SIMULATION BUYER'S GUIDE FOR DESIGN ENGINEERS

MICHELLE BOUCHER | VICE PRESIDENT | TECH-CLARITY

Tech-Clarity

The Role of Simulation During Design

A Resource to Help You Identify Selection Criteria that Matter for Design Engineers

What should you look for in a simulation solution for design engineers in your organization? How do a design engineer's needs differ from those of an analyst?

Simulation can be a powerful design tool for engineers, but if it is difficult to use, it will just slow you down, and no one will use it. How do you avoid that and identify the right solution?

Based on a survey of 195 companies, this report reveals what Top Performing companies value most in a simulation solution for design engineers. While this report is not an exhaustive list of requirements, it serves as a guide to help you focus on the selection criteria that matter most to design engineers.

How Simulation Helps

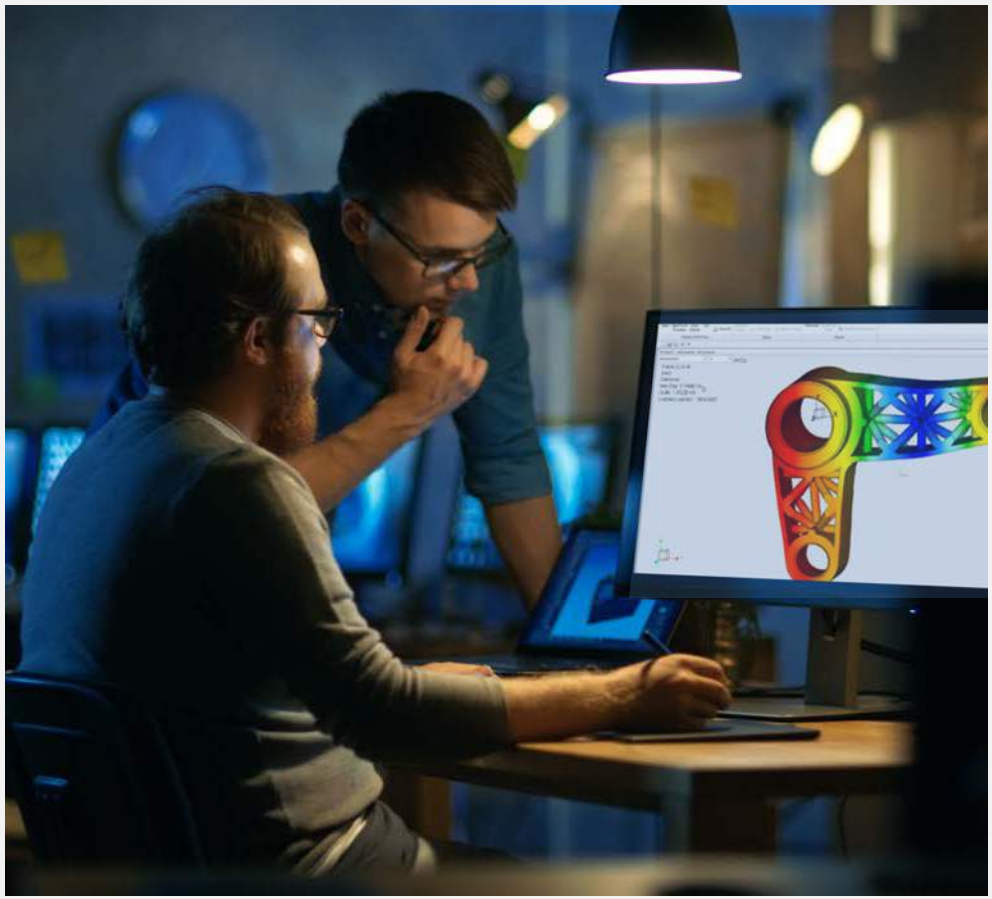
What if you could improve your design efficiency by 7% or lower your prototype costs by 10%?

Our survey results found that Top Performing companies have experienced these benefits and more since their design engineers started using simulation. So what's the best way to see similar results? Let's explore that question.

How Design Engineers Use Simulation

Products have gotten so complex; it is hard to know how a design decision will impact the rest of the design. Simulation can provide insight, enabling you to evaluate different options, design with greater confidence, and ultimately engineer better products. It also helps you catch potential problems early on. As a result, there are fewer delays and less excess cost caused by problems discovered during test or production.

