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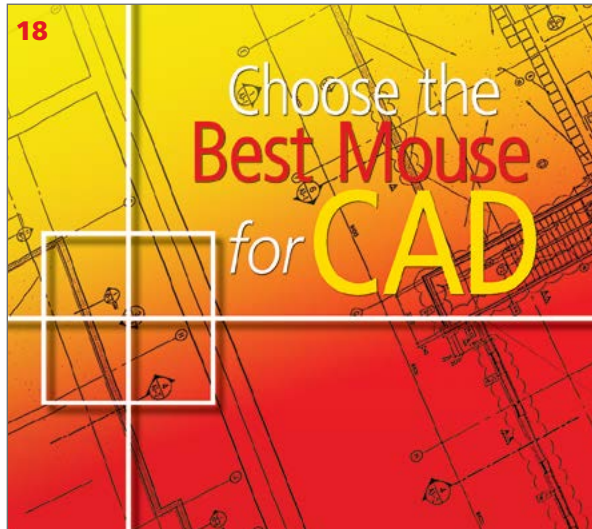# Best Mouse
for CAD

Cadalyst Labs navigates the maze of options for 2D and 3D users

+ Tech Trends
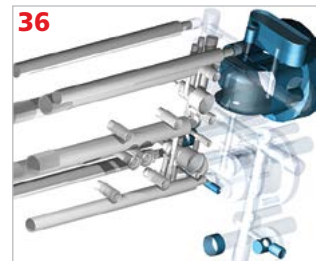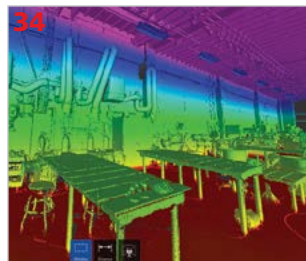**Performance Metrics Drive Building Design**

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Choose the Best Mouse for CAD

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Valuable Input

In a job that requires constant computer use, the little mouse plays a big role — and must be used wisely.

This issue's cover story, "Playing CAD and Mouse," reviews a variety of input devices and offers advice for selecting the one that's right for you. We had a great time choosing which models to review and putting them to the test in Cadalyst Labs; for a tool whose functions come down to pointing and clicking, the options run the gamut! And that's a good thing, because each of us has unique needs when it comes to the software we use, our budget, and our personal preferences.

One thing we all have in common, however, is the need to use an input device safely. If you're a CAD user, chances are you spend nearly your entire day at the computer, using your input device the entire time. If you're doing so without proper attention to ergonomics, sooner or later you could face discomfort, or worse — working with your hand or wrist in an unnatural position can lead to muscle and tendon strain and repetitive-stress injuries. Following are a few reminders about how to minimize that risk:

- **Find a good fit.** Choose an input device that feels comfortable — not too small or too large — and supports your hand in a relaxed, neutral position. Your wrist should be relaxed and unbent as well.
- **Place it correctly.** Keep your mouse close — both to the near edge of the desk to minimize forward arm extension and to the side of the keyboard to reduce lateral arm extension. Keep your forearm horizontal and even with the mouse and your elbow close to your body.
- **Take it easy.** Hold the mouse lightly; don't squeeze or grip it. Release the mouse frequently and even consider alternating between different devices to reduce repetitive motion. Use keyboard shortcuts instead of mouse clicks whenever possible. Remember to take breaks from computer use at least once an hour. And did you know that cold muscles and tendons are at greater risk of injury? Keep warm!

For me, a thumb-operated trackball is the answer for minimizing physical stress and strain. It replaced a standard mouse when I was doing extensive web operations work that caused pain and numbness in my hand and shoulder — and I'm still using it, almost a decade later.

This trusty device has served me well, and never given me a reason to change. But when a new-fangled trackball came through the office, with a low-profile design and fancy new features, I thought I should try it. I put it to use for the better part of a week. But it just wasn't a natural fit for me, so for now, I'll stick with Old Faithful. I hope our cover story helps you find a mouse that's the right fit for you.

A New Chief and a Big Birthday for Cadalyst

This editorial is my last as editor-in-chief of Cadalyst. I'll stay directly involved in Cadalyst affairs, but my responsibilities are broadening to oversee all content development for our parent company, Longitude Media. Cyrena Respini-Irwin, currently the senior editor, will take over as editor-in-chief — a natural move for her, having been a part of the Cadalyst editorial staff dating back to 2006. Along with managing editor Lara Sheridan and the rest of our editorial staff, Cyrena and I are devoted to Cadalyst and to you, our readers.

We're honored that you have made Cadalyst a trusted resource — especially now, as we celebrate 30 years of serving the CAD community. Happy birthday, Cadalyst!

Nancy Spurling Johnson
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cadcentral

By Nancy Johnson and Cyrena Respini-Irwin

Report: 3D Scanning Market to Double in Five Years

[Research and Markets](#) has a published a new report, "3D Scanning Market by Devices, Range, Solutions, Services — Worldwide Market Forecasts and Analysis (2013–2018)." According to the report, the global 3D scanning market is expected to grow from $2.06 billion in 2013 to $4.08 billion by 2018, at an estimated compound annual growth rate (CAGR) of 14.6%.

The Asia–Pacific portion of the market is predicted to increase from $538.5 million in 2013 to $1,087.3 million by 2018, at a CAGR of 15.1%. Over the same time period, the Latin American market will increase from $257.9 million to $732.5 million, at a CAGR of 23.2%.

3D scanning, which uses lasers to gather digital information about objects and structures, is widespread in architecture, manufacturing, power generation, and other industries. Major hardware and software providers include [Faro Technologies](#), [Konica Minolta](#), [Creaform](#), [Surphaser](#), [Autodesk](#), [3D Systems](#), and [3D Digital](#), according to Research and Markets.

ZWCAD Launches 2D/3D CAD for Architects

[ZWCAD Design](#) has released ZWCAD Architecture 2014 ($1,499), a brand-new offering built on its ZWCAD+ 2D/3D platform and tailored for professional architectural design. Features include 3D visualization, parametric building components, flexible annotation, hatch pattern and block libraries, and full DWG compatibility. Organized schedules update automatically when rooms are changed.

Users can customize the design interface to display selected items, or choose from three personalized modes: Standard menu, Elevation and Section, and General Drawing Plan.

A free trial version is available for download from the ZWCAD Design web site.
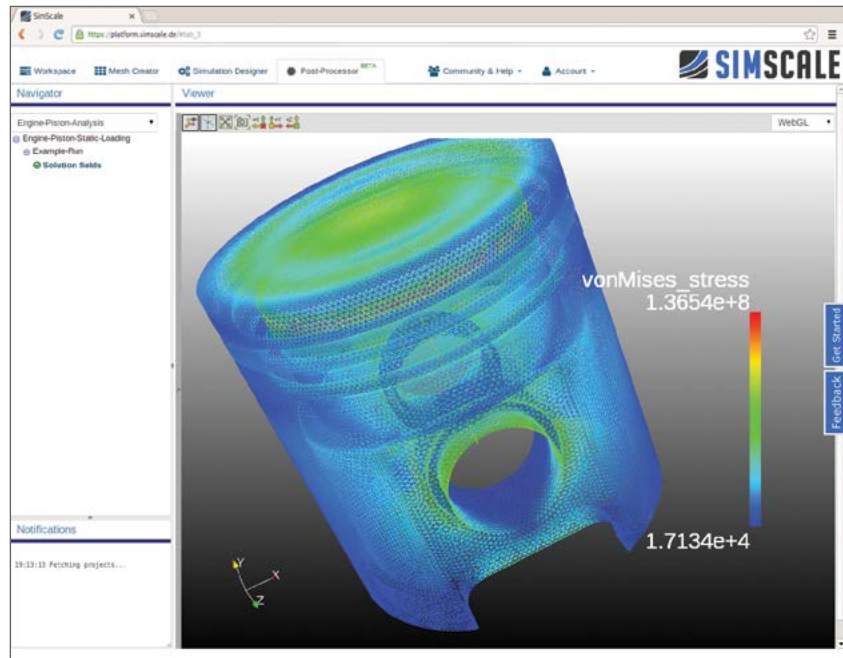
SimScale performs design analysis via your web browser — for free.

SimScale, Geometric Release New Design Simulation Tools

Want to dip your toes into mechanical design simulation but don't have the budget to do so? [SimScale](#) answers the call with its free cloud-based platform that aims to "lower the entry barriers for engineering simulation" by providing access to modeling and simulation technology without the need for costly hardware or software.

Users upload a CAD model to SimScale and select from a variety of simulation processes, including structural mechanics, fluid dynamics, and thermodynamics. The simulation runs

cadcartoon

By Roger Penwill • [www.penwill.com](#)

on hardware allocated on demand. A YouTube video demonstrates the service; search for "Welcome to the SimScale Platform."

SimScale currently supports STEP, IGES, BREP, and STL file formats. The Basic plan is free and allows a monthly quota of 10 simulations and 20 meshes with the limit of one core hour overall. The Professional plan charges according to computing time actually used.

Geometric DFX from Geometric allows product engineers to validate 3D CAD data using design rules based on global best practices. DFX stands for *design for x*, where *x* represents various downstream process checks related to manufacturability, assembly, quality, warranty, penalty, serviceability, environment, reliability, and other criteria.

"Geometric DFX automates the process of DFX validation in a stand-alone package early during the design stage, thereby cutting down the long [manual] review process and identification of downstream issues. It improves the productivity of design and manufacturing engineers as well as enhances collaboration between them to reduce cost and improve quality and time to market," says Sameer Kondejkar, senior director.

The software supports SolidWorks, CATIA, Autodesk Inventor, Creo Parametric, NX, Solid Edge, STEP, and IGES file formats. It comes preconfigured with approximately 100 design rules and can be customized to add organization-specific best practices. Manufacturing processes currently supported include machining, casting, injection molding, and sheet-metal fabrication. A 15-day trial version is available.

Free Plugin Aids ArchiCAD-to-Revit IFC Data Exchange

GRAPHISOFT has developed a free plugin for Autodesk Revit 2014 that improves the Industry Foundation Classes (IFC) model-based data exchange between Revit and GRAPHISOFT ArchiCAD. The GRAPHISOFT ArchiCAD Connection plugin's IFC import function improves the interpretation of architectural models, and it exports Revit model elements in IFC files that are tailored for use in ArchiCAD. The plugin works with Revit Structure, MEP, and Architecture.

Certain Autodesk Software Titles Now Available for Rent

Autodesk has introduced rental plans that give customers access to software monthly, quarterly, or annually, with the option to renew. Software rental is now available for the Autodesk 2014 design and creation suites, 3ds Max, Maya, and the new Maya LT.

"We expect rental plans to be attractive across all the industries we serve, especially for freelancers, startups, or businesses that are project-based in nature," said Andrew Anagnost, senior vice-president of Industry Strategy and Marketing at Autodesk.

Software rental customers will receive benefits similar to those of Autodesk Subscription customers, including product updates, access to select Autodesk 360 cloud services, and basic technical support. Traditional perpetual licenses, which give customers the right to use purchased software indefinitely, are still available. Existing perpetual desktop licenses cannot be converted to rental licenses, or vice versa. Availability varies by country.

New Offerings Extend Reach of Autodesk Software

Remote access to desktop software. Autodesk Remote is now available to Autodesk Subscription customers worldwide. With Remote, designers can use an iPad or remote computer to control Autodesk software installed on their primary computer. Users can open, modify, and save designs without installing software on multiple devices. The iPad app is compatible with Autodesk Inventor only.

High-end rendering for Fusion 360 models. Users of Autodesk Fusion 360, a cloud-based tool for 3D industrial and mechanical design, can download a new plugin from **Luxion** that enables users to transfer models with one click from Fusion 360 to KeyShot, a real-time ray tracing and global illumination program for 3D rendering and animation. In addition, Luxion's LiveLinking technology allows any changes made in Fusion 360 — including materials and color assignments — to be transferred immediately to KeyShot.

Graitec tools added to portfolio. Autodesk has signed an agreement to acquire the Advance Steel and Advance Concrete product lines from Graitec, a global provider of CAD and engineering software for users in engineering and construction. The acquisition will expand Autodesk's building information modeling (BIM) portfolio with structural fabrication and concrete detailing capabilities for structural engineers, detailers, fabricators, and contractors. Advance Steel is structural steel detailing software that produces drawings, bills of materials, and numerical control (NC) files. Advance Concrete produces formwork plans, reinforcement drawings, bills of materials, and NC files.

New facility for makers. On the brick-and-mortar front, Autodesk has partnered with design and manufacturing facility **ADX** to create a new fabrication and manufacturing collaboration space called The Bridge. Housed at ADX in Portland, Oregon, The Bridge provides access to digital and analog fabrication technologies including 2D and 3D design software for digital prototyping, 3D printers, and laser-cutting services. ADX membership is open to the public for a monthly fee.

Hot Tip Harry Shares Six Stellar LISP Tips

by R.K. McSwain

To download this latest batch of AutoCAD customization tips sent in by readers, visit cadtips. cadalyst.com/0913hth. Cadalyst code detective Hot Tip Harry is always on the lookout for new tips; to send in your own, see cadtips.cadalyst.com.

