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Best Practices Guide for

DEPLOYING REAL-TIME SIMULATION ACROSS THE ENTERPRISE

5 helpful steps to make the most of your design process

5 STEPS TO DEPLOY REAL-TIME SIMULATION ACROSS THE ENTERPRISE

By incorporating simulation into the product design workflow, engineers can improve their efficiency. Performing design and analysis together reduces the number of iterations and loops, getting your product to market sooner.

To maximize the gains made available by real-time simulation, product development organizations should deploy these tools across the enterprise. This involves training, adapting your infrastructure, implementing standards, and establishing workflows.

Let's discuss five steps that enable you to not only validate your products' ability to meet design requirements, but also optimize them for weight, strength, or any other desired quantities. Conducting design in conjunction with simulation provides a competitive advantage in the market.

About the Author

Dave Martin is a former Creo, Windchill, and Mathcad instructor and consultant. After leaving PTC, he was the Creo specialist for Amazon. He also worked as a mechanical engineer, Creo administrator, and Windchill administrator for Amazon Prime Air and Blue Origin. He holds a degree in Mechanical Engineering from MIT.

Martin is the author of the books Design Intent in Creo Parametric and Top Down Design in Creo Parametric, both available at www.amazon.com. He can be reached at dmartin@creowindchill.com.

START WITH SOMETHING EASY

For people who don't have a background in finite element analysis (FEA), simulation can be intimidating, so start with something easy, modal analyses.

You can teach people how to perform modal analysis in a matter of minutes. I did this at Amazon and had my entire design team creating and running constrained and unconstrained analyses in less than an hour.

Modal analyses are a great entry point for designers to familiarize themselves with the simulation process. Once they become comfortable, it's easy to learn structural and thermal analyses.

Modal analyses tell you the natural frequencies and mode shapes of an object. This helps you avoid resonant frequencies of the operating environment (like motors) and determine where you might need additional structural support. These provide a judgment of the relative stiffness of a model and can be used as a criterion for selecting between design alternatives.

FORMAT STRUCTURAL RESULTS FOR CLEAR COMMUNICATION

Prior to initiating a simulation, we usually know the structural limits of our material and a desired factor or margin of safety. Use these values to compute the maximum allowable stress for your models.

For display of stress results, change the format of the legend to use this maximum allowable stress as the peak value.

Why is this important? It makes it easy for ANYONE to understand your results.

These provide an easy-to-understand Go/No Go plot showing if and where the model will fail. This makes it easier for anyone, especially non-technical people, to understand your results.

If you cannot clearly communicate your conclusions, it doesn't matter how good your analysis is. To convince stakeholders to make the right decisions, make it easy for them to understand your results.

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Structural analysis allows you to compute the stresses and displacements of an object subjected to loads and forces. This helps you determine if an object will survive its operating environment or if the loading will result in permanent deformation or failure.

SUPPORT THERMAL ANALYSIS WITH TESTING

Simulation is not a substitute for testing. Simulation supports testing and testing supports simulation. This is especially important for thermal analysis.

We can often compute heat loads from the power output of our components. However, boundary conditions from convection conditions depend on an estimated coefficient for heat transfer.

Many factors influence convection coefficients, including material, surface roughness, and the source of the moving fluid.

When approaching the analysis, start with a worst-case estimate. Assume a lower convection coefficient when the fluid is cooling your object and a higher coefficient when the fluid is heating it. This way your estimated temperatures are conservatively higher than expected.

After you perform testing, compare the actual temperatures with your predictions to refine the values for convection coefficient. Your subsequent simulations will have a higher level of fidelity.

Thermal analysis helps you determine temperature and heat flux as a result of conduction and convection. Conduction is heat transfer between objects that are in contact with each other. Convection is the transfer of heat to or from an object from a fluid (liquid or gas) flowing over the object.

EMBRACE COMPUTATIONAL FLUID DYNAMICS

Computational fluid dynamics (CFD) allows you to analyze the coupled effects of fluid flows and thermal fields. By incorporating CFD into your design workflow, you can optimize for these complex interactions.