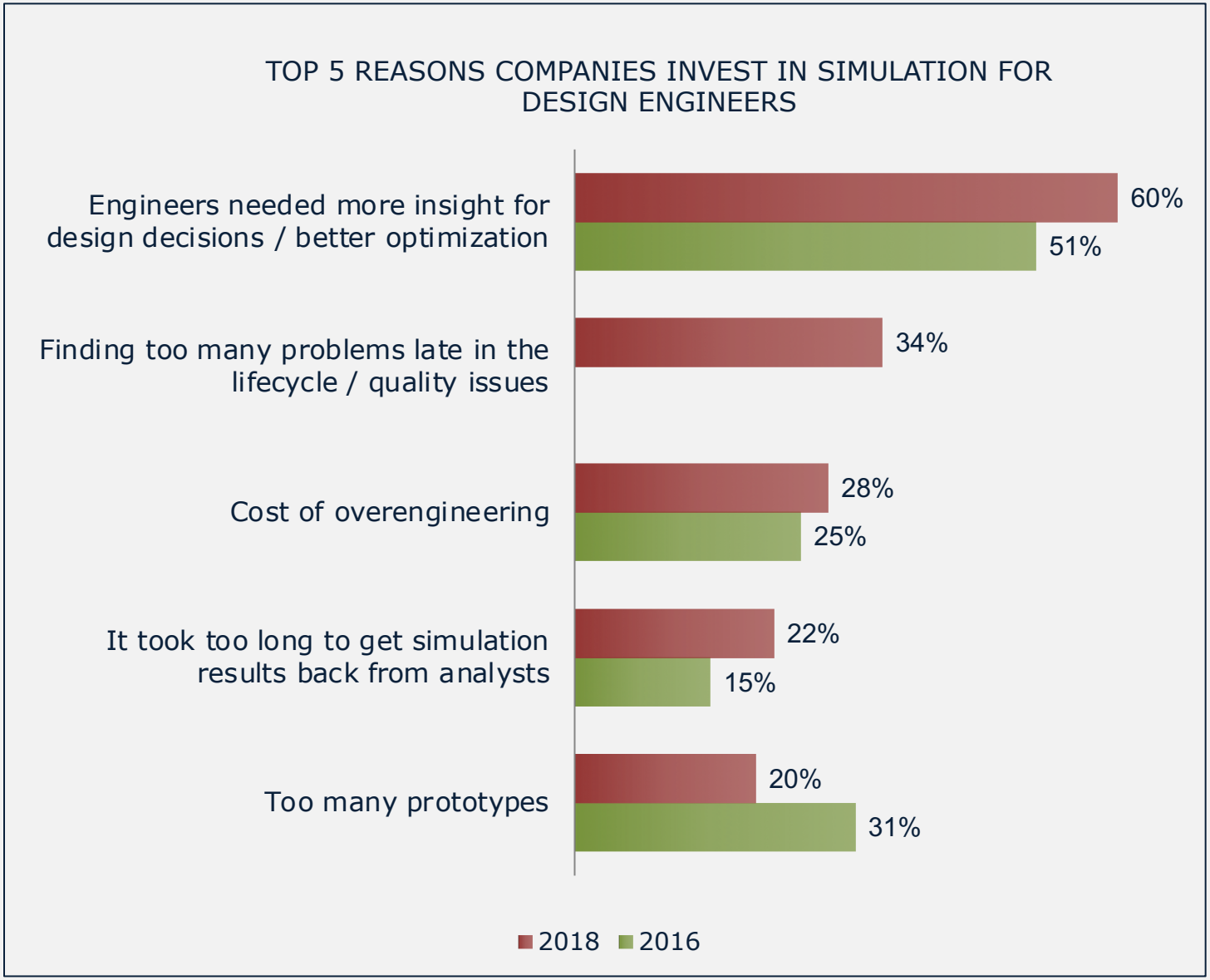
In fact, design engineers get so much value from simulation, 65% would like to conduct more simulations than they currently do. Results from Tech-Clarity's *Revolutionizing Simulation for Design Engineers* show that it is mostly the tools that hold them back, as many solutions are not particularly well suited for the needs of a design engineer. This buyer's guide reveals what to look for in a simulation solution to meet those needs.