- **Measure Multiple Distances** *by Sanjay Kulkarni*
  This tipster had an occasion to measure multiple distances repeatedly, but found the built-in AutoCAD commands too tedious. That experience inspired the creation of a nice LISP routine to perform the task.
- **Match Text by Selection** *by Matt Sibum*
  This selection-based find-and-replace routine for text and mtext prompts you to select a single text or mtext object, then saves the text string. Next, it asks you to select other text/mtext objects. All entities whose text value matches what you select will be replaced with the string from the initial selection.
- **Filtered Flatten Command** *by Raymond Rizkallah*
  To avoid some of the pitfalls of the AutoCAD Express Tool called Flatten, this LISP routine filters out all entities except lines, lwpolylines, circles, and arcs.
- **Convert Individual Text to Mtext** *by Benzigar Peter*
  The AutoCAD Express Tools include a routine for converting text to mtext. The only problem with that tool is that all selected text is converted into a single mtext block. That's where this routine comes in.
- **Entity to Directional Arrows** *by Raymond Rizkallah*
  Convert a polyline, line, or arc into a series of arrows. This could be very useful for showing direction.
- **Determine Weights of 3D Objects** *by Dean Culver*
  This routine gives you the weight of a selected 3D object in terms of various materials. The calculations for each material are easily found in the LISP code, so you can add your own materials as desired.

Autodesk Takes Infrastructure Modeling to the Cloud

Autodesk has expanded its desktop InfraWorks software, which provides 3D modeling and visualization for civil infrastructure design, to encompass mobile platforms. The cloud-based Autodesk InfraWorks 360 Pro promotes building information modeling (BIM) within the infrastructure industry, providing civil engineers and other AEC professionals with tools to collaborate and communicate with project stakeholders from various disciplines and geographic areas.

InfraWorks 360 Pro users can publish, store, collaborate on, and manage large models in the cloud via desktop or mobile devices. The software can enhance proposal creation by aggregating project information and conditions data, including geospatial data, satellite imagery, and point clouds.

Autodesk InfraWorks 360 Pro is available for purchase on a quarterly basis; users have the option to renew at the end of each quarter.

An Autodesk InfraWorks model of San Francisco's Presidio Parkway, accessed via the cloud.

By Heather Livingston

When Buildings Must *Perform*

Technology plays a critical supporting role in architects' efforts to meet requirements for energy use and occupant comfort.

▶ The renovation of the Edith Green–Wendell Wyatt Federal Building in Portland, Oregon, brought together not only LEED compliance, but also performance-driven design: The building must meet specific requirements for energy and water consumption and other environmental impacts. The west facade's vertical reeds provide a dramatic skyline statement while supporting building performance goals.
▲ Openings were cut into into the exterior slab to allow natural light to flood the lower-level conference center.

All images by Nic Lehoux.

When the Obama administration made federal funds available for shovel-ready building projects through stimulus measures in 2009, new life was breathed into many projects of the U.S. General Services Administration (GSA). One such project was the planned renovation of the Edith Green–Wendell Wyatt Federal Building in Portland, Oregon.

In 2006, GSA had engaged the services of SERA Architects and Cutler Anderson Architects to redesign the 35-year-old building, but federal support wasn't available to execute the project at that time. But with funds earmarked by the American Recovery and Reinvestment Act (ARRA), GSA embarked upon a $139 million modernization in spring 2009 that had to deliver a very high level of performance — high enough to garner a LEED Gold rating.

GSA had already indicated a desire to make the building meet sustainability guidelines, but the new source of funding required that it to go further than simply meeting checklist requirements of the U.S. Green Building Council's LEED program. It would elevate the project to the level of performance-driven design.

The concept entails designing a building to meet specific requirements for energy and water consumption and other environmental impacts. Software technologies, although still evolving, are critical to the process. Architects and engineers rely on building information modeling, design simulation and analysis, and solar-study and building-orientation tools — to name a few — to predict how a building will perform, all while it's still in the design phase.

The technologies in play are not new, nor is the practice of considering the energy use and other environmental impacts of a building during the design phase. What's new is the increasing focus on building performance for practical reasons rather than idealistic ones — and the increasing demand for new buildings to meet performance metrics as a condition of the project.

Aiming for Targets

Lisa Petterson, associate principal and director of the Sustainability Resources Group at SERA, explained that the availability of ARRA funding for Edith Green–Wendell Wyatt was linked to the Energy Independence and Security Act (EISA), which put demanding restrictions on the redesign.

"For EISA, the requirements were that we needed to be 55% more fossil-fuel efficient than a typical building," Petterson explained. "We needed to have 30% solar-thermal requirement and 30% energy savings." In addition, EISA required a reduction in potable water use for the exterior environment by 50% and interior by 20%, as well as effective storm-water management.

Finally, SERA had to deliver a guaranteed maximum price (GMP) by September 2010. To meet the accelerated schedule, SERA undertook three to four months of intense building analysis before handing over the design

to Cutler Anderson Architects, said Jim Riley, associate, SERA.

"We spent a lot of time getting ourselves to an understanding of how the building needed to perform, what the systems needed to be in order to meet the performance targets, [and] what the geometry of the building needed to be in order to really take into account the existing structure and its orientation on the site," said Riley. "Then, we presented all of that analysis to Mr. Cutler and said, 'These are the boundaries that we're working within.'"

Performance-Driven Design

GSA, the nation's largest landlord, has excelled for a number of years with its Design Excellence Program. One of the agency's mandates is to provide efficient and economical facilities that are not only functional but also outstanding examples of public architecture.

Achieving building efficiency and economy increasingly requires the use of advanced technologies for applications ranging from design analysis to rendering to modeling for security, wellness, and sustainability. As evidenced by the Edith Green–Wendell Wyatt funding requirements, GSA is putting high-performance design at the top of its list of requirements for new buildings.

Performance-driven building design is a trend that is definitely growing, according to SERA's design team. Petterson said they're seeing a real shift toward it.

"Certainly, it's a long way away from every client coming to us with performance metrics, but I'd say that we actually found it so valuable that we often bring it to the table," she explained,

instead of simply relying on the owner to request it.

Ken Hall, director of Sustainable Design Systems at global architectural firm Gensler, concurs that performance-driven design is gaining ground against traditional building design. Hall believes that more stringent building codes are driving the trend to increase buildings' operating efficiency.

"They set the base level of performance, and that base level is being met and raised continually by the building codes," explained Hall. "Analysis tools are a part of meeting the codes."

Productivity View

Although tightening the codes is a good first step to delivering high-performing buildings, Hall explained, what's really becoming important are the issues of health, wellness, and productivity. "That is in many ways the rising star at this point in time: linking the productivity benefits of employees in buildings with these investments, which makes them healthier and happier and more productive."

Hall cited the LEED program as an important factor in increasing awareness of the health issues tied to buildings. "It has created a market force wherein there is competition to achieve a LEED rating. Individuals would rather be in a LEED-rated building because they believe it's going to be better for them from a health point of view."

And there's more than just anecdotal evidence to suggest growth in this trend. More than 250 design firms are signatories to the Architecture 2030 Challenge to significantly reduce greenhouse gas emissions that result from building construction and occupancy. The National Institute of Building Sciences is working to deliver an Owner Project Requirements online tool, a metric that "identifies performance-based objectives, standards, and lifecycle costs for planning new and renovation commercial building projects." The American Institute of Architects has

◄ The renovated Edith Green–Wendell Wyatt Federal Building is shown in its setting in Portland, Oregon.

created *An Architect's Guide to Integrating Energy Modeling in the Design Process*. Finally, the U.S. Energy Information Administration has reported that building-related energy use will drop by approximately 70% from 2005 to 2030.

Software Still Maturing

When it comes to predicting with any confidence how a building will perform before it's actually built, architects and engineers depend on software technology. Hall said there has been a healthy evolution of tools over the past decade, but there's also plenty of room for improvement.

"We're too early in this to have any one tool that in fact solves all of our problems," he said. The good news is that solutions are diverse because there's a lot of competition in the marketplace, he added. "Everybody is moving forward and nobody has the perfect answer yet. We're trying a little bit of everything that's out there."

The Edith Green–Wendell Wyatt project required more than 60 software applications, the design team estimated. The most useful tools cited for performance-driven design include Autodesk Revit Architecture and Navisworks

Manage; Heliodyne for solar hot water–system design, AGi32 lighting design software, IESVE and eQUEST for energy analysis, Trace Software's solar calc, SketchUp Pro, and the Center for the Built Environment's Thermal Comfort Tool.

To identify the right software tools for the job, Riley recalled, "We tried to do as much 'fast failure' as we could. If we couldn't get reliable results within 80 hours' worth of work, we would drop the software platform and go find something else."

Jeffrey Maas, sustainable design analyst at SERA, believes one area of performance-based modeling that is poised for improvement is the software user interface. Citing the ease of use of Google and Apple tools, Maas said that software developers need to focus on usability that will encourage their products' use and not intimidate members of the design team who may be less tech savvy. Software users also should be able to refine and change assumptions that were input at the beginning of the design process once HVAC, plumbing, electrical, and security systems are finalized.

The designers at SERA say having good graphic output that reflects the analysis conditions would be ideal, as would having a common language that lets the various software programs communicate seamlessly. As the demand for performance-driven building design grows, the software tools that support it will undoubtedly mature as well. ◄

Contributing editor **Heather Livingston** is a freelance writer based in Massachusetts who specializes in design, sustainability, and architectural technology. She also works with the American Society for Healthcare Engineering of the American Hospital Association.

Playing
CAD
and Mouse

by **Heather Livingston** and **Robert Green**

Cadalyst Labs navigates
the maze of input device
options for users of 2D and
3D computer-aided design.
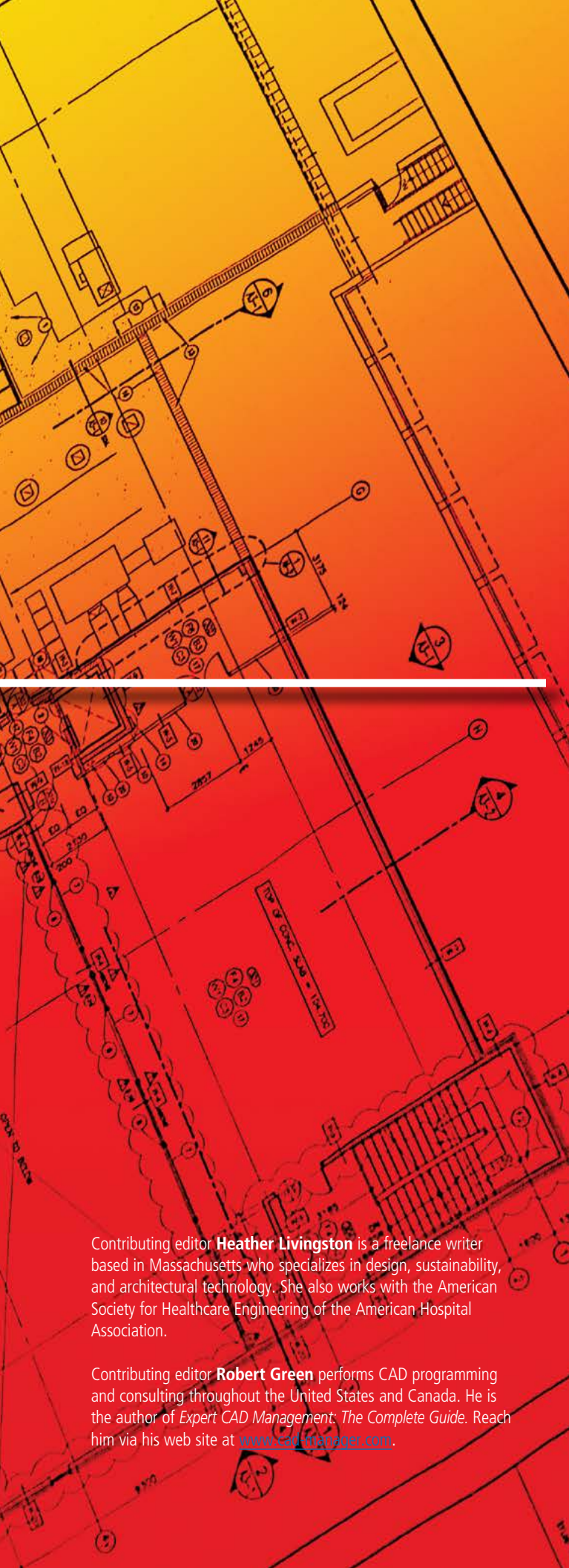
Asking, "Which mouse is best for CAD?" is a lot like asking, "Which software is best for CAD?" The answer depends on the type of work you're doing, your budget, and your personal preferences. These days, your choice of mouse isn't limited by compatibility issues; those are largely a thing of the past. You're free to base your decision on your individual work style and what you find comfortable. Whatever your requirements may be, the market offers a good number of input devices to choose from.

Following a recent Cadalyst poll that asked, "What type of input device (besides the keyboard) do you use at your primary CAD workstation?" Cadalyst Labs decided to take a closer look at the various types of input devices, the tasks that best suit them, and their features and benefits. In the second half of this feature, CAD-management expert Robert Green evaluates a handful of new products and explores how well they meet the requirements of CAD users.

General Features

Selecting an input device requires choosing between corded and wireless models, and if you're shopping for a push/pull–type mouse, you'll also need to decide between laser and optical tracking.

