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Siemens PLM Software

Key simulation enablers

**Simulation capabilities everyone needs**

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Simulation capabilities everyone needs

Today's engineers operate in a highly competitive world. Manufacturers must get products to market as fast and efficiently as possible. That competitive environment leaves little margin for error. Miss a delivery or launch, and a competitor gets your market share. Fail to satisfy a customer need, and a competitor takes advantage of your misfortune.

As a result, manufacturers are pursuing product development strategies to mitigate those risks. One such approach is to find new ways to leverage simulation and analysis. Some are looking at leveraging simulation earlier. Some are encouraging its use by more stakeholders. Some are looking to extend the value of existing models.

Regardless of the strategy, there are a number of key enabling simulation capabilities everyone needs. Control, re-use, multiphysics, and automation are just some of those crucial and essential capabilities. Siemens PLM's Femap™ software delivers them all.
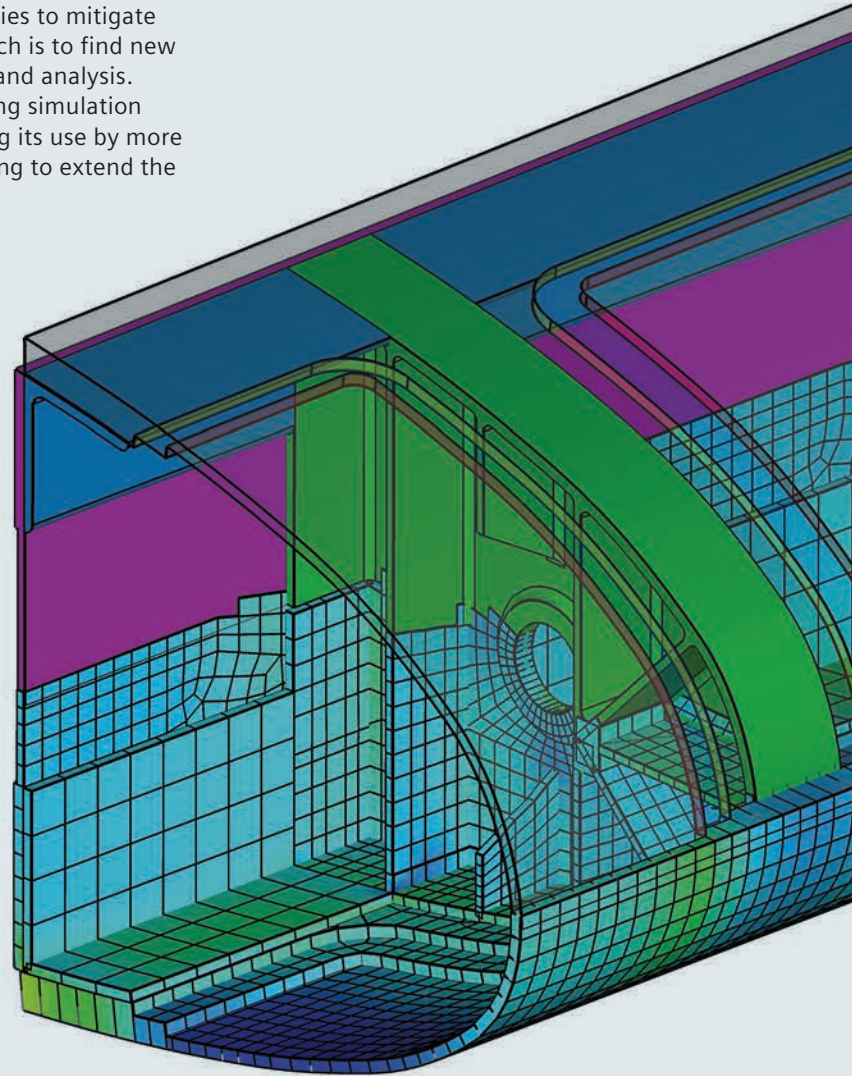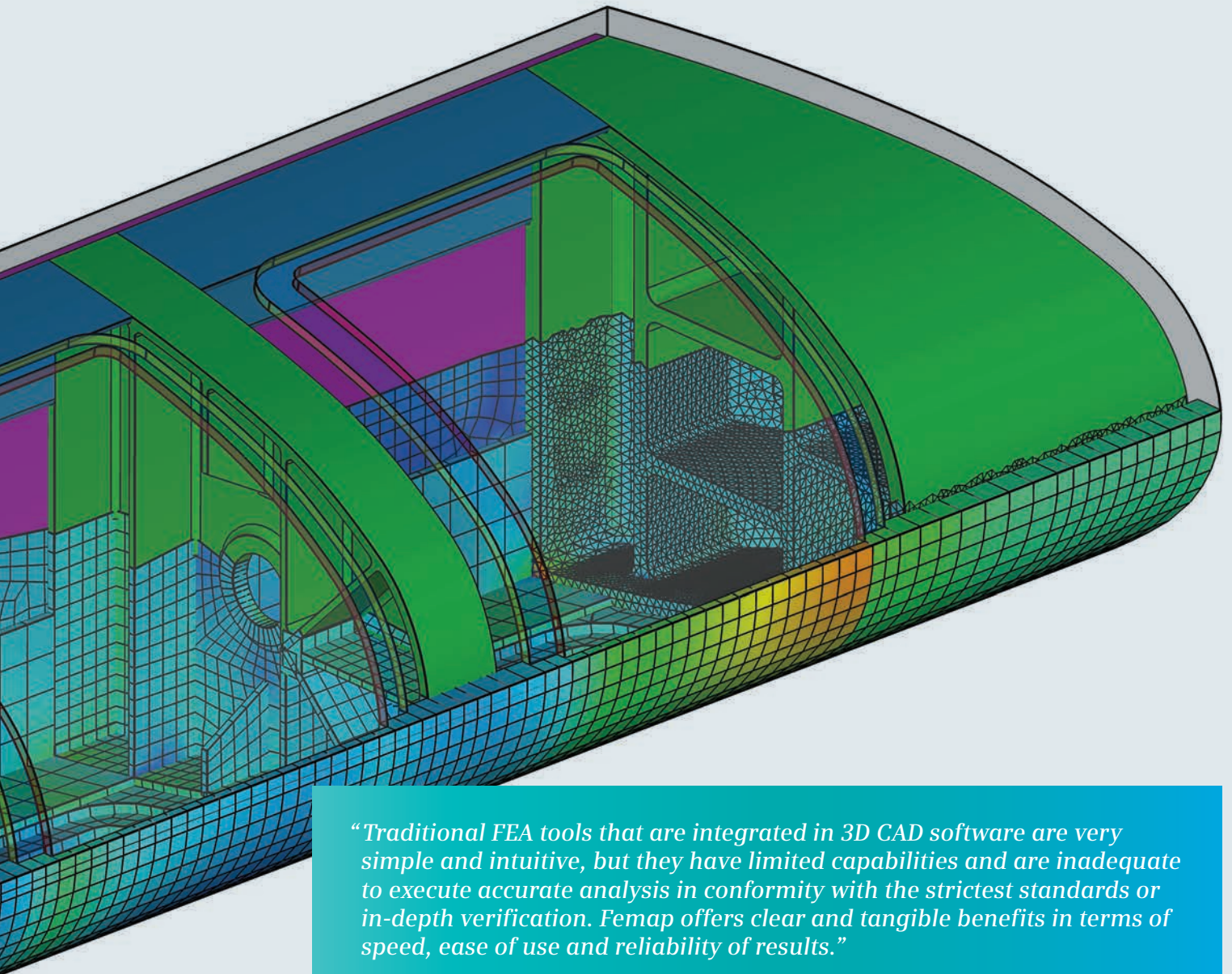
"*Traditional FEA tools that are integrated in 3D CAD software are very simple and intuitive, but they have limited capabilities and are inadequate to execute accurate analysis in conformity with the strictest standards or in-depth verification. Femap offers clear and tangible benefits in terms of speed, ease of use and reliability of results.*"

Stefano Milani
Finite element modeling (FEM) manager
*Ener Consulting*

Sometimes, you need more control

The changes triggered by current trends are having a major impact on what engineers need from their analysis tools. Analysis has traditionally required a highly specialized skillset. To make simulation more accessible, solution providers have worked to find ways to simplify and streamline their software applications. The results have been to accelerate the simulation setup process and to reduce the barriers to use.