Why Invest in Simulation for Design Engineers?

Design Better Products

Companies invest in simulation for design engineers for a variety of reasons (see graph). Comparing responses from 2018 to 2016 reveals a trend that simulation is becoming more intertwined with the design process. Better insight for design engineers remains a top reason to invest in simulation, with even more companies citing it in 2018 than 2016. Unfortunately, "quality issues" was not an option choice in 2016, but in 2018, over 1/3 of respondents are investing in simulation to find problems during the design process rather than at the end.



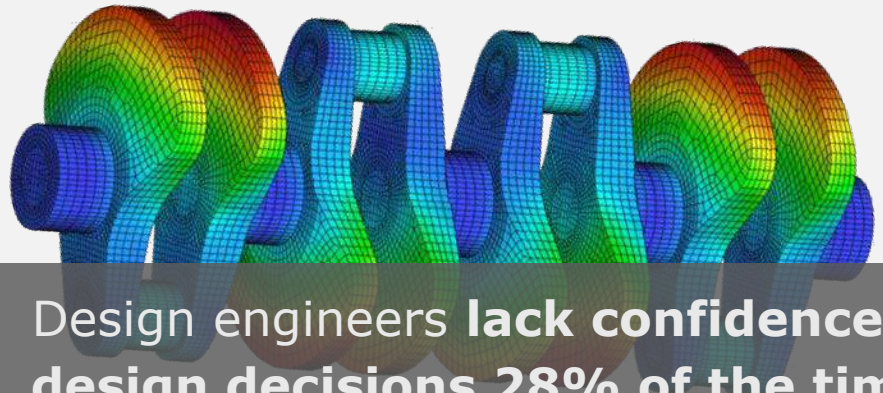
Establish the Right Selection Criteria

Design Engineers and Analysts Have Different Needs

Design engineers have different requirements for a simulation solution compared to analysts. Analysts require definitive simulation results. With their extensive training, they have the advanced skills necessary for complicated simulations and the knowledge to make the right assumptions.

Design engineers, on the other hand, are looking for directional insight to help guide their decisions. The ideal simulation tool for a design engineer should allow you to keep your focus on design work with minimal disruption to the workflow. If you can answer questions like, "Where's the ideal spot for this mounting hole?" your designs will be better, and analysts can focus their time on more complex problems.

This type of guidance can be invaluable. Design engineers lack confidence in design decisions 28% of the time.[1] With the right simulation solution, you can improve your confidence.



Design engineers **lack confidence in design decisions 28% of the time.** With the right simulation solution, you can improve your confidence.

Defining Top Performers

To determine the most important qualities in a simulation solution for design engineers, Tech-Clarity analyzed what Top Performing companies value in a solution. We defined Top Performers as the top 20% of companies who outperform their peers in critical design metrics (see Table for metrics used) and the remaining 80% as Others. Top Performers meet or beat their targets while Others miss their goals by 17% to 21% on average. The table shows the average performance of both Top Performers and Others. We will now reveal the top ten selection criteria Top Performers value most in a simulation solution for design engineers.

DEFINITION OF TOP PERFORMERS

METRIC	TOP PERFORMERS	OTHERS
Design due dates	Beat deadlines by 1%	Within 21% of targets
Product cost targets	Right on target	Within 17% of targets
Product development budget	Under budget by 4%	Within 20% of budget

96% of respondents agree that if simulation results were immediate in the modeling environment the company would benefit in many ways.

1. CAD Integration

Streamline the Workflow

CAD integration is the most common capability Top Performers look for in a simulation solution for design engineers. If the tools are not integrated, you have to switch applications to run a simulation, disrupting your workflow and wasting time. An integrated CAD/simulation solution allows you to access the simulation tool directly from within your design environment.

2. Quick Results

Time Is Money

Fifty-seven percent of Top Performers said that quick results are an essential quality in a simulation solution. In fact, 34% of respondents use simulation less than they should because the analysis takes too long. With fast results, you can quickly evaluate several different options to pick the best design solution.