Corded vs. wireless. Comparatively few input devices on the market today have cords, but plenty of options still exist for those who prefer that old-fashioned connection, shun batteries, or want to save a few dollars. Wireless input devices, which send signals to the computer via a wireless receiver plugged into a USB port, won't get tangled up on the desktop or need to be repositioned because they reached the end of the cord; the downside is limited battery life and the prospect of having batteries die at a critical moment — although an increasing number of wireless mice can be charged via a micro-USB cable.

Optical vs. laser. A push/pull–type mouse relies on optical or laser technology to track the device's position as it moves around the desktop. The key differences between the two options are precision and price. **The more dots per inch (dpi) a mouse can track, the more sensitive and accurate it is.** Laser mice, which track more than 2,000 dpi, navigate sharply through tasks and typically cost $20–$50. They are ideal for precise CAD work but can be too sensitive for standard office and e-mail applications. **A typical optical mouse tracks 400–800 dpi,** so it can be a little less responsive but is a reliable choice for nearly any task — and can be had for $10–$20. Laser mice tend to track better on a greater variety of surfaces, whereas optical mice can lose functionality on rough or uneven surfaces, glass, and shiny materials such as highly polished granite.

All in all, the optical mouse will function at its best when used on a mouse pad alongside your workstation. CAD coordinator Curt Moreno says, "At a bare minimum, no CAD

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Contributing editor **Robert Green** performs CAD programming and consulting throughout the United States and Canada. He is the author of *Expert CAD Management: The Complete Guide.* Reach him via his web site at www.cadmanager.com.

workstation should be without a trusty optical mouse, even if it is just standing by as a more custom device is used daily."

Standard Mice

Although many CAD users still rely on a keyboard for left-handed controls and a mouse for right-handed input (or vice versa for lefties), the mouse and ribbon menu have taken over as the primary method of command execution in a CAD environment. The standard mouse — whether laser or optical, corded or wireless — remains the most popular choice among CAD users, with more than half of Cadalyst poll respondents using it as their primary input device. The most valuable benefits of the standard mouse are its adaptability to almost every type of task and its ease of use, regardless of whether you're working in CAD or responding to an e-mail message. In addition, standard mice are typically less expensive than 3D, programmable, and other specialty versions. And choices abound: An army of hardware providers — including Belkin, Dell, HP, Kensington, Logitech, and Microsoft — offer a huge variety to support the needs of practically any user.

Programmable Mice

Programmable mice are outfitted with buttons that the user can customize (via a software interface) to perform tasks, such as cycling through open windows or executing multistep CAD operations. Some standard mice and 3D navigation devices have integrated programmable buttons for one-handed use, but many users opt to use a programmable device in one hand and a standard mouse in the other. The downside of programmables includes a higher price point (typically $60–$100) and ergonomics that some users find disruptive. If you're not accustomed to using all your digits to input commands, you could experience discomfort or even stress injuries as you adjust your mousing technique. Manufacturers include Anker, Logitech, and Razer.

Moreno uses the World of Warcraft Cataclysm, an 11-button MMO gaming mouse from SteelSeries. "I enjoy the heft and build of this mouse as well as its programmability,"

he explains. "The mouse is about 20% larger than the standard optical mouse, and it has a braided cable that is extremely long."

As Moreno pointed out, many programmable mice are designed for gamers, and accordingly, their software makes it easy to assign common gaming functions to buttons. Assigning CAD functions, however, will likely require more time-consuming, manual effort. Be sure you fully understand how that flashy gaming mouse will function for CAD work — or play it safe and stick with a traditional programmable model.

Trackballs

Once the darling of the desktop, trackballs seem to be fading from use these days. Only 9% of Cadalyst poll respondents said they prefer the trackball, a statistic that is backed up by the limited number of models available. However, there are some great reasons to give one a try if you haven't done so yet.

Unlike a mouse, the trackball remains stationary; its roller ball sits nestled on the device, so you don't need as much space to use it. Not having to move the mouse around the desk means you'll experience less arm fatigue throughout the day. Cursor movement is controlled via your fingertips or thumb. The smaller movements required to relocate the cursor make trackballs more precise and sensitive than standard mice, as well as more ergonomic. In addition, the trackball is larger than most mice, so it can provide a more comfortable experience for those with large hands. On the negative side, trackballs can be uncomfortable for small-handed users, can take extra time to master, and are more expensive than traditional mice, running $35–$135. They are available from ITAC, Kensington, Logitech, and others.

3D Navigation Devices

Among the Cadalyst readers polled, 3D mice were the second-most popular input devices, with 12% of respondents preferring them. Available with and without programmability, they are ideal for 3D modeling environments and are said to provide a more natural, intuitive way to interact with digital 3D content. By gently manipulating the controller cap, 3D mouse users can simultaneously pan, zoom, and rotate 3D models or camera position while using a standard mouse or input tablet with the opposite hand to select, create, and edit.

This two-handed working style is reported to increase productivity and quality of design work for users. A 2008 study by the Technology Assessment Group, "The Economic Payback of 3D Mice for CAD Design Engineers," found that more than 84% of CAD design engineers experience a noticeable or significant improvement in their product designs and their ability to detect design problems as a result of using 3D mice. The average productivity gain reported by CAD users while using 3D mice was 21%, and the typical payback period for 3D mice was reported to be less than one month.

Patrick Davis, a virtual design and construction manager, prefers the 3Dconnexion SpacePilot for his building information modeling (BIM) work. Models also are available from companies including SpaceControl and Novint, and prices range from $99 to $399.

Ergonomic Mice

If you suffer from repetitive stress injury (RSI) or carpal tunnel syndrome but prefer the functionality of a standard mouse, an ergonomic mouse might be your answer. A well-designed ergonomic mouse will keep your hand resting in a neutral position, reducing strain and preventing or minimizing the types of movements that can cause RSI. If such a device works for you, it would be well worth the $35–$120 investment. Models are available from a variety of companies, including 3M, CST, Ergoguys, Evoluent, Goldtouch, and HandShoe Mouse.

To Each Their Own

Clearly, there's no single best mouse for everyone — in fact, there are probably several great options for any given individual. Your choice will depend on the software you use, your preferences regarding features and overall feel, your physical needs, your budget, and more.

Concludes Moreno: "Like anything, I feel that the choice of input devices relies more on the use case rather than the market, and any single market has multiple use cases. For instance, an architectural drafter may use a [3Dconnexion] SpacePilot for building the bulk of a massing model and structure in Revit. Then he or she may switch to an optical mouse for fine detail work, or to a Wacom tablet for a stylus interface with [Autodesk] 3ds Max to artistically texture and render his mod-

els. Finally, he may use something like the Leap Motion gesture controller to have finer control over the model in presentation or review with clients."

Armed with this general overview, the product evaluations that follow, and some dedicated research, your pursuit of the perfect solution need not be a game of cat and — well, you know.

Product Reviews

Cadalyst editors selected seven devices to be evaluated by Robert Green, a contributing editor and CAD-management expert. Editors chose a variety of devices to fit a range of budgets, keeping prices at less than $100 (with one exception). The included models are all PC compatible and readily available from standard online retailers.

Our review process involved assessing installation on a desktop workstation and a notebook PC, and putting each device through its paces with 2D and 3D CAD applications.

Pricing shown for each device includes the manufacturer's retail price and, in most cases, the lowest price we found from a reputable online retailer at the time of publication (listed in parentheses). Warranties and return policies are provided by manufacturers and could vary for devices purchased from other sources.

Microsoft Comfort Mouse 4500

Corded mouse
Overall Grade: A

Pros: Low cost; no batteries required; tracks well on surfaces other than glass; 2D/3D CAD zooming/panning supported; ambidextrous design.
Cons: Wheel spins so freely that controlling fine motions is challenging.
Price: $24.95 retail ($14.99)
Microsoft | 877.696.7786 | **www.microsoft.com**

Remember when a mouse was reasonably sized, had basic buttons and minimal features, and a cord tethered it to your computer? The low-priced Microsoft Comfort Mouse 4500 harkens back to those good old days, with a few new twists.

Using a wired USB connection with a generously long, 6.5-foot cable, the Comfort Mouse 4500 even allows connection to full-size workstation towers tucked away under desks. It installed flawlessly on my desktop and laptop machines and even played nice with my wireless keyboard.

The full-sized (2.6" x 4.6") housing and symmetrical design make it easy for right- or left-handed users — even those with big hands — to find a comfortable resting position, while the rubberized coating provides a sure grip with very light pressure. The slick plastic motion

pads gave the mouse a fast feel on tabletops, mouse pads, and laminated desktop surfaces alike, and the BlueTrack optics — which Microsoft describes as "combining the power of optical with the precision of laser" — tracked perfectly on everything except a glass-top table.

From a button standpoint, the Comfort Mouse 4500 has CAD programs well covered, with normal left and right click and a scrollable, clickable, and left-to-right selectable wheel. This tilt wheel, as Microsoft calls it, covers the zooming, panning, and translation functions that 2D and 3D CAD users

The Comfort Mouse 4500 from Microsoft fits most users' hands and is inexpensive.

expect to perform with just an index finger. Throw in two more left and right buttons (which fall under the thumb and the pinky), and you've got everything you need for a custom mouse experience at a bargain price.

One thing I didn't like was the free-spinning nature of the wheel when in zooming mode; I wish it were just a little stiffer and easier to control.

The Comfort Mouse 4500 is covered by a three-year limited warranty. Microsoft honors returns for 30 days from the date of purchase provided the item has not been opened or altered from its original state and does not show wear or damage.

I would have no problem using this mouse all day, every day for CAD and general office programs, but I have to say, as someone who has become accustomed to using a wireless mouse, it really was weird using a mouse with a cord again. **Highly Recommended**.

Microsoft Wireless Mobile Mouse 4000
Wireless travel mouse
Overall Grade: B

Pros: Fits easily in laptop bags; tracks well on surfaces other than glass; no mouse pad needed.
Cons: Too small for large hands; wheel spins too freely; requires a battery.
Price: $34.95 retail ($19.99)

Microsoft | 877.696.7786 | www.microsoft.com

Are you looking for a compact wireless mouse that'll work for CAD, yet fit in the smallest laptop bag? That's the niche this travel mouse is striving to occupy, and for the most part, it succeeds.

Using a wireless USB-mounted nanoreceiver, the Mobile Mouse 4000 installed perfectly on both test machines. Like its big brother, the Comfort Mouse, the Mobile Mouse 4000 has slick motion pads and BlueTrack optics that result in fast and accurate performance on all surfaces I tried, other than glass. The unit requires one AA battery, and the stated battery life of 10 months under normal use seems achievable given the sturdy, bottom-mounted power switch that lets you disconnect the battery when not in use.

Its small size (2.4" x 4") and wireless architecture make it easy to tuck this mouse into your laptop bag, but also made it difficult for me to find a natural resting position for my hand. In fact, after 30 minutes of use I experienced noticeable tendon fatigue. (I do have large hands, so I may be overly sensitive to this issue.)

A single extra button on the left side of the mouse and a standard scrollable, clickable wheel covered most CAD zooming and panning functions, but could be limiting for 3D rendering and visualization software users. As with the Comfort Mouse, I found the wheel a bit too easy to spin.

The Mobile Mouse 4000 is covered by a three-year limited warranty. Microsoft honors returns for 30 days from the date of purchase provided the item has not been opened or altered from its original state and does not show wear or damage.

The Mobile Mouse 4000 feels well built and nicely balanced. For travel scenarios where compact size is a boon and

RollerMouse Re:d is positioned at the foot of the keyboard. Users control the roller bar with their fingertips.

Mouse Alternative Promises Comfort for CAD Users

What's black and white and "Re:d" all over? It's the latest version of the RollerMouse from Contour Design. Optimized for CAD use, the RollerMouse Re:d ($265) promises precise cursor control that increases user productivity while decreasing stress on the neck, shoulders, elbows, and wrists.

"With the new tracking technology, Contour Design has redefined precision, so it's not really relevant to discuss dpi anymore," says CEO Steven Wang. "Dual laser sensors track the motion inside the roller bar and give you the most accurate pointing device you can get." It's that improved precision that makes Re:d the first RollerMouse suited to CAD work, and the larger surface gives users more control when pointing, rolling, or clicking.

Also beneficial for CAD users: "When the rollerbar reaches the end of travel, the cursor goes into autodrive and keeps traveling toward the end of the screen," Wang says. "This is a helpful feature on large and multiple screens, because there is no need to lift and pan the mouse to move across the screens. The adjustable cursor speed button makes it easy to slow the cursor when even more precision is needed."

short-duration software use is the norm, this mouse is a fine choice. But, due to ergonomic incompatibility, I wouldn't want to use it for extended periods of time and certainly wouldn't adopt it for use at my desktop CAD workstation.

Microsoft's Wireless Mobile Mouse 4000 is easy to take and use anywhere, but may be too small for some hands.

Logitech G600 MMO Gaming Mouse
Programmable corded laser gaming mouse
Overall Grade: C-

Pros: None significant for CAD use.
Cons: Very uncomfortable; not designed for large hands; optimized for gaming, not CAD.
Price: $79.99 retail ($59.99)

Logitech | 800.231.7717 | www.logitech.com

Users can customize the functions of buttons on the Logitech G600.