However, increased accessibility and more simplistic user interfaces come with a trade-off: many streamlined systems take most of the control of the simulation out of the user's hands. For many engineers and analysts, this is a deal-breaker. The ability to fine-tune and drill down into the model's critical simulation details are important to achieving the results they need. The loss of granularity can lead to a loss of control. That, in turn, can produce simulation results that do not represent the true behavior of the design. Instead, engineers need a tool that will let them accelerate and streamline model development without sacrificing fine control over minute details of the model's design.

Giving engineers and analysts as much control over finite element meshes as possible is a start. Along these lines, a viable simulation tool should provide features such as manual, seeded, automated and interactive meshing with detailed control parameters. It should also handle many different element types, including shell, beam, assembly, volumetric and composite. Another crucial area of control is applying loads and boundary conditions. The best analysis solution should support a wide range of forces, torques, excitation loads and much more.

Clearly, control of a model is essential to its success. However, the ability to explore a complex level of detail is just as crucial to creating accurate simulation data. Without this, engineers and analysts risk making critical mistakes that could threaten the project's chances for success.
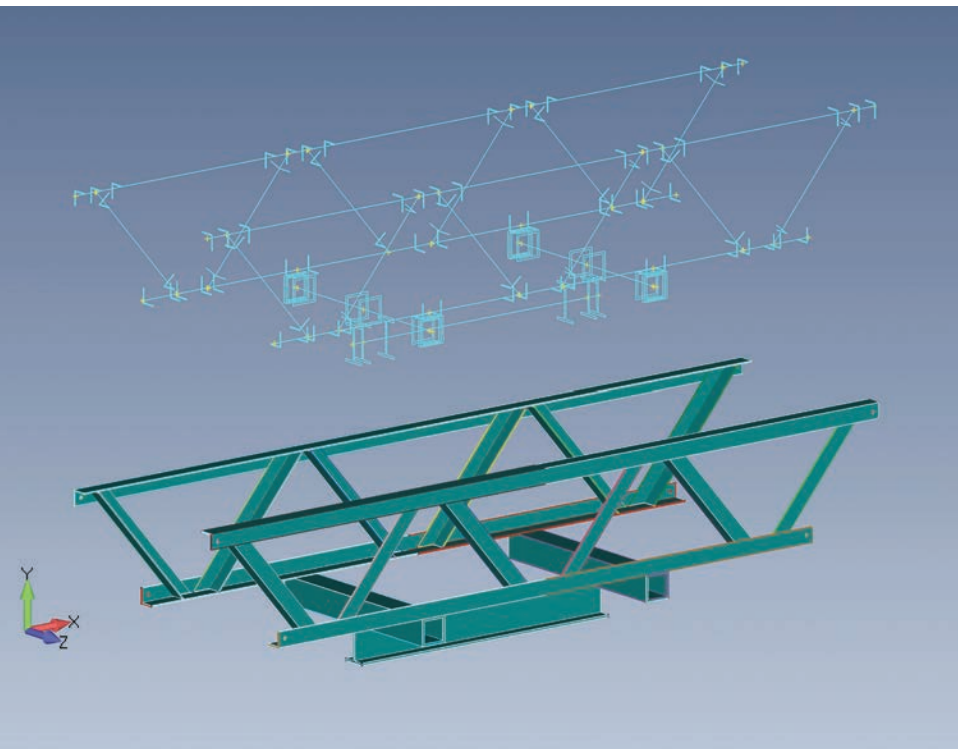
Ready for designs from any CAD application