Instant Results Will Help

The faster the results, the better. An overwhelming 96% of respondents agree that if simulation results were immediate in the modeling environment and design engineers could conduct the ideal amount of simulation, the company would benefit in many ways. The reported benefits include fewer late stage problems, faster to market, greater design optimization, and more innovative designs.

3. Accurate

Results Should Be Reliable

Another quality Top Performers look for is accuracy. Results need to accurately point you in the right direction.

During the course of this research, many expressed concerns that a tool that has been simplified for design engineers will not be accurate enough. This is a valid concern that emphasizes the importance of selecting the right software. The right solution should provide you with accurate directional insight without compromising ease of use.

4. Optimization Tools

Create Better Designs

Engineers often have to balance competing criteria such as high quality and low cost or lightweight and durable. Manually evaluating multiple parameters to arrive at the best solution can be nearly impossible without help. Optimization capabilities simplify this process by quickly evaluating numerous iterations.

Optimization may also include sensitivity analysis, testing limits, and maintaining factors of safety. You can also identify overengineered areas where you can remove material, without compromising structure. Not only does this lower material costs, but it also reduces weight to improve energy efficiency and lowers the customer's cost of ownership.

5. Support for Frequent Design Changes Without Redoing Preprocessing

Enable Design Exploration and Innovation

In 2016, only 18% of Top Performers identified support for changes as an important quality in a simulation solution. Now, 52% of Top Performers say support for changes is a critical consideration. This is another example of how Top Performers have evolved their view of simulation as a design tool.

Engineers report they spend 43% of their design time on changes.[2] Some solutions require you to redefine preprocessing parameters with each change. Preprocessing involves preparing a model for simulation which includes defining the geometry, mesh, and boundary conditions. It is the most time-consuming part of an analysis, taking up 38% of simulation time.[3] Avoiding this step with each change saves valuable time and will allow you to do more simulations.

Optimization tools can not only **reduce material costs, but also reduce weight** to improve energy efficiency.

6. Ease of Use / Easy to Set Up Analysis

Empower Design Engineers to Use Simulation When Needed

As mentioned earlier, 65% of respondents would like to use simulation more during design, but the tools hold them back. Fifty-eight percent feel design engineers lack the expertise and 36% find the tools too hard to use. Solutions that limit the time and effort required to set up an analysis, define the mesh, simplify the model, and other preprocessing steps will be easier to use. A tool that integrates into the design environment can also be helpful.

7. Support for My CAD

Reduce the Barriers to Simulation

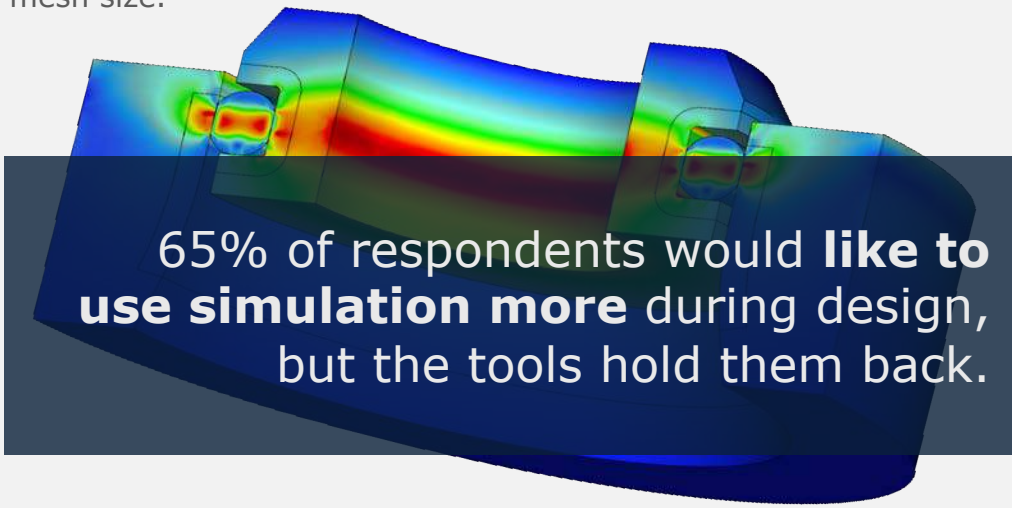
Traditionally, much work goes into preparing a CAD model for simulation. If the simulation tool doesn't support the desired native CAD format, the CAD data must go through a translation so that the simulation tool can retrieve it. However, this process doesn't always work perfectly, and you can waste a lot of time cleaning up geometry. A simulation tool that has native support for your CAD data avoids this step, saving significant time and removing another barrier to simulation.