Programmable gaming mice are often mentioned as favorites by CAD users, so we were excited to put one to the test in Cadalyst Labs. When I unpacked the Logitech G600, excitement turned to giddiness as I looked at all the buttons I could program. I wanted so badly to like this mouse, as it reminded me of the good old days when I could program my tablet puck's 16 buttons to do my CAD bidding. The G600 includes three primary buttons, 12 thumb buttons, a clickable scroll wheel that tilts, and a G-Shift button to double the number of customizable functions. Using a 6.5-foot cable and a wired USB connection, the G600 installed without a hitch, and the buttons on the left side of the unit lit up with perfect visibility.

Upon trying to use this mouse, however, my joy began to fade. First, the medium-sized plastic housing — 3" x 4.5" x 1.5" and noticeably devoid of any ergonomic shape — looks and feels like an inexpensive, no-frills mouse. And given that the programmable buttons are on the left side of the housing (for a right-hander's thumb), the ambidextrous shape doesn't make much sense. Further, given the narrowness of the hous-

ing, I found it uncomfort-able — almost impossible — to position my thumb on the programmable buttons. And even if I could find a comfortable way to handle the mouse, those buttons were way too close together for my (admittedly large) thumb to operate.

The G600 uses a software utility to map program controls (for known video games, not CAD tools) into the various programmable buttons, but it only has basic right and left buttons and scroll/pan functionality on the top of the mouse. So unless you can operate the side-mounted button array (which I really couldn't) and have the patience to manually assign CAD functions to your buttons (which is doable, with some trial and error), the G600 performs like a basic mouse.

The G600 comes with a three-year limited hardware warranty. Logitech does not publish a return policy; a representative told Cadalyst that returns are handled case by case.

If your goal is to program an otherwise conventional mouse to lob hand grenades in your favorite video game, the G600 would probably be a good choice — if you don't have large hands. For CAD work, invest in something else.

Logitech Performance Mouse MX
Wireless programmable laser mouse
Overall Grade: A+

Pros: Great ergonomic feel; rechargeable; cordless; tracks well even on glass.
Cons: Right-hand-only design.
Price: $99.99 retail ($73.60)

Logitech | 800.231.7717 | www.logitech.com

Are you searching for a full-size wireless mouse with great ergonomics that'll track crisply, even on a glass desktop? The Logitech Performance Mouse MX covers all these bases.

Using a wireless USB-mounted nano-receiver, the MX installed perfectly on both test machines. With its tactile footpads, it had slightly slower feel than the Microsoft Comfort Mouse 4500 when sliding
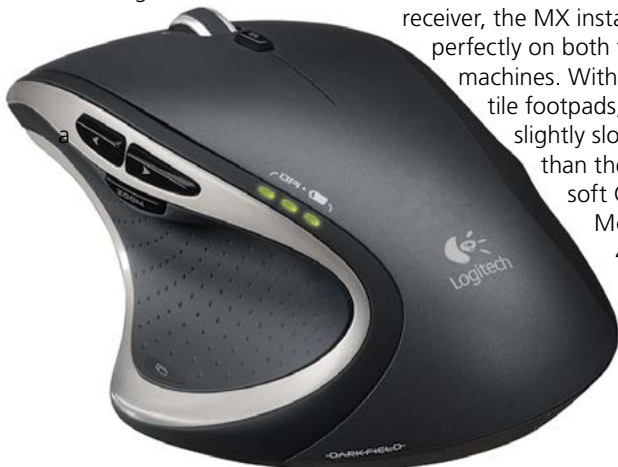
across tables and desks. Thanks to Logitech Darkfield laser tracking, it even tracked on a glass conference table — the greatest challenge to surface performance. Another bonus: The MX is rechargeable via a mini-USB cable.

The MX has CAD and general office programs covered with all the standard buttons, switchable ratchet/free-spinning clickable scrolling wheel, and left and right pan buttons integrated into the wheel so that the index finger alone can navigate 2D and 3D CAD space very intuitively. Four customizable thumb buttons let you turn your most-used multistep CAD processes into single-click actions. Throw in the backward and forward buttons for browser controls, and you've got a mouse that works very well in virtually any program you need to use.

The 3.28" x 5" x 1.85" unit accommodates even large hands, and all the buttons fall right under your fingers and thumb in resting position. But there's no mistaking that this mouse is designed for right-handed users — I can't fathom how a left-hander could use this device.

The MX comes with a three-year limited hardware warranty. Logitech does not publish a return policy; a representative told Cadalyst that returns are handled case by case.

Everything about the feel, function, and build of this unit is high quality, and using it felt like slipping on a pair of broken-in shoes. Of all the mouse options reviewed, the Logitech Performance Mouse MX is the one I'd use most, all day, every day for all my programs, not just CAD. Even at its high price point, I consider this unit a bargain. **Highly Recommended**.

The Performance Mouse MX from Logitech offers excellent CAD functionality.

The Kensington Orbit wireless trackball is a solid option for 2D CAD users.

Kensington Orbit
Wireless trackball with scroll ring
Overall Grade: A-

Pros: Good size for larger hands; very precise tracking response; nonskid base; power switch for battery conservation.
Cons: Requires batteries; a bit large for laptop bags.
Price: $39.99 retail ($34.86)

Kensington Computer Products Group | 877.350.4141 | www.kensignton.com

I've never been a trackball fan. It seems that every time I've tried to use one, it strained the tendons in my hands and fatigued whichever finger (or thumb) operated the ball. Despite these prejudices, I tried to keep an open mind when testing the Kensington Orbit wireless trackball and, surprisingly, I found it to be superior to trackballs I've used in the past.

Not much larger than a conventional mouse, the 4.5" x 5.5" x 2" Orbit has a solid nonskid housing that stayed put on desktops and cushioned mouse pads alike. Using a USB nanoreceiver and two AA batteries, the Orbit installed flawlessly. The unit worked perfectly even when used alongside a conventional mouse, making it a viable choice for users who prefer to use two devices in combination.

Thanks to the wide base — wider than any mouse I've used — my hand easily found a relaxed position, with my index and middle fingers using the trackball in tandem while my thumb performed left-click duties and my ring finger, the right-click. For vertical scrolling, two touch-sensitive pads are mounted in a ring around the ball. This took a little getting used to, but became comfortable once I started using my index or middle finger to scroll while the other finger remained on the ball. With a bit of practice I was able to scroll/zoom in CAD programs and coordinate the double-clicking action with the trackball to use context menus with no problems — but I still wasn't comfortable after a half-hour's use. I concluded that for 2D CAD use, where zooming on one axis is all you need, this mouse would be fine, but trying to translate/rotate in 3D space (such as orbiting or panning) was unnaturally difficult.

The product has a 60-month manufacturer's warranty, plus a 90-day money-back guarantee (for original buyers who bought the product in the United States).

All in all, would I ditch my full-featured mouse for the Orbit trackball? No. But the Orbit is much better than other trackballs I've tried in the past, and it would serve a primarily 2D CAD user well. I'm willing to bet that existing trackball fans would become fond of the Orbit in short order.

ITAC Evolution USB MOUSE-TRAK
Corded trackball
Overall Grade: A

Pros: Excellent stability; sturdy build; great ergonomics, producing almost no hand or arm fatigue; no batteries required; CAD zooming and panning supported; ambidextrous design.
Cons: Expensive; too large to carry in a laptop bag.
Price: $149

ITAC Systems | 800.533.4822 | www.itacsystems.com

ITAC's evolution MOUSE-TRAK (eMT) isn't going to win any awards for beauty; it looks like a cross between a trackball and a mouse on steroids. But if the idea of a large, easy-to-actuate trackball with six easy-to-click buttons appeals to you, you'll likely love it.

The device is sturdily constructed of ABS plastic, measures approximately 4.5" x 8" x 2.5", and uses a 1.5-meter USB

3D Motion: Control without a Controller

More input devices are available to computer users today than there are keys on a keyboard, but a new technology has jumped into the market that aims to replace digital doohickeys with digits — that is, fingers.

Not to be confused with touchscreen technology, the Leap Motion 3D motion controller ($79.99) allows humans to interact with their computers by moving their hands and fingers in space. A 3" USB controller sits on the desktop, sensing when you point, wave, reach, and grab, then translates those gestures to control 3D software.

Leap Motion is Windows- and Mac-compatible and is supported by a variety of games and other software available in the Airspace app store. At press time, one CAD-related option was already available: Autodesk's free plugin for Maya 2014 modeling and animation software lets users control almost any aspect of Maya using Leap Motion, according to the description.

ITAC's evolution MOUSE-TRAK offers great ergonomics.

3Dconnexion SpaceNavigator
Corded 3D navigation device
Overall Grade: A

Pros: Reasonable cost; no batteries required; quality construction; compact enough to carry in a laptop bag; ambidextrous design.
Cons: You'll still want a conventional mouse for non-CAD use.
Price: $99 retail ($87.99)

3Dconnexion | 781.890.8452 | www.3dconnexion.com

If you've ever had the chance to use a 3Dconnexion controller, you're familiar with what the 3D mouse has to offer. If not, imagine a mouse that sits stationary on the desktop and acts like the stick control on a flight simulation game, plus an integrated z-axis controller — you can pull the controller up or push it down — and you'll start to get it.

Using a wired USB connection, the 3" x 3" x 2" SpaceNavigator installed just fine and worked alongside other installed keyboards and mice on both test machines. Upon launching into CAD programs, the ability to translate, rotate, and move along the z axis can only be appreciated in 3D graphics environments. Using a 3D mouse for 2D CAD drawing wouldn't make much sense, but to visualize almost any type of 3D model environment, the 3Dconnexion units are unparalleled in functionality. You simply can't understand how easy it can be to spin around, translate, or slide along axes until you've used this device. And even if you still like to use a conventional button mouse for command input, you can add the Space-Navigator for visualization; it isn't much more expensive than a high-end traditional mouse.

Everything about the SpaceNavigator is solid, well constructed, and highly tactile. It hardly takes any hand motion at all to operate the device, which you'll get used to quickly. The SpaceNavigator comes with a two-year limited warranty that covers breakage but not returns for aesthetic or other subjective reasons.

After we concluded our review of this model, 3Dconnexion introduced the SpaceNavigator Wireless ($129), which includes a micro-USB receiver and a rechargeable battery.

My only issue with 3Dconnexion products in the past has been cost — as high as $399 for the top-end model, which is simply too much for many CAD budgets. But the SpaceNavigator offers 3D navigation functionality for less than $100. At that price, if you do 3D CAD with any regularity, you really should try out the SpaceNavigator yourself; a short review doesn't do it justice. **Highly Recommended**.

3Dconnexion's SpaceNavigator lets users navigate intuitively through 3D design space.

connection cable. The six-button trackball installed flawlessly on both test machines, and the symmetrical design makes it 100% ambidextrous.

The large size of the unit (as large as my outstretched hand and weighing a full pound), along with a pronounced hump for the indentation of the user's palm, made the device very comfortable to rest my hand on; all the buttons fell comfortably under my fingers with only minimal arching. The ball of the unit is huge compared to those of other trackballs I've used, making the motion feel more linear than curved. Rubberized nonskid feet make it stay put on the desktop.

The eMT has three left-hand and three right-hand buttons that can be customized using the default Windows pointer driver, so no custom software is required. The unit covers the usual CAD zooming and panning functions serviceably, very much like other trackball controllers I've tried.

A full warranty covers the eMT for two years, after which ITAC Systems will handle repairs and refurbishing for up to five years through its RMA procedures. Returns are accepted within 30 days of purchase.

The eMT's size, cost, and unusual appearance will probably relegate it to niche status, but trackball lovers — particularly those who would like a larger unit for a more relaxed arm and hand feel — should give it a look. **Highly Recommended**.

Lenovo ThinkPad Helix

Hybrid device offers practicality of a laptop and convenience of a tablet on a Windows 8 platform that's powerful enough to support CAD.

◀ With a detachable screen that can function as a tablet, the Lenovo ThinkPad Helix can be configured four different ways.

If you pay even a small bit of attention to the tech world, you've probably heard a lot of talk about tablets lately. Research organizations trumpet the death of the PC, while other market experts counter that nothing could be further from the truth. I believe that reality lies somewhere in between — so, when the opportunity arose to review Lenovo's Think-Pad Helix tablet/laptop hybrid, I jumped at the chance.

Lenovo describes the ThinkPad Helix as a "premium convertible" that combines laptop performance with the flexibility of a tablet, and the description is apt, if not understated. The ThinkPad Helix brings together the best elements of a full HD tablet and an excellent keyboard without losing the usability or benefits of either.

The Helix comprises a stand-alone, touch-screen tablet that docks to its keyboard. The tablet connects to the keyboard dock facing forward or backward with what Lenovo calls a "rip and flip" design, which allows use in four distinct arrangements, including:

- **laptop mode,** with the tablet and keyboard connected in the traditional configuration;
- **tablet mode,** with the tablet used alone for mobile applications;
- **tablet+ mode,** where the tablet faces the user with the keyboard connected and folded behind it to provide more power, ports, and battery life than the tablet used alone; and
- **stand mode,** where the keyboard sits behind the tablet to serve as a base while the user gives a presentation or works on the tablet for extended periods.