The balance between the need for total control and the need for a streamlined interface is not the only issue engineers face in selecting the ideal simulation application. Because the modern manufacturing world has not settled on a single, standardized computer-aided design (CAD) format –or even a single file format – most engineering operations use a variety of CAD solutions. This lets them create models and designs that meet the needs of a wide range of clients. Likewise, it also lets them outsource work – whether for customers or for their own needs – to outside engineering teams.
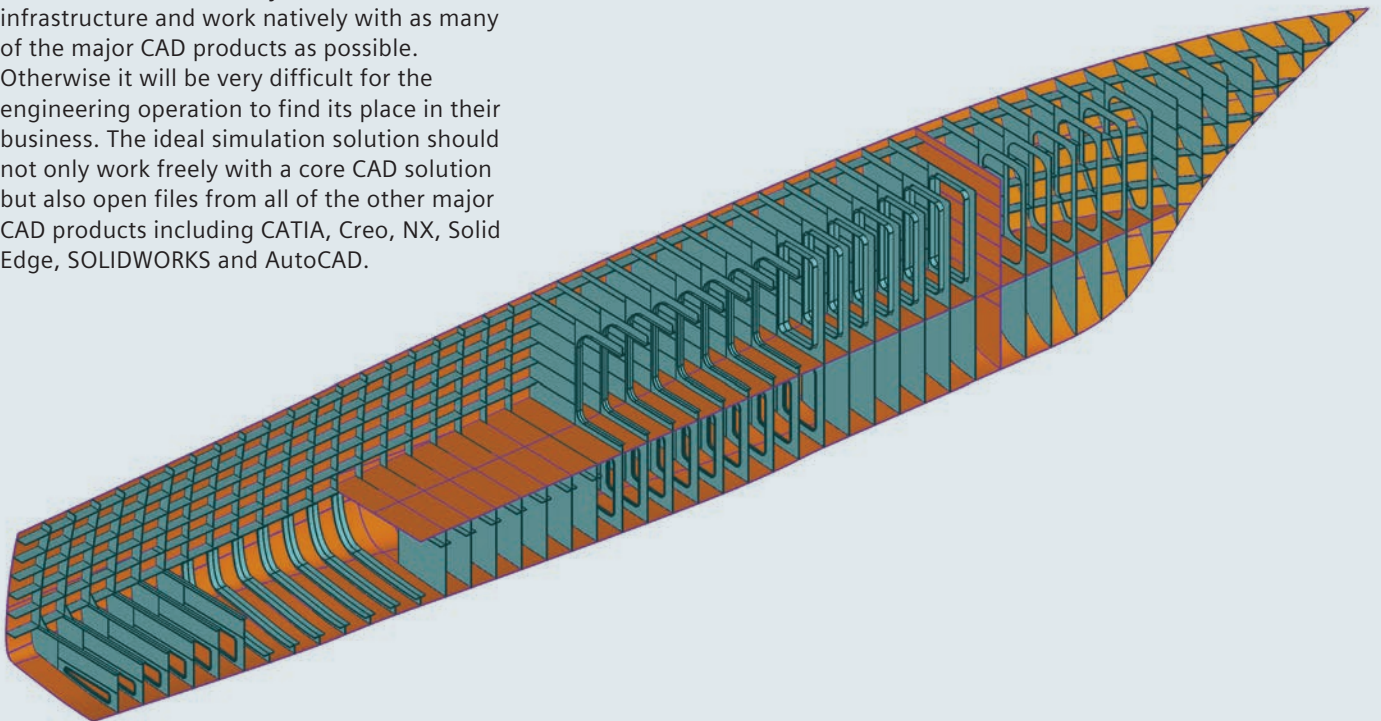
The result is that engineering companies must create CAD models for a wide range of software products. These models must not only be viewable but also editable and available for update whenever necessary. Otherwise, they risk not meeting their customers' needs and possibly losing valuable business.

