REVOLUTIONIZING SIMULATION FOR DESIGN ENGINEERS

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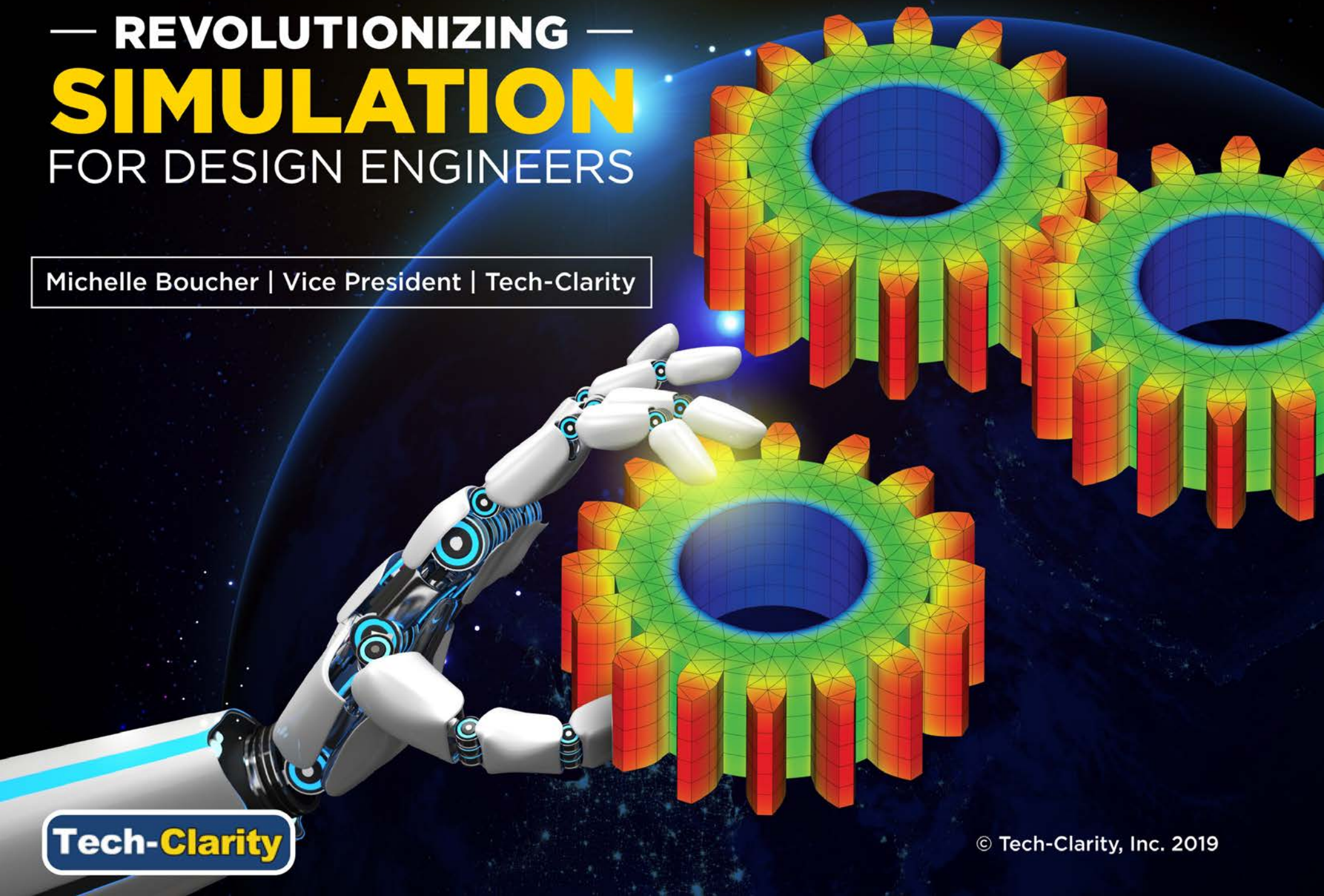