Lenovo ThinkPad Helix
Hybrid tablet/laptop

A

Pros: Mobility, Intel processor, touch screen, 4G LTE capable, long battery life.
Cons: Spendy, bulkier than a typical tablet or an Ultrabook.
Price: $1,549.99

Lenovo
855.253.6686
www.lenovo.com

Hardware design. The ThinkPad Helix is designed in the image of Lenovo's other tablets and laptops, with a black satin finish and the distinctive red LED over the "i" in the ThinkPad logo. It comes with a choice of Intel Ivy Bridge processors: the i5-3317U, the i5-3247U, or the i7-3667U. Lenovo reports that upcoming models of the Helix will offer fourth-generation Intel Haswell processors.

The touch-screen tablet is responsive and features an 11.6" 1080p IPS screen that is vivid and bright. It includes a Wacom stylus that fits nicely into the 11.6-mm-thick bezel for storage. Much like other tablet designs, the Helix has both front- and rear-facing cameras, a power port, a 3.5-mm headphone/microphone jack, power and volume buttons, and a physical Home button. Unlike some tablets, the Helix also includes a USB 2.0 port, a Mini DisplayPort, and a SIM card slot for cellular service up to the latest 4G LTE networks. The unit ships with Intel HD 4000 graphics and 4 GB of DDR3 RAM, but is available with as much as 8 GB of RAM.

The unassuming ThinkPad keyboard has an 8.8-mm profile, is spill resistant, and sports a full set of keys. Fans of Lenovo keyboards will be glad to see the much-loved TrackPoint pointing stick but may be surprised to see Lenovo's recently revised glass touchpad, which is a joy to use. Keys are pleasant to the touch, with a good strike. The attached dock includes two USB 3.0 ports, one Mini DisplayPort, and the power port.

The docking mechanism features six points of connection: two large guide rails to simplify aligning the two units, two locking hooks that secure the units, and two data/power posts for functionality. A loud click lets you know the tablet is fully seated and the connection is secure. A release button on the left side of the dock is both easily accessible and not very likely to accidentally release.

Software performance. Whereas the average tablet is designed around a mobile operating system such as iOS or Android, the ThinkPad Helix uses a full version of Microsoft Windows 8. This alone separates it from the army of tablets with keyboards, because you can install and operate any program designed to run on Windows 8. With this unit, you don't have to worry about which apps are available at which app store. The lastest versions of Microsoft Office, AutoCAD, and video games will all feel at home when installed on the Helix.

HP Designjet T120

Compact 24" printer is just the right size for small offices that are short on space.

HP's web-connected Designjet T120 is geared toward the entry-level market, from the single user to the small office, and is capable of producing D-size sheets. It is compact enough to sit on a desktop, but is available with a stand for a more conventional installation. The Designjet T120 produces very high-quality prints — but takes its time in doing so. Also, sound-sensitive users will want to look elsewhere, as the T120 can be quite noisy while printing.

The HP Designjet T120 supports roll media as well as sheets.

Features

Without the stand, the T120 measures roughly 39" wide x 12" tall x 21" deep; the optional stand and catch bin bring the height of the unit to about 36". The unit weighs less than 60 lbs, so a single person can move it easily.

The printer supports 2"-core roll media as wide as 24" and sheets as wide as 13". The roll media is easy to load, and the built-in sheet tray operates in a fashion similar to the bypass tray on your office printer or copier. Even though the roll media sits at the rear of the printer, the minimal depth of this unit means you do not have to move it away from the wall to change media.

Making changes to the printer settings and checking ink levels and connectivity status could not be much easier. The software behind the 4.3-inch" color touchscreen is intuitive, and the screen itself can be pivoted up from its flat position on top of the printer for easier viewing. As with all Designjet printers of recent years, the T120 has an embedded web server that lets user check the status of the printer and supplies as well as view and change printer settings.

The Designjet T120 also features 256 MB of onboard memory, but no hard drive for storing jobs meaning that to reprint an item, you will have to send it again from the application.

Connectivity

Wired connectivity can be achieved via adirect USB connection or Ethernet port network. Setup takes just a few minutes, and Windows 7 even includes a driver for this printer, so you can begin printing soon after assembly. For best results, users will probably want to update the default driver with the latest version available from HP.

But the Designjet T120 need not be tethered to your PC or network. It is one of the first wide-format printers with built-in Wi-Fi capability, delivering full printing functionality without all the cords. Not only that, but you can take this wireless con-

HP Designjet T120
24" Wide-Format Printer

A

Pros: High print quality, light weight, small footprint, Wi-Fi capability.
Cons: Speed is sacrificed for quality; somewhat noisy.
Price: $999

HP
800.772.9897
www.hp.com

nectivity with you on your laptop, tablet, or smartphone when you use HP Designjet ePrint & Share, a free, web-based service available for HP Designjet T-series ePrinters. You can even e-mail a document to the T120 for automatic printing.

Print Quality and Speed

The T120's print quality is excellent, as you might expect from HP, based on the company's long experience in this field. An optimized resolution as high as 1200 x 1200 dpi and a minimum line width of 0.04 mm yield crisp line drawings.

That quality, however, comes at the cost of print speed. According to HP specifications, the Designjet T120 can produce 40 D-size pages per hour. In our tests, an 11" x 17" black-and-white line drawing printed from AutoCAD 2013 took slightly more than two minutes to complete. For comparison, the same print job took only 49 seconds on an HP Designjet T1100.

The T120 includes a single CMYK print head with four individual ink cartridges. (Introductory sizes of all four are included with purchase.). Full-size cartridges retail for about $40 (38-ml black ink) and $32 (29-ml individual colors).

Purchase Considerations

Because of its small footprint, you may plan to place the T120 near your workspace, but be aware that, for its size, the unit is fairly noisy while printing. HP includes a one-year limited

> **The Designjet T120 need not be tethered to your PC or network. It is one of the first wide-format printers with built-in Wi-Fi capability, delivering full print functionality without all the cords.**

hardware warranty, with the option to purchase longer-term service and support.

The HP Designjet T120 appears to be a good solution for the small office or one-person operation. However, if print speed is the most important feature for you, then you should consider another options. Otherwise, the excellent print quality, small footprint, and embedded Wi-Fi make the T120 a leader in its price range. **Highly Recommended**.

Cadalyst contributing editor **R.K. McSwain** is a designer and CAD systems administrator for Pate Engineers in Houston. He has been using and programming AutoCAD for more than 15 years. Contact him through his web site, CADpanacea.com.

Autodesk ReCap

Powerful pair of tools easily turns laser scans and photographs into quality visualizations and high-resolution 3D models.

O n the heels of its successful launch of 123D Catch, a mobile app for consumers that turns photographs into 3D models, Autodesk introduced ReCap — a pair of reality-capture applications for professional designers, architects, and engineers who want to create intelligent 3D models from photos and point cloud data. ReCap Photo and ReCap Pro are available at no extra charge to users of Autodesk 2014 design and creation software suites. Using these tools, you can visualize massive point clouds as realistic surfaces and interact with them, performing CAD-like operations such as select, tag, move, measure, clash detection, and object extraction — all with native points.

Autodesk ReCap Photo

Autodesk ReCap Photo, available via the Autodesk 360 cloud service, creates high-resolution, textured 3D data from a series of photos taken at different angles around an object. The software leverages the cloud to process and store the photos and data. Unlike 123D Catch, ReCap Photo does not limit the number of photos you can submit, and it processes photos in full resolution for a more accurate 3D model. The geometry generated from the photos is a mesh rather than an ACIS-like solid.

Prior to creating a model, you can adjust settings to control the model-conversion process. The first option is mesh quality: draft, standard, or maximum. The better the mesh you desire, the more time is required to process the data. ReCap Photo provides an estimate of processing time based on your photos and the level of quality you select. In my very unscientific tests, producing a standard mesh took twice as long as draft quality, and maximum quality took approximately five times as long as draft.

A 3D model of a statue created using Autodesk ReCap Photo.

A second option specifies the registration of matching points. Use this option to select survey points or reference distances to add scale to your project.

The final option lets you select the images that will be used to generate the texture map for the project. The selected photographs are uploaded to Autodesk cloud servers.

Using ReCap Photo is very easy, provided that you follow some simple but essential guidelines about photographing the object, which can be found in the "Autodesk ReCap Photo Getting Started Guide" (bit.ly/19ZYy2y). Maintaining consistent camera angle and overlap between each image yields a better model.

Get started by uploading a series of photos to My Cloud Documents in your Autodesk 360 account. Next, select files to use in creating the 3D model. (For my testing, I used images that Autodesk provided and I created several of my own scenes.)

Click on the Submit Project button to begin converting your photos to a 3D model. Once the scene is created and the model generated, you will receive an e-mail notification with a link to your file.

You can view the finished model directly in your web browser or download it as a ZIP file with any accompanying textures and materials. ReCap Photo lets you save the resulting model to RCS (Autodesk ReCap), FBX (Autodesk), OBJ (Wavefront), or IPM (mobile viewer) format.

Highly Recommended · Cadalyst Labs

Autodesk ReCap Photo and ReCap Pro
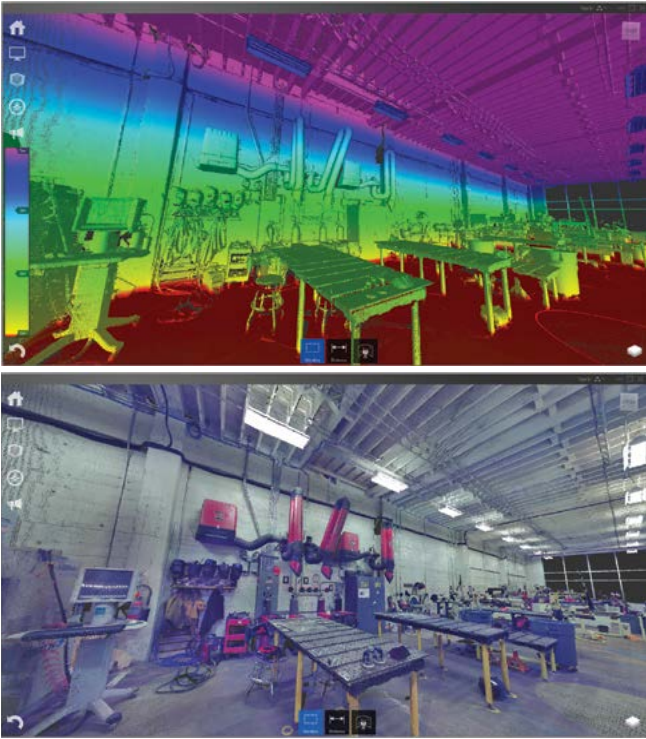
A+

Reality Capture Tools

Pros: Easy to use, quality results, vital tools for today's workflows.
Cons: None significant.
Price: ReCap Pro is included with Autodesk 2014 design and creation suites; ReCap Photo is freely accessible to any 2014 design suite user.
Autodesk
www.autodesk.con/recap

Laser scan data in Autodesk ReCap Pro (top) shows height variance in a factory. That same data was converted into a usable 3D model (bottom) using ReCap Pro.

Autodesk ReCap Pro

Autodesk ReCap Pro, the second tool in the ReCap duo, is a data-preparation environment designed to enable faster, better visualization of point clouds inside other Autodesk 2014 applications. It runs on the desktop and provides functionality similar to other point cloud–viewing applications — that is, you can index, combine, view, and edit point cloud data, including light detection and ranging (LIDAR) data, prior to importing it into other Autodesk 2014 applications.

If you are reading this article, then you probably have had some experience working with point clouds, and you may know that laser scanners can produce flawless data that can be edited and repurposed in a variety of ways. But to utilize this point cloud data, you typically need computer hardware that can accommodate very substantial memory and processing requirements. There may be hundreds or thousands of files to manage, and the storage requirements are significant. Although functionality is always improving, CAD software traditionally has not done a very good job of managing and processing that enormous amount of data.

When I get a new scan data set, the first thing I do is look at the point clouds, and visualization is the most basic operation that I perform. To execute this task, I have to be able to open and manage all the relevant point cloud files. Autodesk ReCap Pro provides the tools to do that.

The ReCap Pro user interface (UI) resembles that of Microsoft Windows 8 Metro. At the time of my review, this interface was not easy to use; however, Autodesk reports that it has made changes to the UI to improve the user experience. Otherwise, the software is fairly easy to use. From the Home screen, you can open an existing project, start a new project, access Help, change settings, and exit the application.

Prior to importing the raw point cloud files into ReCap Pro, you have to adjust the import settings for all or a selected group of files. There are five settings that you can control:

- **Noise Filter** determines how aggressively stray points are excluded from the imported scan file.
- **Distance Range** dictates which points are included in the imported scan, based on a minimum and maximum distance from the scanner.
- **Intensity Range** sets the range of points that are imported based on the reflection (intensity) values.
- **Decimation Grid** controls the number of points to import by setting the smallest cubic volume that a single point can occupy.
- **Coordinate System** aligns the point cloud to a specific ESPG coordinate reference system.

Once you start the import process, ReCap Pro begins indexing the files. This indexing process, which converts the point cloud files to Autodesk's proprietary Reality Capture Scan (RCS) file format, can take anywhere from a few seconds to hours, depending on the number and size of the files imported. The Import Settings dialog box displays the status of the import process. When the indexing process is done, you can save an aggregated scene of the project to a single Reality Capture Project (RCP) file that links to the processed data.