Similarly, the simulation solution the company adopts to resolve their analysis needs should fit smoothly within this infrastructure and work natively with as many of the major CAD products as possible. Otherwise it will be very difficult for the engineering operation to find its place in their business. The ideal simulation solution should not only work freely with a core CAD solution but also open files from all of the other major CAD products including CATIA, Creo, NX, Solid Edge, SOLIDWORKS and AutoCAD.
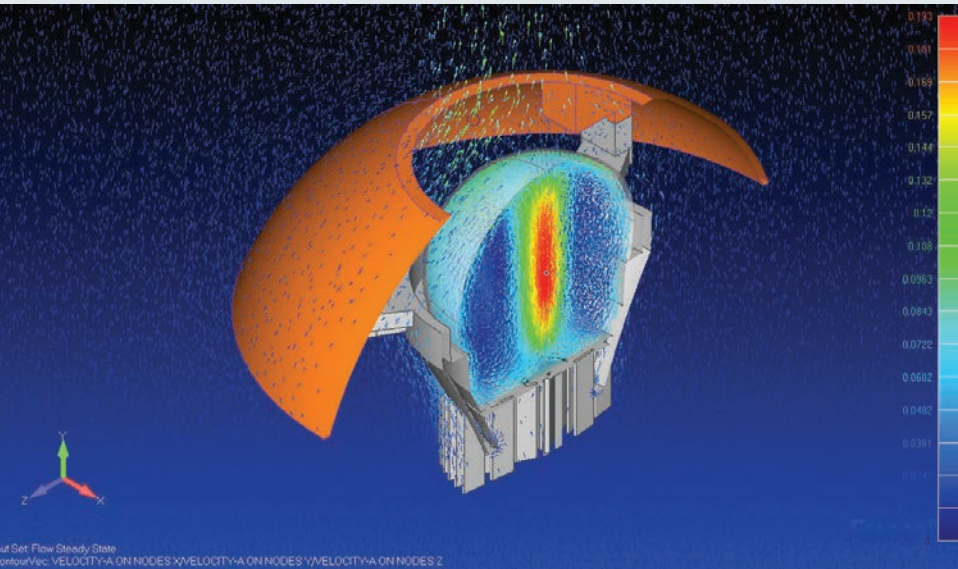
In addition to the ability to open models from most CAD applications, engineers need the ability to tweak and change designs. To make analyses run faster, they will often remove small details or change geometry as part of a larger idealization and simplification effort. Models opened natively or imported will often be stripped of the features and parameters that control geometry. As a result, engineers have no controls over how to change the model. Instead, engineers need direct modeling capabilities to accomplish this task. Such capabilities allow engineers to change model geometry, even without features or parameters. Direct modeling is a natural fit for preparing models for simulation.

> "*The use of Femap satisfies complex analysis needs, and more importantly, I feel that its ease of use is amazing. I have used various types of structural analysis software tools in the past, but Femap is especially easy to use and extremely helpful.*"
>
> *Yuta Araki*
> *Engineer*
> *Astroscale*

Ready for any type of engineering physics

ut Set: Flow Steady State
ontourVec: VELOCITY-A ON NODES X/VELOCITY-A ON NODES Y/VELOCITY-A ON NODES Z

The need to handle a wide variety of possibilities is not limited only to differing CAD file formats. Simulation tools that only meet the demands of a single type of physics will leave engineering teams in the lurch when they test their designs against real-world conditions. Far too many products face too many stresses in the modern engineering environment for designers to safely say their product is ready for the market without rigorous analysis of multiple types of physics.

Along the same lines, forcing engineers to cycle through multiple simulation products – repeatedly preparing the mesh to meet the needs of the individual simulation software – only wastes valuable time and resources.

At a minimum, simulation software should handle:

• excitation analyses to predict the effects of the kinds of repeating load that might result from impacts in the field

• thermal analysis for equipment that operates in hot environments

• fluids to predict that impact on pumps and other hydraulics

Note that these different types of physics sometimes interact. For example, in high-temperature environments, material expansion due to heat results in induced structural stresses.

Because almost all of these kinds of simulations could be critical to a product's success in the field, choosing a simulation solution that forces the engineering team to focus on a single type could be catastrophic. At best, it could result in slow-downs as they cycle through different solutions.

To prevent serious problems down the line, systems must simulate support structures, dynamics, optimization, advanced nonlinear structures, rotor dynamics, heat transfer, and fluid flow. Moreover, the solution should offer some control over solver input variables and support a variety of solvers, each of which may focus on one particular type of physics. These includes NX™ Nastran®, ANSYS®, LS-DYNA, Abaqus® and TMG.

Easy results interpretation

Just because the engineering team has access to a simulation tool that handles multiple simulation types does not mean that the team has every feature it needs. Creating analysis results that can be shared across the company is pivotal. The results must be understandable and accessible to a wide range of stakeholders involved throughout the product development process. Results that are indecipherable to anyone but the analysis specialist are of very limited utility. However, the option to export data into information other stakeholders can understand transforms the technology into something far more useful.

