.
- **Scalability:** For many enterprises, IT needs such as processing power, application capabilities, storage and network demands can increase or decrease at any time. Hybrid cloud deployments can augment existing resources by leveraging cloud-based resources to better handle "bursts" of activity.
- **Performance:** Some industry estimates maintain that 70% of current IT investment is earmarked for maintenance, resulting in fewer resources available for innovation. By adding a public cloud or an externally hosted private cloud to existing systems deployed on-premises, performance and responsiveness can be improved. It can also minimize associated increases in IT complexity by using efficient on-demand provisioning and easier, web-based system administration typically provided with cloud services.

Other Factors to Consider

Armed with a greater understanding of the advantages associated with hybrid cloud deployment models, there are other considerations to keep in mind as well:

- **Security:** When evaluating options, consider the account access controls and data encryption, because confidential information is often transmitted via the public Internet. Also confirm whether existing user accounts and groups can be used to create a single sign-on environment that is both secure and efficient.
- **Integration:** In a hybrid environment, it's important to know whether the organization's on-premises applications like enterprise resource planning, customer relationship management and associated computing resources are able to be (and/or should be) integrated with private and/or public cloud platforms and systems. If integration is required, the solutions to evaluate are reduced, because providing smooth integration among various systems requires well-developed application programming interfaces and web services that not all systems provide.
- **Storage:** If large amounts of data are involved, cloud-based storage can get expensive, depending upon the vendors used. On the other hand, hybrid options can often be used to offset the cost of cloud-based storage by using relatively inexpensive, on-premises hard drives or network-attached storage devices. Such devices offload the storage requirements of the cloud-based systems.
- **Compliance:** The role that compliance will play in a hybrid cloud environment depends on a variety of factors, such as regulatory mandates, industry standards, audit requirements, geographic location and associated laws, and the capabilities and limitations of existing IT infrastructure. For businesses in heavily regulated industries, such as pharmaceutical, medical devices, biotechnology or transportation, it may be a requirement that some specific applications and information reside on-premises behind the company firewall rather than in the cloud.

The hybrid cloud computing model offers the promise of augmenting enterprise capabilities and systems, while enabling organizations to deploy and consume cloud-based resources at a pace that best suits their IT and business goals and budgets. DE

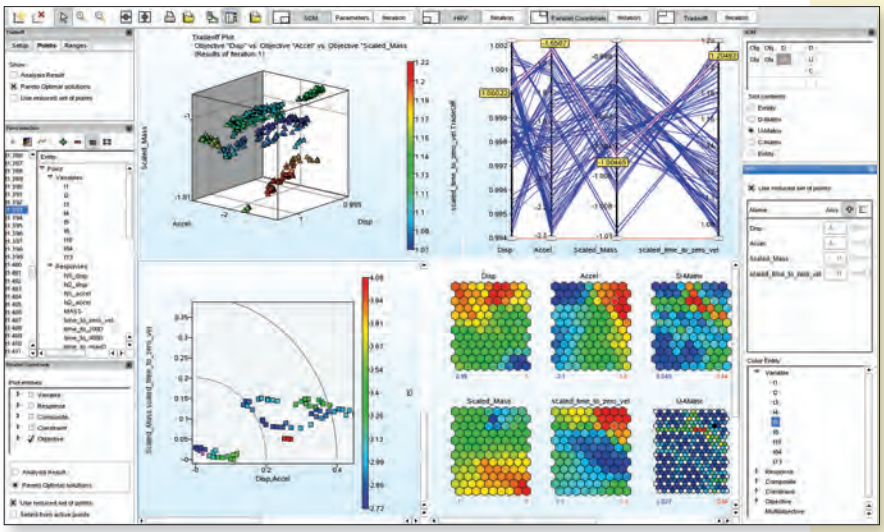
Greg Milliken *is the president of M-Files Inc., the developer of M-Files flexible cloud, on-premises and hybrid enterprise content management (ECM) solutions. For more information, visit M-Files.com. Send e-mail about this article to DE-Editors@deskeng.com.*

LS-OPT®

The Stand-alone Simulation-based Optimization Tool for LS-DYNA

Version 5 includes the following improvements:

- Flow chart based interface for optimizing multi-disciplinary processes
- Streamlined load balancing of solver job schedule through resource definition
- Tracking of design parameters and their sources
- Progress monitoring of phases and stages



LS-OPT includes a graphical post-processing tool with the following features:

- Result plots (Correlation Matrix, Scatter plots, Parallel Coordinate, Self-Organizing Maps, Time-history, Statistical)
- Metamodel plots (Surface, 2D cross-sections, Accuracy, Global sensitivities, History sensitivities)
- Pareto plots (Trade-off plots, Parallel Coordinate, Self-Organizing Maps, Hyper-Radial Visualization)
- Stochastic Analysis (Statistical tools, Correlation, Stochastic Contribution)
- Optimization History

Capabilities:

- Multidisciplinary and Multi-Objective Optimization
- Process Simulation and Optimization
- Reliability-based Optimization/Robust Design Optimization
- Fringe plot display of statistics on LS-DYNA models
- Network-based scheduling with job queuing interface
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Optimization is enabled using a direct optimization method (NSGA-II) or adaptive surrogate-based methods (based on Neural and Radial Basis Function Networks, polynomials, Kriging or Support Vector Regression).

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