During my testing, a 1.5-GB dataset with eight original files took about an hour to complete. A single 5-GB PCG file took approximately four hours.

After the importation process is complete, you can organize, clean up, and analyze the data. ReCap Pro provides several methods to organize the data and remove or hide portions of the point cloud. You can create scan regions that you can toggle on and off, specify temporary clip regions, turn off or remove scan files, or delete unwanted points permanently. By viewing the scene using various color modes and lighting schemes, you can gain insight into elevations, normals (which help identify surfaces), and reflectivity.

Once you finalize and save your scene, you can open that RCP file in many other Autodesk 2014 applications, including Revit, AutoCAD, and Navisworks. In my tests, I found that manipulating the model in another Autodesk application was better when using the RCP format than when using the native scan file format.

Today's design workflows — from architecture to product development to factory design — rely on reality capture technologies to save time and money and improve accuracy when working with as-built data. Autodesk's new ReCap products make it easy and affordable to turn scanned data and photographs into high-resolution 3D models that you can bring into your Autodesk design software to begin your design process in context. If you're a user of any Autodesk 2014 product suite, you've got to give these tools a try. **Highly Recommended**. ◀

Cadalyst contributing editor **Patrick Davis** is a virtual design and construction manager for Atkins North America and an Autodesk Certified Instructor for Revit Architecture. He has been contributing to Cadalyst since 1998 and is coauthor of the *Introducing Autodesk Revit Architecture 2011 and 2012* books from Wiley Publishing.

TurboCAD through the Years

The release of the software's 20th version inspires a longtime user and beta tester to reflect on its development — and its role in the success of his business.

TurboCAD 3 was a gift from one of my partners when I joined Advanced Micro Instruments back in 1995. I installed it on a tiny Pentium 133 Hitachi laptop with a postage stamp–sized screen and began making drawings.

My company, Advanced Micro Instruments, was started to make oxygen analyzers in competition with Teledyne Analytical Instruments. Some might think that a start-up with no money and a me-too product going up against an established major company would be a recipe for failure, and in the pre-PC days they would have been quite right. But the world was changing, and products like IMSI/Design's TurboCAD made — and are continuing to make — all the difference.

Nowadays, a couple of guys in a garage with a PC, Turbo-CAD, ExpressPCB, and the CCS C compiler can compete on equal ground with any of the old-line companies. (And on the Internet, no one can see your garage.) I believe TurboCAD and programs like it are going to spur huge changes in the world economy as these affordable, yet powerful technologies level the playing field between small businesses and corporate giants. It's just a matter of time.

Let me explain. A giant company has colossal overhead, which it balances with its economies of scale. I know of one company where the rule of thumb was that you needed to make 80% gross profit to make your numbers — that is, the parts cost of whatever was sold could be no more than 20% of the selling price. Overhead was 65%, leaving a 15% net profit, which was OK, if not stellar.

As a guy in a garage, you turn these numbers around. Your overhead is closer to 20%, so you can afford to make the product with twice the parts cost and still beat the giant company on price. And because you care enough to do whatever it takes, and you don't go home at 5 o'clock, you provide better service and a better product to boot. After a while customers notice, but it takes quite a long time for the dinosaur companies of the world to pay any attention, and by then it's too late — their customers have become your customers.
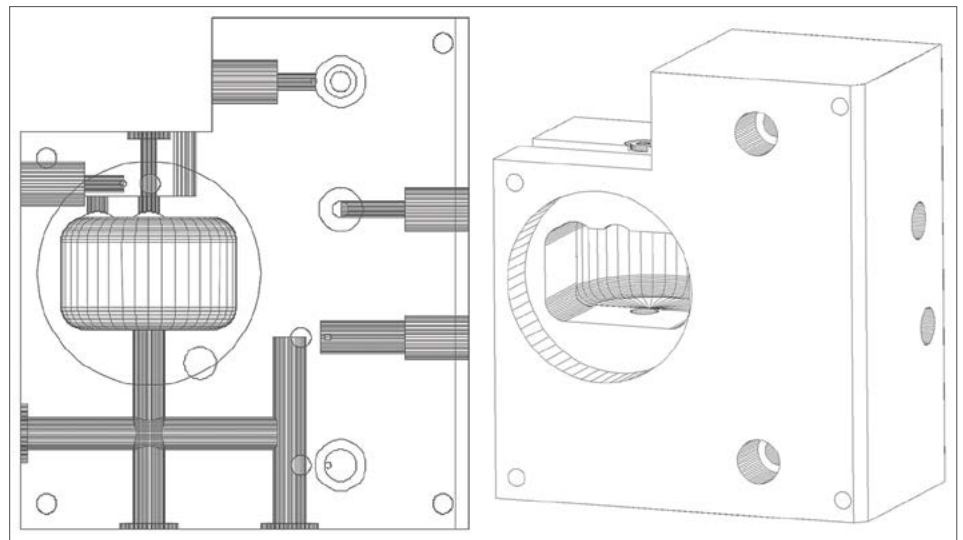

Figure 1. At left is the early block design of our oxygen analyzer (front view), modeled in TurboCAD v4 or so. The dark areas are holes drilled for gas passages, and we placed an oxygen sensor in the pocket on the left front. At right is a hidden line rendering of the current assembly, modeled in TurboCAD v20.

Starting from Scratch

Back in 1995, all this was not obvious to me. I just knew I had to draw up some metal brackets so our sheet metal guy could make a box for our first analyzer. TurboCAD had the considerable advantage of being free, at least to me, and I knew just as much about it as I did about AutoCAD or any other solution I might have considered at the time — that is, nothing at all. My background is in electronics and analyzer applications, not mechanical design, and I was a CAD neophyte.

Fortunately we had been working with a wonderful, very experienced mechanical guy who had his own machine shop, and pretty soon he licked me into shape. We started with simple things like the brackets, but shortly I ran into my first real challenge.

First, a bit of background: My company makes oxygen analyzers that measure trace levels of oxygen, down to less than one part per million (ppm). Since air contains 210,000 ppm of oxygen, roughly, the partial pressure of oxygen in the air is about 3 psi. The rate at which any gas diffuses through a leak is proportional to the difference of partial pressure across the leak, which means that if you have any sort of leak in your

oxygen analyzer, it will measure how bad the leak is, rather than measure the oxygen content of the sample gas. People are always surprised about how this works, but believe me, it does.

Traditionally, oxygen analyzers have been made by screwing together a bunch of parts to provide the sample handling and bringing the sample into a block, into which the sensor is placed. All those parts contain potential leak sources and the fittings take quite a bit of skill to assemble, so this kind of design is both expensive and unreliable. We decided to put everything into a single block of metal instead, drilling holes for the gas passages and integrating all the various bits into a single assembly (**figure 1**).

TurboCAD was ideal for this. When version 4 came along, I could make a hole by subtracting a 3D cylinder from a 3D solid. I soon realized that if I wanted to be able to edit my models, I needed to make two copies of everything — one for doing the Boolean subtractions and the other so I could move or change elements, then redo the whole thing after I'd deleted the assembly.

The truly neat feature of modeling in CAD back then was that I could experiment with the positioning of the passages and screw holes without spending a fortune on machining. I found I could illustrate how the sample passages worked by subtracting the finished block from a solid block — only the holes were left! It became easy to see which elements were running into each other (**figures 2 and 3**).

Growing with the Software

Around this time I was asked to become a beta tester for TurboCAD, so I've been able to use each version as it came out. Occasionally the software wiped out drawings and introduced bugs — such are the hazards of beta testing — but along the way I've used it to develop a whole series of analyzers, all using this basic idea of machining rather than assembling. I also use TurboCAD to make all the other drawings it takes to manufacture such a device: the sheet metal, the assemblies (**figure 4**), and the illustrations.

As new versions came along, one after the other, I became increasingly productive. The parts tree arrived with version 8, offering for the first time a built-in history of 3D object construction. Then the ability to define movable holes via the Hole tool arrived in TurboCAD 12, so I could edit a 3D object rather than starting over each time. The holes could even be threaded! Now I was able to tell when my countersinks ran over the edge of a block. Blocks had appeared in version 3, allowing multiple instances of a part in a drawing without filling up memory, and I found out about them after exposing my ignorance on the beta testers' forum.
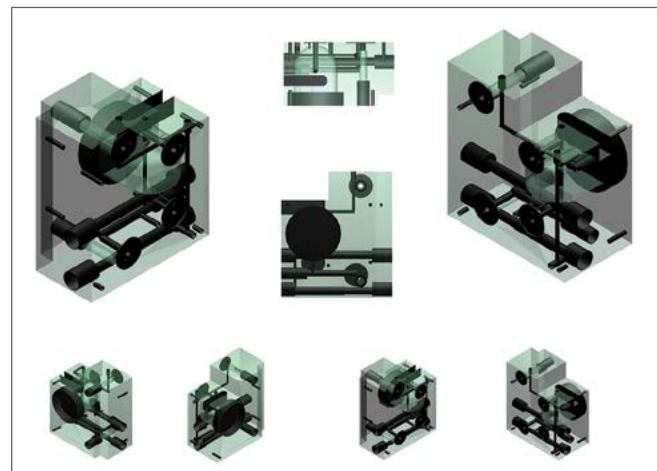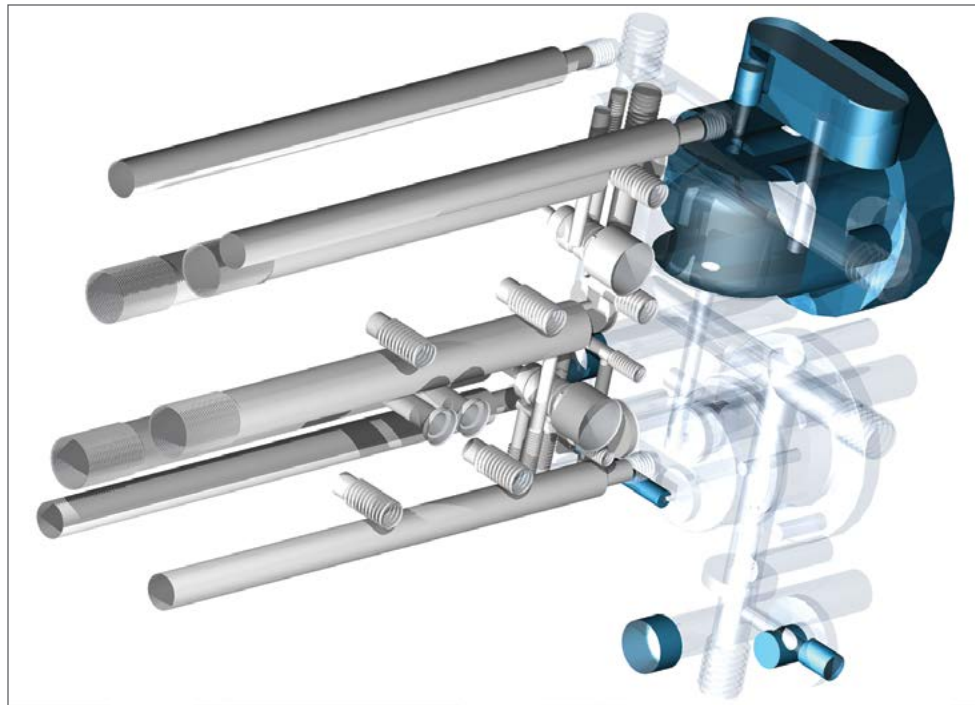

Figure 2. This image — the negative, as it were, of two blocks stuck together — shows the holes of one mating with the similar holes of the other. Screws hold them together.

Figure 3. Various views of the negative of the oxygen analyzer block. To generate these views, I put the negative into a glass copy of the main block and rendered the whole thing.

People on the TurboCAD user forums are very helpful — for example, someone once told me that you could use leaders rather than making callouts manually from lines, circles, and text. Suddenly assemblies became a lot easier!

Over the years, rendering tools got better and renders became better looking. At first you had to use two viewports to put a hidden line render over a ray tracing, but now you can do both at once. And finally, with TurboCAD 19, IMSI/Design introduced a 64-bit version, and I could make a complete assembly without crashing my computer.