The ideal simulation solution delivers results in file formats that anyone can use. This includes forms accessible to team members who do not have access to the simulation tools or the skills to interpret complex simulation data. These formats must be easily openable and shareable and should not require powerful or resource-intensive tools. Anyone should be able to view, rotate and even interrogate those results to find answers they need.

However, this increased accessibility cannot come at the cost of diminished control. Users of the simulation tools still need to be able to create analysis and simulation models they can control and manipulate at the most detailed level possible without sacrificing that all-important level of accessibility.

Dealing with legacy models

Just as the ability to share simulation results with individuals outside of the core engineering environment is important, it is also essential that stakeholders be able to access and re-use analysis models that have been run previously. This functionality allows engineers to build on past design decisions as well as reverse engineer past results.

Re-using historical simulation results offers many advantages. It saves engineers time, reduces costs and squeezes more use from existing analyses without having to recreate new simulation files from scratch. Often, older simulation results have a great deal of useful information that reduces the need for fresh batches of data. Unsurprisingly, this can save engineering teams work hours, costs, and compute time.

However, just because a system makes it possible to revisit old results does not mean its job is done. With access to the simulation model, engineering and analysis teams can edit and work with the simulation model to run new analyses. Thus, it is vital to not only open simulation models and results from the past, but also to edit, manipulate and alter them as needed. This capability includes opening simulation models from other preprocessors so that data from other tools remains available. Then, once engineers access that data, they must be able to leverage full control of its features such as the loads and boundary conditions.
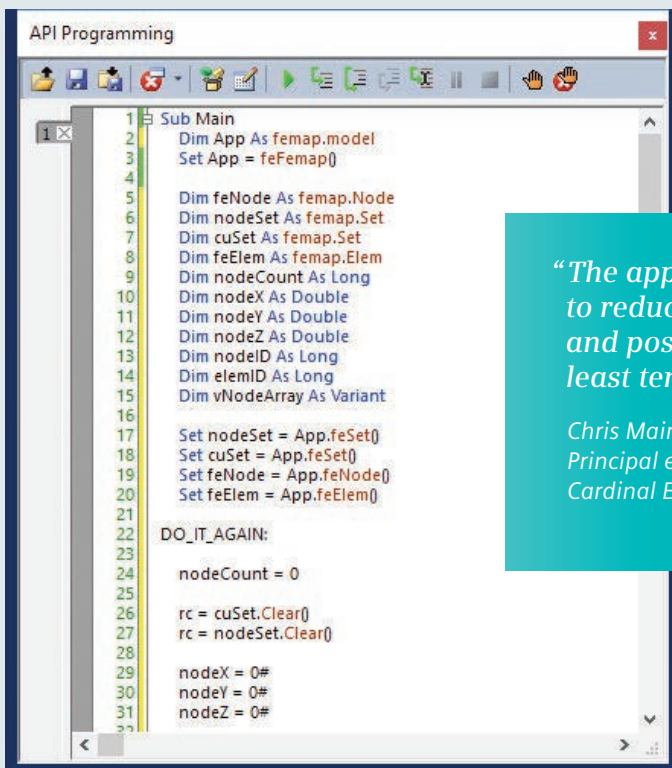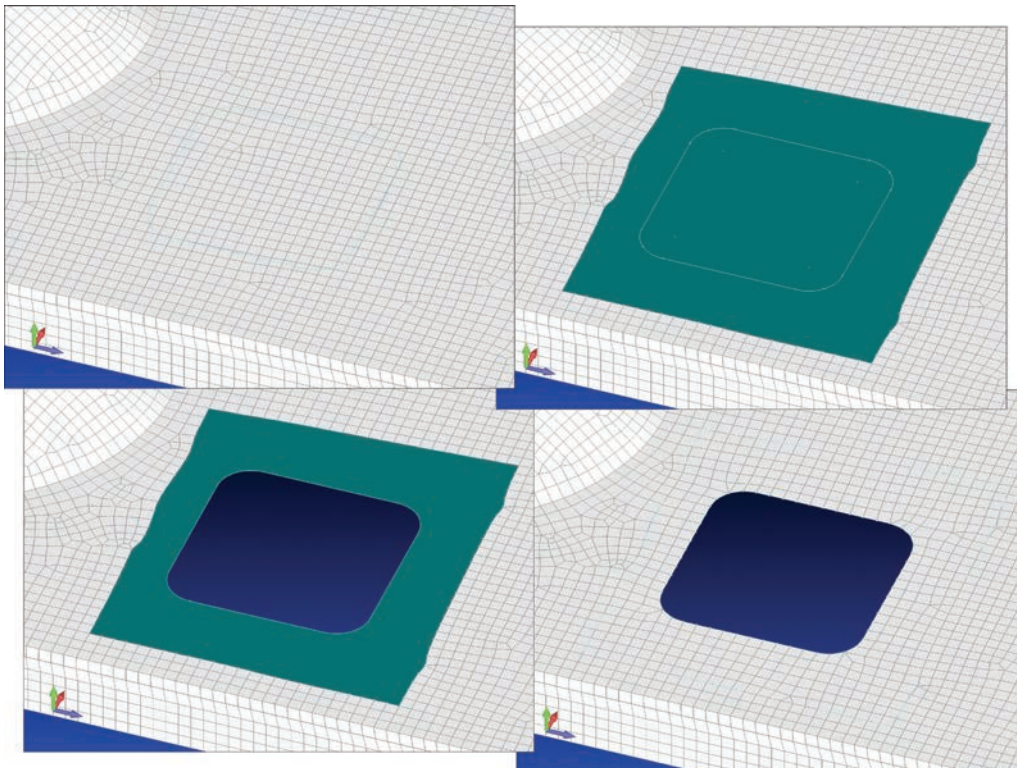
Automation of repetitive tasks