Here are some examples,

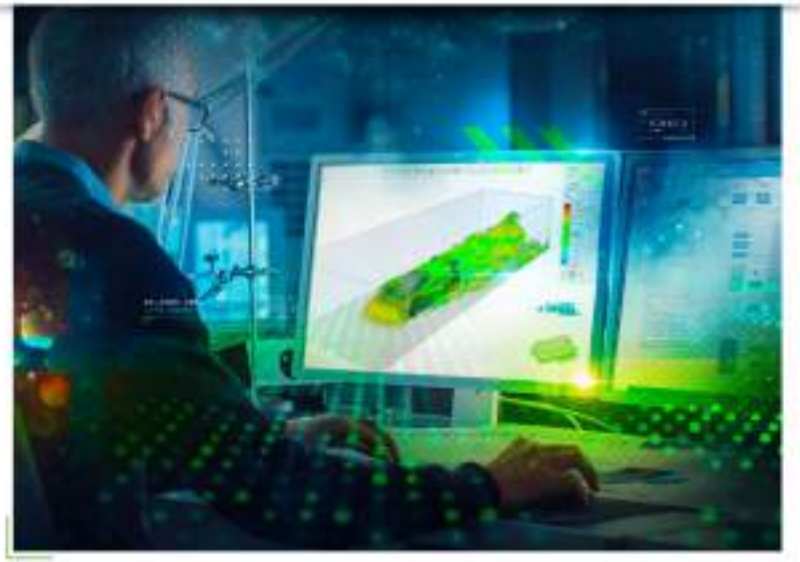
Electronics within enclosures. CFD enables you to position components and inlet/outlet vents for optimal cooling.

Routed pipe systems with pumps, turbines, and valves. CFD identifies and helps eliminate turbulent flows.

Airfoils. CFD helps you visualize pressure differentials and vortex shedding in real-time as you make changes.

Normally, CFD requires complex software and an expert to operate it. Creo Simulation Live changes that. Design engineers can now set up and run CFD simulations with minimal training and knowledge.

In addition, CSL runs off your computer's graphics processing unit, so you have results in seconds instead of hours, days, or weeks, which you would expect with traditional export-and-analyze workflows.



Computational fluid dynamics is a numerical method for calculating the internal and external flow of fluids in or around an object to measure velocity, pressure, and temperature over a time domain.

REQUEST A DEMO →

TRAIN ON THE BASICS AND ESTABLISH STANDARDS

In every company I have worked for, there were many more design engineers than analysts. In addition, every analyst I have known has had a backlog of work.

This has resulted in design engineers missing out on the value of simulation in their day-to-day work.

Real-time simulation empowers design engineers to perform their own simulations, freeing up analysts to address the complex problems that truly require their expertise.

To get the most of real-time simulation, train your designers and design engineers in the basics of structural, thermal, modal, and fluid analyses.

THEN, ESTABLISH STANDARDS FOR

- What analyses your designers can and should perform on their own;
- When and how they should seek help;
- The formats for preparing results and reports.

With training and standards, your designers will have clear guidelines on how to use real-time simulation to improve process workflows across the enterprise

BONUS TIP: USE SIMULATION TO EXPLORE MORE DESIGNS

When I was at Amazon, a favorite Jeff Bezos quote of mine was, "If you double the number of experiments you do per year, you're going to double your inventiveness." In product design, you can increase your experiments by incorporating Design Exploration (a tool available in Creo) with real-time simulation.

In Design Exploration, you create branches for design alternatives. This eliminates saving your models under different filenames, so they're easier to investigate and evaluate. It also facilitates design reviews by allowing engineers to share these alternatives with their peers.

Add real-time simulation, and as designers switch between different branches, the results of the real-time simulation update immediately. This provides instant feedback regarding the quality of different choices.

When you use real-time simulation with Design Exploration, you perform more experiments, achieve higher quality, produce more innovative designs, and arrive at the best answer quicker.