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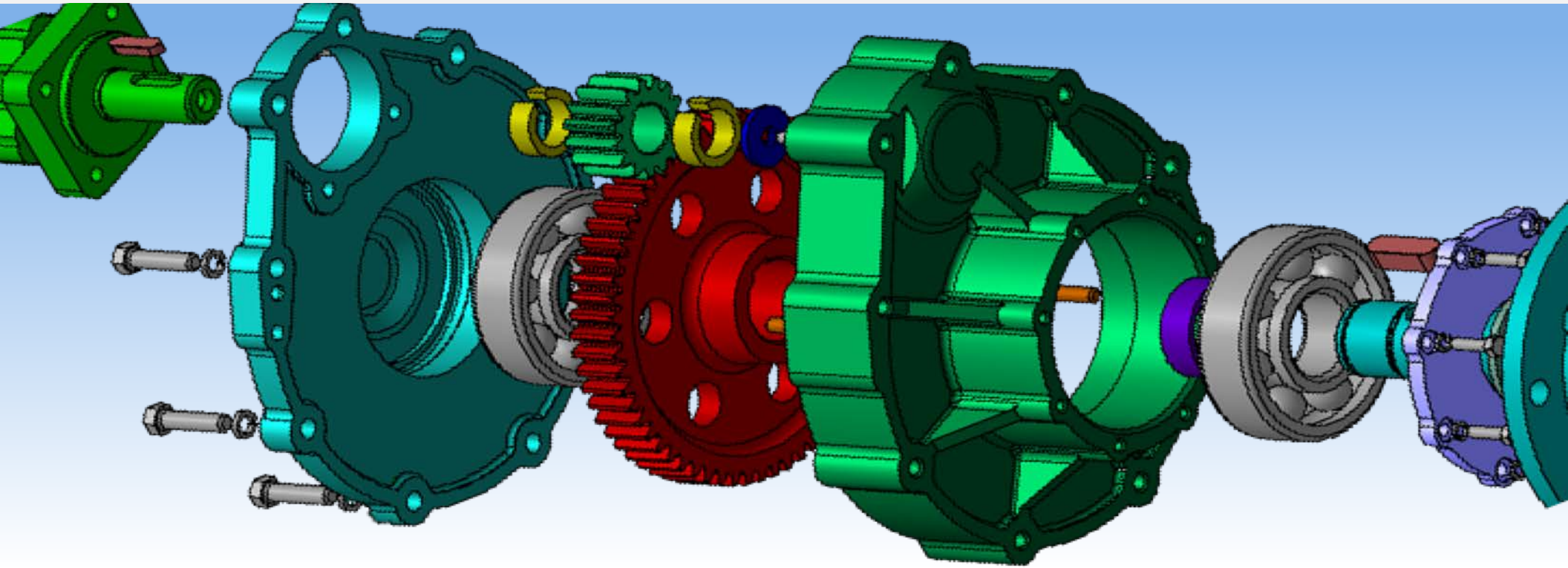
The Engineering Opportunity

Engineering Decisions Can Make or Break Your Products

How do you empower engineers to design the best products possible?

Engineers want to design great products. Unfortunately, factors like increasing product complexity, competing design criteria, and knowing how design decisions impact other parts of the design make it hard. On top of this, ever-shrinking timelines mean engineers have their work cut out for them. Yet, exceptional engineering has become critical to success in today's competitive global market.

This research study, based on a survey of 195 companies, examines the design process and identifies top challenges that hold engineers back. The report reveals how to empower engineers with insight to improve product quality, lower cost, and accelerate time-to-market, all while developing more innovative products.



What's Most Important for Your Product's Market Success?