When I worked for a large corporation, it would take an entire department several weeks to make the assembly drawings for an analyzer. I can now do it in a day or two, by myself,

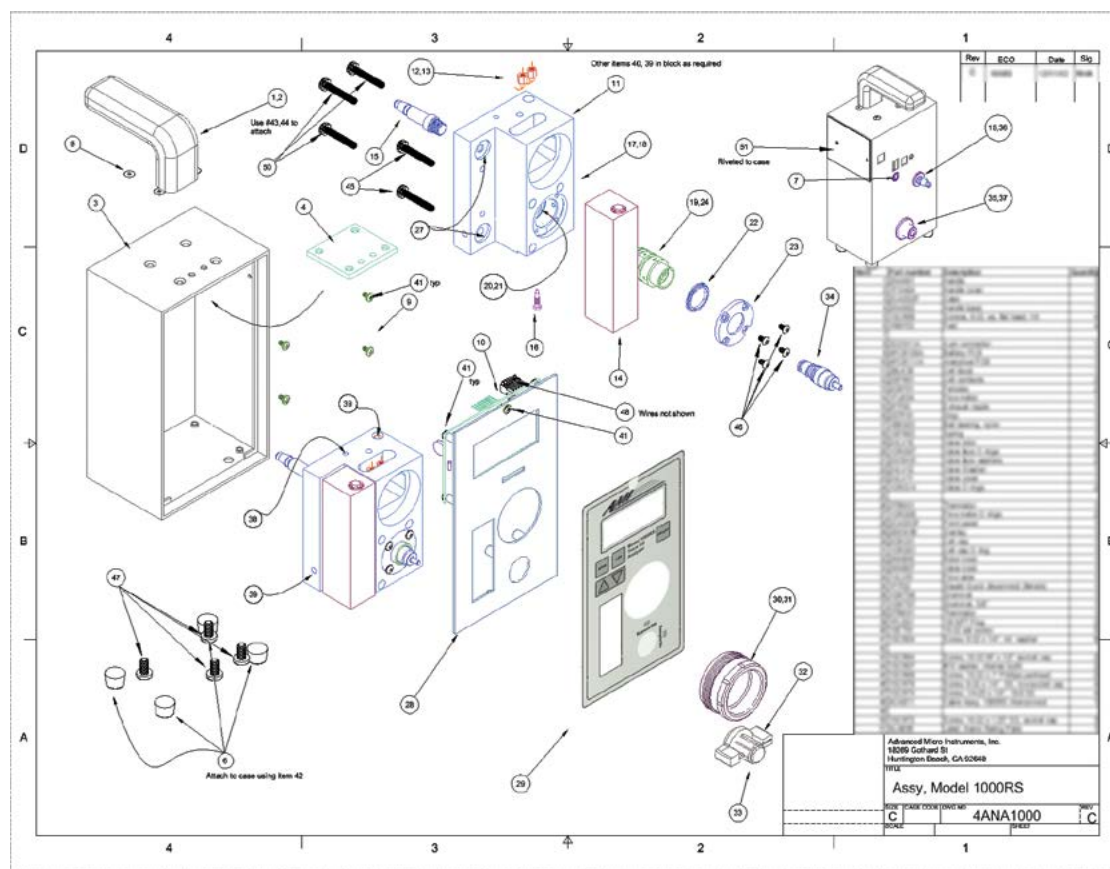**Figure 4.** A typical assembly drawing, made in TurboCAD 16 or so. All the widgets are modeled in 3D, and the screws are probably taken from vendors' ACIS models, though I may have made some myself. (Everything here is rendered in hidden line; I did that for printing this example as a PDF.) The flat piece at bottom center, labeled with "AMI," is a printed piece of plastic with built-in electronic switches, drawn in Corel Draw, turned into a JPG image, and applied to the surface of a sheet. It was a real pain to get the drawing scale and positioning right.

using TurboCAD. Of course I get a head start by reusing earlier models, but even so, the increase in productivity is incredible.

TurboCAD Today

TurboCAD 20 — I use the Pro version — brings a whole series of improvements. Most importantly, it appears the stability has improved; I don't get crashes. The Redsdk graphics are fast and reliable, and I no longer have to use the native draw capability. I can model an entire analyzer in 3D model space without worrying about memory limitations. I don't use the architectural or the parametric modeling capabilities, but the nonflashy, basic operations that I rely on seem to continually become more stable and responsive. The software just *works* — and that's the single most important feature of a CAD program!

Why TurboCAD?

Designers use CAD for two reasons: to design something and to communicate to others how to make what they designed. It is easy to get lost in the minutiae of making a perfect drawing, but at the end of the day, its sole purpose is to communicate clearly to the person who needs the information. TurboCAD offers the right level of sophistication to enable you to do both without an impossible learning curve or daunting price tag.

Of course, other CAD programs, such as AutoCAD, have always been options. Many years ago, my machinist used AutoCAD, so I spent a lot of time watching him use that software. It was apparent that the user interface of TurboCAD

was much more intuitive than the Command line approach of AutoCAD at the time. I've had occasional problems with file export and import over the years, but nothing severe enough that it gave me a reason to switch. I also liked the fact that IMSI/Design was an upstart company, just like mine!

Design that used to require an entire engineering department now just takes one person and the right software. Add a web site that you can develop on the same PC, and now you have a company that can compete with the best — except that your overhead is nothing compared to those old-line behemoths.

Nowadays, my company is no longer located in a garage. It is a thriving small business with real employees, including a couple of engineers other than myself. Even as we grow, I'm still able to blow away my competition with better products, better prices, better service, and better delivery — and a lot of that is thanks to TurboCAD. ◄

Roland Aldridge holds a degree in engineering science and economics from the University of Oxford. He has been designing gas analyzers since about 1980, working as engineering manager at Teledyne Analytical Instruments and Rosemount Analytical before becoming an owner of privately held Advanced Micro Instruments for the past 18 years.

cadmanager

By Robert Green

Become a CAD Ecosystem Expert
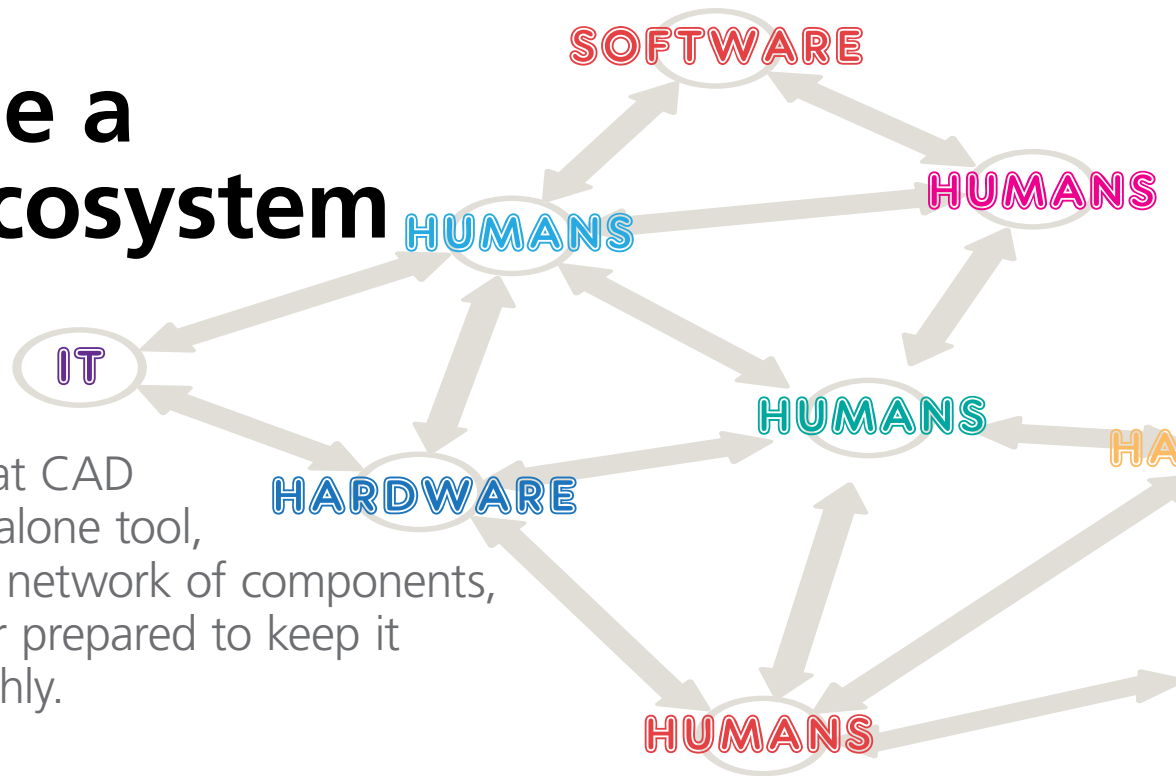
Once you understand that CAD is not a stand-alone tool, but a complex network of components, you'll be better prepared to keep it running smoothly.

What should CAD managers actually *manage*? Senior management teams and CAD managers alike ask me this question, and it's one I've struggled to answer intuitively. One day, it dawned on me that I could explain CAD management by presenting CAD as a multidisciplinary ecosystem that must be managed in its entirety in order to work properly, not just as a tool or a standalone piece of software.

In this edition of "CAD Manager," I'll offer you practical advice on how to best to manage this interconnected web of hardware, software, and human elements — lest it manage you. Here goes.

The CAD Ecosystem

Over the years, I've come to understand that all CAD-related work is accomplished by navigating a complex process that uses a distributed ecosystem of components as follows:

Design intent. A user (engineer, architect, designer, etc.) thinks about the design and develops parameters/constraints to input into a CAD tool.

Hardware interaction. A user then employs a mouse, keyboard, monitor, and computer to input those parameters into a CAD application.

CAD interaction. A user navigates the menus, ribbons, and toolbars of the CAD application to transform the design into a workable model.

Network interaction. The CAD files are then managed via a network or cloud infrastructure.

Output. The CAD design is ultimately output to plots, PDF files, or other means via a peripheral or software driver, which may reside on the user's machine or on a network.

Iteration. Design reviews, client feedback, and internal processes will result in multiple iterations of the above process until a final design is documented. As the design evolves, all the above steps repeat.

It is this multistep process — and all the hardware, software, driver, and peripheral components that facilitate it — that I call the CAD ecosystem.

Every Part Matters

Once I started viewing CAD work as a result of an interdependent ecosystem of actions and components, I realized the following:

The user drives everything. If your CAD users don't understand what they're designing, they won't succeed in their task. If they understand the design but don't understand CAD, they'll be very inefficient.

CAD is just one piece of the system. CAD tools are great, but without functional hardware, networks, and output peripherals — plus great design content — CAD won't do much for you. Anybody can go to the hardware store and buy tools, but that doesn't mean that anybody can build a house!

IT is crucial. So where will you get that great hardware and fast, reliable network you need to run your CAD tools? Your IT department. Thus, if your IT department can't do its job, you won't be able to do yours.

Output problems abound. As I've progressed from using early versions of AutoCAD to 3D mechanical design tools, I've frequently been struck by how often we still have trouble creating plots and proper documentation for design reviews and final deliverables.

So, simply stated, CAD managers who can manage CAD software have only conquered one aspect of the CAD ecosystem. They may still fail if they are faced with incompetent users, outdated hardware, or nonfunctional networks.

What Can You Control?

Let's break the ecosystem down again, but this time let's consider what the CAD manager can do to manage each piece of it.

Design intent. If your company hires good engineers, architects, and designers, then you won't have to worry much about this. On the other hand, if your company habitually hires people with insufficient CAD skills, it may be time for you to get involved with the candidate screening and interviewing process.

Hardware interaction. If your IT department delivers the necessary hardware and properly configured software, you won't have to worry. But if anything about the hardware environment is problematic, then you need to provide input. For example: If hardware is underspecified for CAD applications, fight to get involved with specifications on next year's budget. Don't be a victim of inadequate hardware!

CAD interaction. This is where your application of standards and training are really put to the test. Of course, if your company hires competent workers (as outlined above), your job will be easier. The majority of CAD managers feel most comfortable managing this part of the CAD ecosystem, and thus tend to fixate on it even when other problems are more urgent.

Network interaction. If the network functions properly, then you won't have issues here. However, if your network is problematic, then it is time for you to get involved with IT. General users often don't experience network errors because their needs are limited (for example, because their file sizes are small), but when you start moving around 20-MB Civil 3D projects, building information models, or SolidWorks assemblies, network deficiencies become obvious. As with hardware, get involved and do not suffer network issues without making some noise.

Output. As long as output software and peripherals work, you can spend your time training and standardizing so users can produce quality output without hassle. On the other hand, if software, peripheral, or network issues make plotting and documentation a problem, you must address the issues right away.

Iteration. Design reviews, client feedback, and internal processes will always be a part of the design process. CAD managers can best manage the iterative process by having strong relationships with project managers and key personnel so deadlines are chosen wisely and are well understood.

For each of the above steps, the approach is the same: Diagnose the problem and do whatever it takes to solve it. Otherwise, productivity will suffer dramatically, because each of these elements is essential to the operation of the CAD ecosystem.

Find the Bottlenecks

When we think about the CAD ecosystem, it becomes apparent that it is only as good as its weakest component. Or, put into a traffic analogy, you can only move as many cars as your narrowest road will allow. It is futile to have huge roadways if they get bottlenecked down to a single lane. CAD ecosystems exhibit the same characteristics as a road network — overall throughput is governed by the least robust part of the system.

So how do you go about finding your bottlenecks and targeting them? Here's my approach:

Write it all down. Go through the "What Can You Control?" section above and write down your impressions for each part of your CAD ecosystem. No problem is too small; get it all out on the table so you can fully comprehend the problems.

Which problems impede production? You may not care for a particular PDF creation utility your company uses, but does it work? On the other hand, a plotting room that users cannot easily navigate may be causing real delays. Determine which problems hinder productivity, and give them priority over those that are mere annoyances.

Create a prioritized task list. Now that you have thought through the CAD ecosystem, diagnosed the problems, and decided what you need to fix, the question becomes, What should you work on first? The answer: Whichever problem is causing you the greatest productivity losses.

Work through the list in order. No matter what else you might want to work on, you must tackle the highest-priority tasks first. The goal is to make your CAD ecosystem faster and more efficient, and there's no better way to do that than by attacking the problems in order of importance.