Storing and accessing existing simulation data is not the only way engineers and analysts can save time and resources. One of the oldest and most common tricks of frequent software users is to automate their tasks. This technique not only relieves some of the tedium of frequent repetition, it also reduces the number of hours needed to complete work.

One such way to automate tasks is to develop shortcuts or macros. These repeated sequences of actions in the software can be recorded and bound to a triggering key. Simply pressing that key kicks off the sequence of actions. To enable this capability, simulation tools must offer solutions to automate the navigation of the most common menus options. This makes it easier for them to speed up the process of completing their most common simulation tasks.

Another way to automate tasks is to use an application programming interface (API) to develop new or custom automation functionality as part of the simulation application. Using the API to extend the tool's capabilities in simple ways can have a dramatic impact on productivity.

But, as always, these features must not prevent engineers from manipulating and observing the simulation data at the level of detail and control they need to create effective models.

"The application of Femap's custom tools enabled us to reduce the time for developing finite element models and postprocessing analysis results by a factor of at least ten."

Chris Mairs
Principal engineer
Cardinal Engineering

Summary

Today, companies are exploring the application of simulation to many different phases of development. In some cases, it is used as a means to reduce weight. In others, it is a means to avoid multiple rounds of prototyping. Regardless of how analysis is applied in development, there is a set of core capabilities that engineers need, including:

- Model and mesh control: Many of today's simulation tools remove control over the model and mesh in an effort to speed analysis tasks. Instead, engineers need the right balance between control and speed.

- Multi-CAD support: Any company working with suppliers and customers receives 3D models from a variety of CAD applications. The right simulation solution needs to accept designs in a wide range of neutral and native formats.

- Accessible simulation results: Engineers not only require the ability to quickly build and easily organize analysis results. They also need to share those results with many stakeholders across the company in an easy-to-use and accessible format.

- Re-using past analyses: Many companies have a long heritage of applying simulation in design. Engineers need simulation solutions that can not only open the results of those analyses, but also edit and rerun them as new simulations.