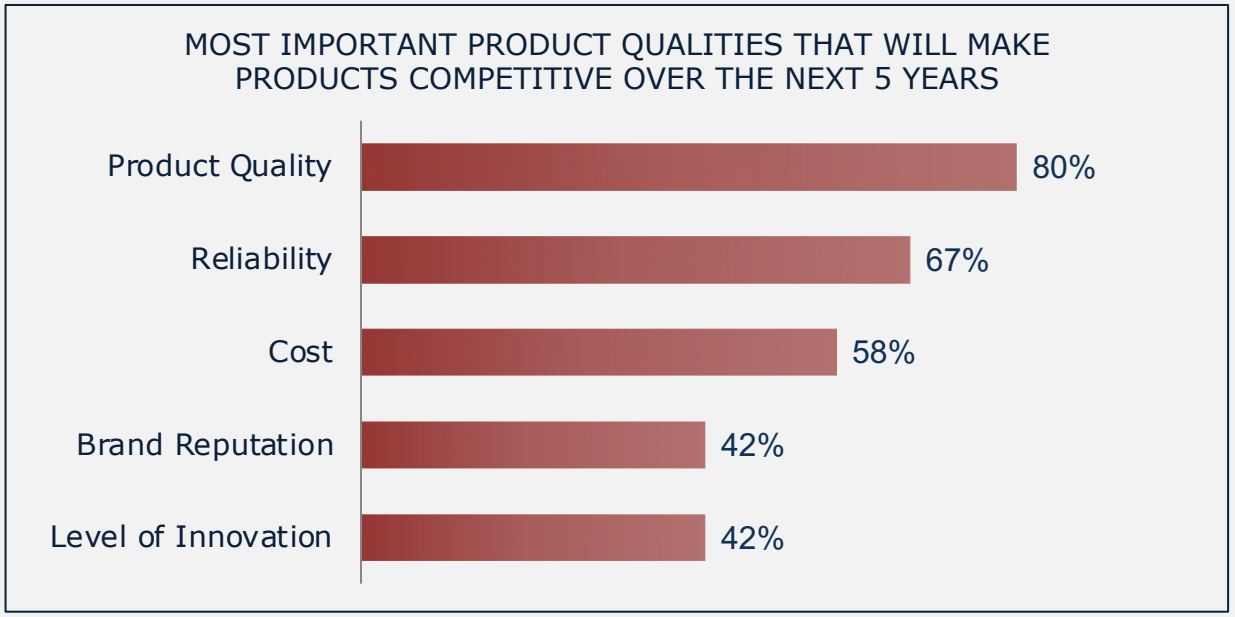
Product Quality

As companies face mounting pressure from global competitors, engineering criteria have become essential to competitively differentiate products. In fact, 80% of survey respondents believe that product quality is the most important product attribute to keep products competitive (see graph). Reliability and cost come next. This indicates customers have high expectations for quality and durability but don't want to overpay. To be successful, companies should balance these criteria.

Engineering Decisions Are Critical – and Not Easy

Requirements for quality, reliability, and cost often conflict so balancing them is no small feat. Unfortunately, product complexity makes it hard for engineers to know the full impact of each design decision. Indeed, 76% of survey respondents rate design decisions that impact product competitiveness as 'somewhat hard' to 'extremely difficult.' This leads many engineers to overengineer, which unfortunately drives up cost.

Companies who can make this decision process easier will have an advantage.



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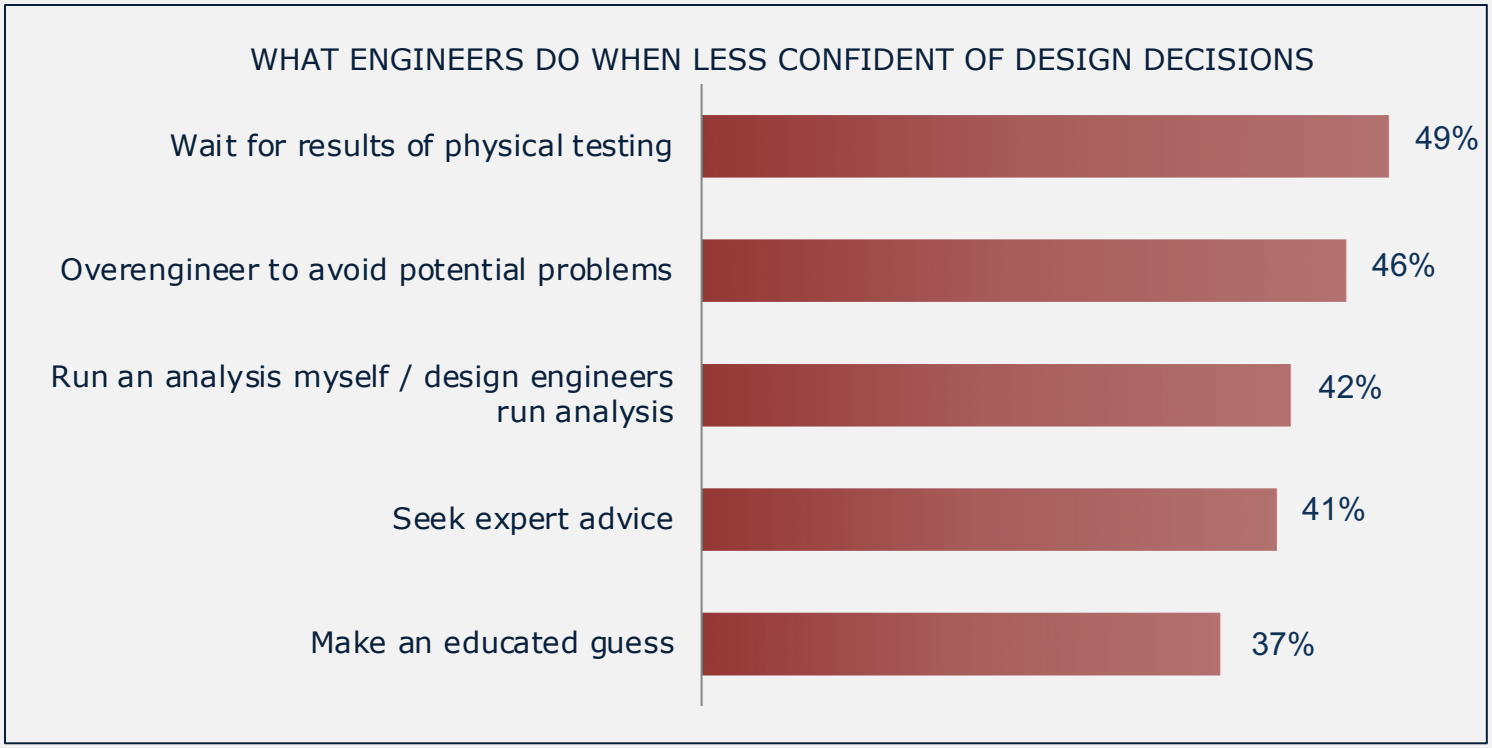
Consider the Opportunity for Improvement