I had a boss once, named Kurt, who used to tell me, "Work on the stuff that needs to be worked on!" As I've gained more management experience, I've come to realize how great that advice is.

Fix the Ecosystem

Armed with your new understanding of your CAD ecosystem and its shortcomings, you can now build a CAD management action plan that targets your biggest problems first. Share this plan with your senior management, IT department, and users to solicit their input and advice. You may find that nobody else sees the ecosystem the way you do, because they've never taken the time to analyze it like you have.

Use the attention you get to adjust the interviewing process for new hires, alter IT plans, specify better hardware, improve training programs, and simplify the output of CAD work. As you do so, never lose sight of the fact that CAD isn't an island; it is a multidisciplinary ecosystem that requires detailed analysis and attention. It may take a while to get your point across, but keep educating your coworkers about the concept and you'll see them catch on.

Summing Up

I believe that as software becomes more complex, hardware devices become more diverse, and networks become more cloudy, the CAD ecosystem will become bigger and more difficult to manage. As this happens, the CAD manager has a stark choice to make: Understand the ecosystem and manage it, or let the ecosystem spin out of control and manage you! I can only hope that this edition of "CAD Manager" has armed you with a strategy to proactively manage your CAD ecosystem — and the motivation to do so. Until next time. ◁

Robert Green performs CAD programming and consulting throughout the United States and Canada. He is the author of *Expert CAD Management: The Complete Guide.* Reach him via his Web site at www.cad-manager.com.

Eleven Efficiency Boosters for AutoCAD 2014

High-profile features are nice, but these subtle improvements will really enhance your productivity.

The big, shiny new AutoCAD 2014 features may get all the attention, but you and I know that it's often the more subtle enhancements that turn out to be the most valuable. Remove just one step from a process you do all the time, and you'll notice an instant bump in productivity. In this edition of "Circles and Lines," I'll cover some of the less flashy, but still valuable new features inside AutoCAD 2014.

1. Draw arcs clockwise. For as long as I can remember, AutoCAD has preferred to draw arcs counterclockwise. That was the way of the world — and we all just dealt with it! In AutoCAD 2014, changing the direction of an arc is as easy as holding down the Control key.

2. Fillet an open polyline. Have you ever tried to fillet an open polyline to itself? It was impossible — until now! AutoCAD 2014 is more than happy to let you do this, the end result being a single closed polyline.

3. Nicely numbered layers. AutoCAD has also learned to count! You'll find that numbered layer names are now listed in their natural order, such as 1, 2, 4, 5, 10, 21, and 25, as opposed to listing them as 1, 10, 2, 21, 25, 4, and 5. And if you're wondering whether there is a system variable to control this feature (for those of you who've already succumbed to AutoCAD's inability to count), I'm afraid not. Maybe that will come in the next release.

4. Longer Layer drop-down list. Are you tired of scrolling through a long list of layers when you use the Layer drop-down list on the ribbon? You'll find that AutoCAD 2014 has expanded the Layer drop-down to fill the entire height of your screen (**figure 1**). This change provides you with easier access — but sadly, you won't burn as many calories.

5. Merged Layer Merge. Layer Merge was a popular Express Tool that grew up to become a full-fledged Auto-CAD command a few releases ago. Now you'll find that Layer Merge is fully incorporated into the Layer Properties Manager (**figure 2**). If you aren't familiar with LayMrg, it's used to merge one or more layers onto a destination layer. The layers that were merged are then deleted. It's an awesome time-saving tool!

6. Xref linetypes and layers redo. Do you use xrefs? A couple of tweaks have been made to the display of xref linetypes and layers that won't really affect your productivity but
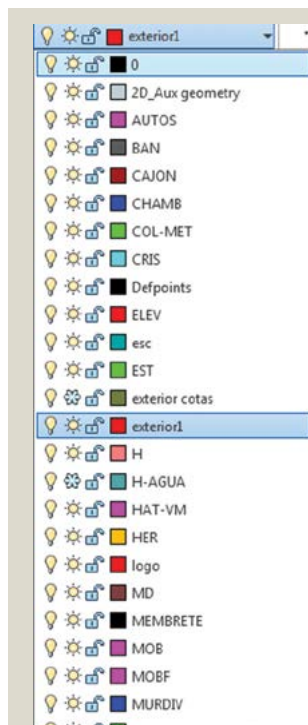

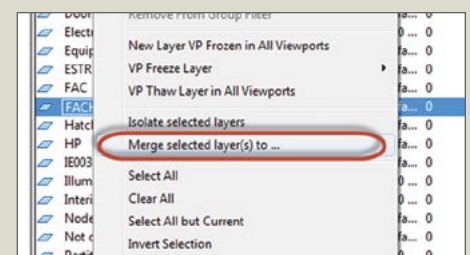**Figure 1.** The Layer list on the ribbon now extends the full height of the user's screen.

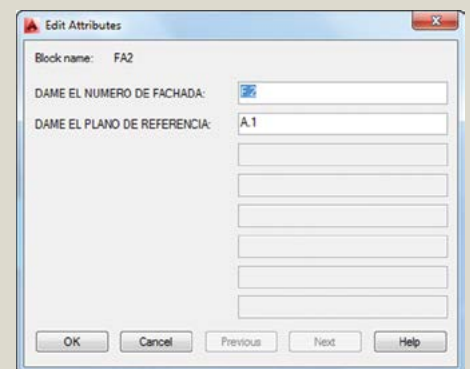**Figure 2.** Layer Merge can now be found in the Layer Properties Manager.

Figure 3. Attributes now display in a dialog box by default.

might cause mild confusion if you aren't aware of what happened. You'll find that xref linetypes are no longer displayed in the Linetype drop-down list on the ribbon or in the Properties palette. No loss there, as you couldn't modify them anyway — and if you can't edit them, why display them? Xref layers are still displayed on the ribbon (so you can easily control their visibility), but you'll find they are no longer displayed in the Properties palette.

7. Easy xref-to-overlay changes. You're going to love the new, simple double-click in the Type column of the Xref Manager that changes attached xrefs to overlays (and vice versa). And how would you know that if someone didn't point it out? (You're welcome!) Have you been frustrated when you couldn't select multiple xrefs to change at one time in the Xref Manager? Now you can do this via the right-click menu.

8. Dtext gains a memory. We all still use single-line text (dtext) from time to time. Have you ever noticed that regardless of how you set the justification, it always returns to "starting point" the next time you use it? That's no longer the case; AutoCAD 2014 remembers the last setting and uses it as the default for the next use of the Dtext command.

9. Sheet set date fix. Are you a sheet set user? If not, you probably should be. And if you are, you may have noticed that whenever you create a new sheet, AutoCAD uses the creation date from the template file instead of the new sheet. That minor (but annoying) detail has been corrected.

10. ATTDIA change. When inserting a block with attributes, the default method of displaying attribute prompts is on the Command line. The new method displays the attributes in a friendly dialog box; ATTDIA is now set to 1 by default (**figure 3**).

11. New system variable. I'll end with one of my favorite additions to AutoCAD 2014. If you've ever added a baseline or continued dimension to your drawing, only to realize that you forgot to change the dimension style to that of the base dimension, you're going to love this new system variable. Set DIMCONTINUEMODE to 1, and baseline and continued dimensions will always reflect the same dimension style as the base dimension! You will also find that this is the new default behavior, so you don't have to remember the name of yet one more system variable.

Now you know some new tips for AutoCAD 2014; be sure to give them a try. I think you'll find that these minor, everyday features in AutoCAD add up to a major improvement in productivity. Happy AutoCAD-ing! ◁

Lynn Allen, Autodesk technical evangelist, speaks to more than 30,000 users worldwide each year. She has written Cadalyst's "Circles and Lines" column since 1993 and is the creator of Cadalyst's popular AutoCAD video tips. Follow her on Twitter at @Lynn_Allen or e-mail her at lynn.allen@autodesk.com.

For the duration of this review, I replaced my tried-and-true 17" desktop-caliber laptop with the ThinkPad Helix. I suspected that I would not be able to go very long before supplementing this change with my larger laptop. To my surprise, I found that the Intel i5 processor packed enough power to handle all my office and CAD needs. AutoCAD 2014 and AutoCAD Civil 3D 2014 worked well on the Helix. However, large 3D CAD models and extensive Civil 3D calculations did reach the limits of the unit's Intel HD 4000 graphics and installed RAM. For better performance, I recommend the i7 model with 8GB of RAM. Still, the Helix outperformed any tablet or hybrid I've ever seen attempt these demanding tasks.

To test more recreational applications, I used the Helix for video streaming and to play Borderlands 2 and Elder Scrolls V; all were enjoyable experiences.

Battery performance. One of the great features of the Lenovo ThinkPad Helix is its battery life: six hours of use in tablet mode and ten hours when docked to the keyboard. Perfor-

mance under continuous use was slightly less, but six or more hours of continuous gaming, CAD work, and video playback is not representative of this device's practical use. In a more realistic scenario of e-mailing, web surfing, writing, and YouTube viewing, I found that the Helix can easily last all day and into the evening.

Price and warranty. The Lenovo ThinkPad Helix that I reviewed has a base price of $1,549.99. It comes with Lenovo's standard three-year warranty, with a one-year warranty on the battery.

The Lenovo ThinkPad Helix is a fantastic choice for any work-related scenario that involves mobile computing. The Intel processor and Windows 8 combination opens a world of mobile computing options that clearly surpasses the capabilities of the average iOS or Android tablet.

It is easy to recommend the Lenovo ThinkPad Helix, a business-class device that offers the mobility of a tablet, the software support of a full-fledged Windows 8 computer, the battery and size benefits of an Ultrabook, and the style and reliability of the Lenovo brand. **Highly Recommended**. ◁

Cadalyst contributing editor **Curt Moreno** is a Houston, Texas–based CAD coordinator, writer, and featured Autodesk University speaker who has been using AutoCAD since 1990. Reach him via his web site, www.kungfudrafter.com, or follow @wkfd on Twitter.

Building Bridges between Platforms

For civil engineering firm IDS to function, data must move smoothly between GIS and CAD — and Amanda Nunley Menard is the person who gets it there.

Amanda Nunley Menard's job bridges two worlds: CAD and geographic information systems (GIS). She is the GIS manager at IDS Engineering Group, a Texas-based firm that provides infrastructure design services for public and private clients. As such, Menard produces maps, designs and maintains databases, and builds web mapping applications. She also moves masses of data between the Esri ArcMap GIS and AutoCAD and Bentley System's Micro-Station CAD platforms — and vice versa — giving her coworkers tools that are essential to their work.

Cadalyst: How did you become interested in GIS?
Menard: When I started my career, I had the intention of becoming a computer programmer. At the same time, I loved science, and I'm an environmentalist at heart. While I was pursuing my bachelor's degree in Computer Science at Texas A&M University, I learned about GIS, and it seemed like a perfect way to blend what I was good at with what I was passionate about. When I changed my major to Geography, I had my first formal training in GIS — and I have loved it ever since.

What role does CAD play in your work?
I'd consider myself an advanced GIS user, but I'm still a pretty novice AutoCAD/[AutoCAD Map 3D] user. Although I rarely work directly in Auto-CAD, I spend a large amount of time converting data between CAD and GIS, working with coordinate systems, scaling issues, and data translation.

I never received any formal training in AutoCAD. Instead, I started experimenting in AutoCAD Map 3D a few years ago, out of necessity: Every day we are asked to show a CAD drawing as a layer in one of our GIS maps, and no matter how great that CAD drawing is, it rarely displays the way you'd expect in GIS.

The most common reason that I use CAD is to scale drawings from surface (ground or flat) coordinates to grid (curved) coordinates. And sometimes doing basic things, such as turning off or freezing CAD layers, is just easier in CAD than ArcMap.

What kinds of projects do you support as GIS manager?
Our GIS group creates maps and databases for all of our civil engineering departments. For our Land Development and Municipal Utility District groups, for example, we produce aerial exhibits and site maps of subdivisions, land plans, and facility locations. We also transfer CAD infrastructure utility maps into GIS, showing sanitary sewer lines, water lines, and storm line locations. Then, through CCTV programs and analysis, we can show areas where problems have been detected and indicate required repairs.

What aspects of your job do you particularly enjoy?
I work with a great team of people in our company, and I love the variety of projects I get to work on. Every day, I get to try something new or I have the opportunity to analyze data in a new way. Since the technology is always changing, I'm constantly learning new things.

My most rewarding project to date was developing our internal GIS web sites. When I first started at IDS, our GIS department was just starting to grow. We spent a lot of time creating basic maps and finding data for our engi-

Menard uses a variety of programs and databases to produce detailed utility maps.

neering groups. Our goal in creating an online tool was to allow them the opportunity to reference data and generate quality maps on their own.

To accomplish this task, our group had to work with several departments within our company. It was a great team-building experience. Even though the software has continued to change, those sites are still in production today, and I look forward to the opportunity to create even better web mapping apps.

Tell us about your life outside work.
I enjoy spending a lot of time with my family and friends, relaxing, traveling, and hanging out with my Australian terrier, Quigley. I head up to College Station for Aggie games, play fantasy football, and read a lot of books. ◄

Know a CAD user we should feature? Send your suggestion to editors@cadalyst.com.

Details & Data

To read more of Amanda Nunley Menard's story and view additional images of her projects, visit www.cadalyst.com/menard.