- Automation of tasks: Simulation productivity is key. As a result, engineers need the ability to create macros and even build their own functionality with the simulation application's API to automate their tasks.
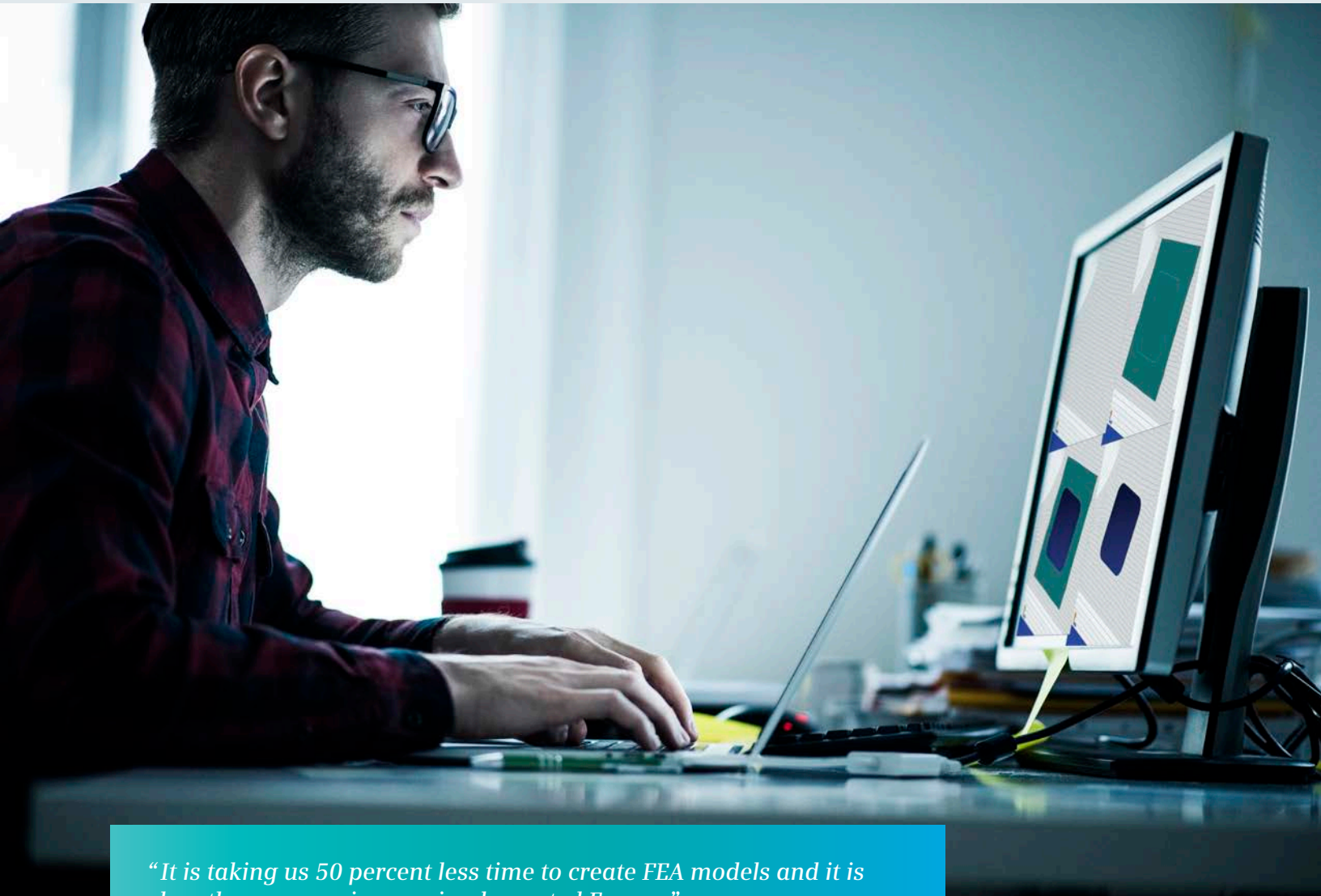
"It is taking us 50 percent less time to create FEA models and it is less than a year since we implemented Femap."

Jeremy Pollard
Chief engineer of structures
AIM Altitude

About Siemens PLM Software
Siemens PLM Software, a business unit of the Siemens
Digital Factory Division, is a leading global provider of
software solutions to drive the digital transformation of
industry, creating new opportunities for manufacturers
to realize innovation. With headquarters in Plano, Texas,
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