Engineers Need More Confidence in Decisions

Because of the many challenges they face, engineers lack confidence in their decisions 28% of the time. To bridge that confidence gap, they use a variety of approaches. Of the top five (see graph), the most common tactic involves waiting for results of physical tests, which wastes time. They also overengineer products, which adds excess cost and hurts price competitiveness.

Wasted Time

While the cost implications are significant, engineers report that when they take additional steps to improve their confidence, it wastes an average of 4.7 days. Further, 29% say it takes even more than a week. Imagine the time savings if engineers could make decisions with a high level of confidence as they design.



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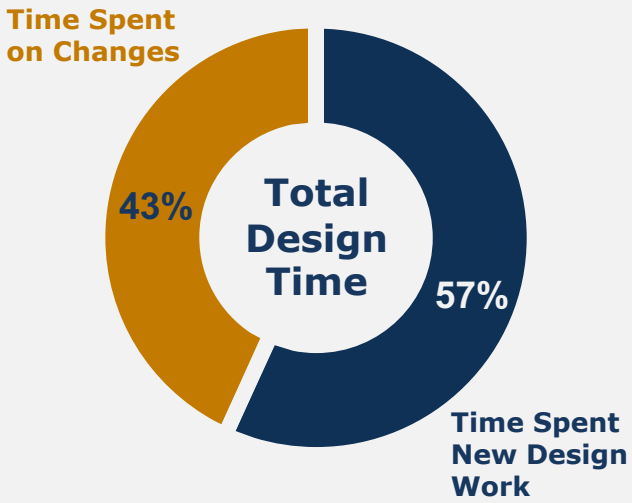
Understand the Impact of Changes

Many Changes Are Due to Late Stage Problems

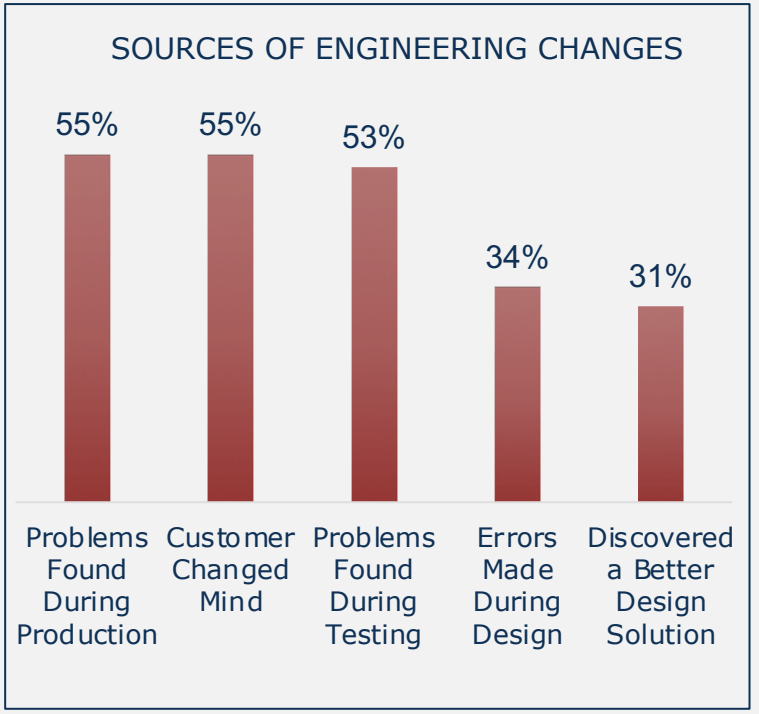
Changes become the inevitable repercussion of poor decisions, and they consume a significant part of the design process. In fact, engineers report that on average, they spend 43% of their design time making changes. That's a good chunk of time that takes resources away from new development work and innovation.