8. Automatic Meshing

Ensure Simulation Is Accessible to Design Engineers

Finite Element Analysis (FEA) uses a mesh that breaks down surface geometry into many small elements. To simplify calculations, each small element is analyzed, and then the software combines the results across the entire surface. Analysts can spend a lot of time perfecting a mesh for the precise results they need. This way they get more detail where it's needed, and they can reduce processing time in other areas.

For quick design guidance, software that can automatically mesh the model will be easier to use. Also, software that supports the latest advancements in computational power, such as High Performance Computing (HPC) or GPU processing, can accelerate processing time without the engineer adjusting the mesh size.



Vendors have made enormous strides to make it easier to work with **different CAD formats.**

9. Support for Multi-CAD

Provide Flexibility to Work with Legacy, Customer, and Partner Data

As another instance of the shift to simulation as a design tool, in 2018 more Top Performing companies view support for multi-CAD as important (38% vs. only 9% in 2016). Many scenarios involve multi-CAD data including internal reasons (legacy data, acquisitions, personal preferences, etc.) or to support data from customers, suppliers, or partners. Vendors have made enormous strides to make it easier to work with different CAD formats. In many cases, engineers can work with multi-CAD data as easily as native geometry, without going through a tedious conversion process. This capability should extend to simulation as well.

10. Technical Support

Select a Vendor That Will Be a Trusted Partner

The final quality Top Performers value in a simulation solution for design engineers has to do with the vendor itself: good technical support. If you have questions or run into problems, it is crucial that you have access to resources to help you so that you can continue working. Hours of availability, supported languages, flexible contact options, and knowledgeable support staff are all important considerations.

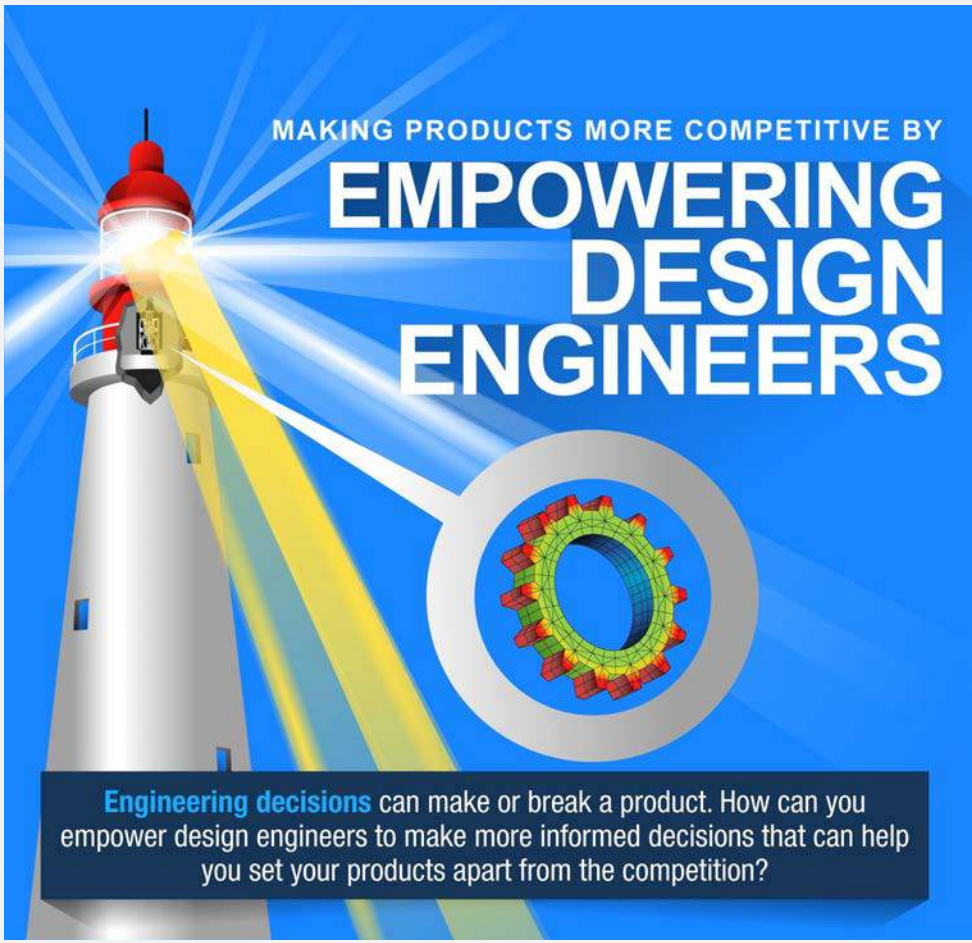
Select the Right Simulation for Your Needs

Recommendations

Based on industry experience and research for this report, Tech-Clarity offers the following recommendations to select the right simulation solution for your design engineers:

- Empower design engineers with simulation tools to help guide their decisions.
- Understand your needs for a simulation solution.
- Consider how the needs of a design engineer are different from those of an analyst.
- Focus on how simulation can best integrate with the design process to improve design decisions.
- Select a simulation solution that will be easy for your design engineers, integrates with your existing CAD tool, and supports existing workflows.
- Consider a solution that makes it easy to set up an analysis and includes features that minimize preprocessing steps and provides quick results.
- Ensure the solution supports design optimization.
- Select a vendor who can provide the required support resources when needed.

For more information,
download Tech-Clarity's infographic:



About the Research

Data Gathering

Tech-Clarity gathered and analyzed 195 responses to a web-based survey on engineering and design. Survey responses were collected by direct e-mail, social media, and online postings by Tech-Clarity.

Demographics

The respondents represented a mix of company sizes, including 53% from smaller companies (less than $100 million), 24% between $100 million and $1 billion, and 23% over $1 billion.

The respondents were comprised of a little over one-half (57%) individual contributors, over one-quarter (27%) managers, 7% vice presidents or directors, and 10% executive levels.

The respondents represented a good mix of industries, including 36% Industrial Machinery, 18% Automotive, 15% Life Sciences, 13% Aerospace & Defense, 13% Durable Consumer Goods, 13% Engineering Services, 12% High Tech and Electronics, and others. Note that these numbers add up to greater than 100% because some companies are active in more than one industry.

Of the respondents, 57% were in engineering or design roles, 12% Manufacturing Engineering, 8% Program/Project Management, 7% Industrial Design, 5% Management/ Administration, and the remainder were from a variety of roles including Simulation Analysts, IT and other roles. The respondents reported doing business globally, with most doing business in the North America (71%), over one-third (37%) doing business in Western Europe, 31% doing business in Asia, 13% in Eastern Europe, 8% in Latin America, 8% in Australia, 7% in the Middle East, and 4% in Africa. Note that the numbers total greater than 100% because companies reported doing business in multiple geographies.

Acknowledgments

Michelle Boucher
Vice President
Tech-Clarity, Inc.

About the Author

Michelle Boucher is the Vice President of Research for Engineering Software for research firm Tech-Clarity, an independent research and consulting firm that specializes in analyzing the business value of software technology and services. Michelle has spent over 20 years in various roles in engineering, marketing, management, and as an analyst.

Michelle graduated magna cum laude with an MBA from Babson College and earned a BS in Mechanical Engineering, with distinction, from Worcester Polytechnic Institute. She is an experienced researcher and author having benchmarked over 7000 product development professionals and published over 90 reports on product development best practices.

Tech-clarity.com
TechClarity.inc
@TechClarityInc
Tech-Clarity

Tech-Clarity is an independent research firm dedicated to making the business value of technology clear. Our mission is to analyze how companies can improve the way they research, innovate, develop, design, engineer, produce, and support products through the intelligent use of best practices, software, and IT services.

References

1. Michelle Boucher, "Revolutionizing Simulation for Design Engineers," *Tech-Clarity*, 2019.
2. Ibid
3. Michelle Boucher, "Addressing the Bottlenecks of FEA Simulation," *Tech-Clarity*, 2016.