Changes occur for many reasons (see graph on right). Some of them are good, especially during the innovation stage when you are evaluating different ideas. Some changes are unavoidable, such as when the customer changes his or her mind or the market shifts. However, a primary source of changes comes from problems. Fifty-five percent of respondents say that changes are a result of issues found during production and 53% attribute changes to problems discovered during tests. The trouble is that these changes happen very late in the development lifecycle.



Late Changes Take More Time

Interestingly, but not surprisingly, respondents say that changes made during the last 25% of the design cycle take 98% longer, nearly twice as long to implement, compared to changes during the first 25% of the lifecycle. Imagine how much time you could save if most of those problems could be identified earlier when they take half as long to fix. Considering the time implications, companies who avoid those late stage problems will have an advantage. The cost of making the wrong decision is high, but with engineers lacking confidence in decisions 28% of the time, the risk is of making the wrong decision is significant. Engineers need to be more empowered to improve their decision making. Achieving this may require new approaches to design. Interestingly, 63% say immediate insight into the impact of design decisions would help them make better decisions to improve product competitiveness. As a result, they will be better prepared to incorporate the product qualities shown in the earlier graph. Let's examine some best practices to support engineering decision making.



Identifying Top Performers

How Top Performers Were Defined

To determine best practices, Tech-Clarity analyzed the behaviors of Top Performing companies. We defined Top Performers as the top 20% of companies who outperform their peers by meeting their targets for:

- Design due dates
- Product cost
- Development budget

The remaining 80% were labeled "Others." Top Performers meet or beat their targets while Others miss their goals by 17% to 21%.

To develop recommendations, we then focused on what Top Performers do, especially what they do differently.

The Top Performer Advantage

Top Performers do a better job of staying on schedule and on budget. Their ability to meet their goals means they likely experience fewer late stage problems that cause delays and drive up costs. This indicates they make better decisions throughout the design process. Also, compared to their peers, survey results show they rate their processes as more effective to:

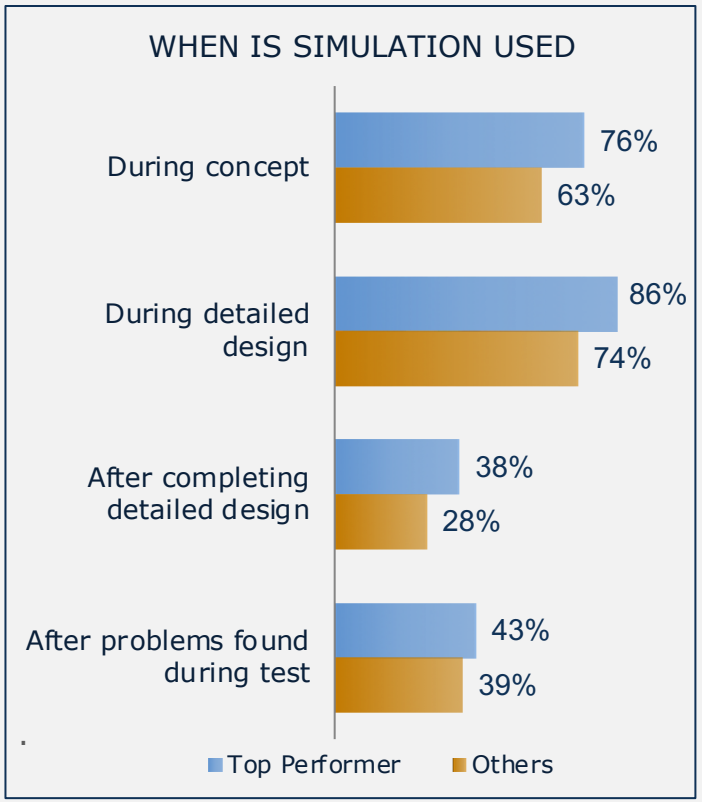
- Understand trade-offs
- Optimize products
- Identify problems early during the development processes

Together, these factors give them a competitive advantage. Now let's explore Top Performer practices.

How Top Performers Make Better Decisions

Top Performers Rely on Simulation

Simulation can provide engineers with early insight into design performance so that they can make better decisions. Top Performers tend to rely on simulation more than their peers. When engineers at Top Performing companies are unsure of their decisions, their most common approach is to run an analysis themselves, reported by 48%.

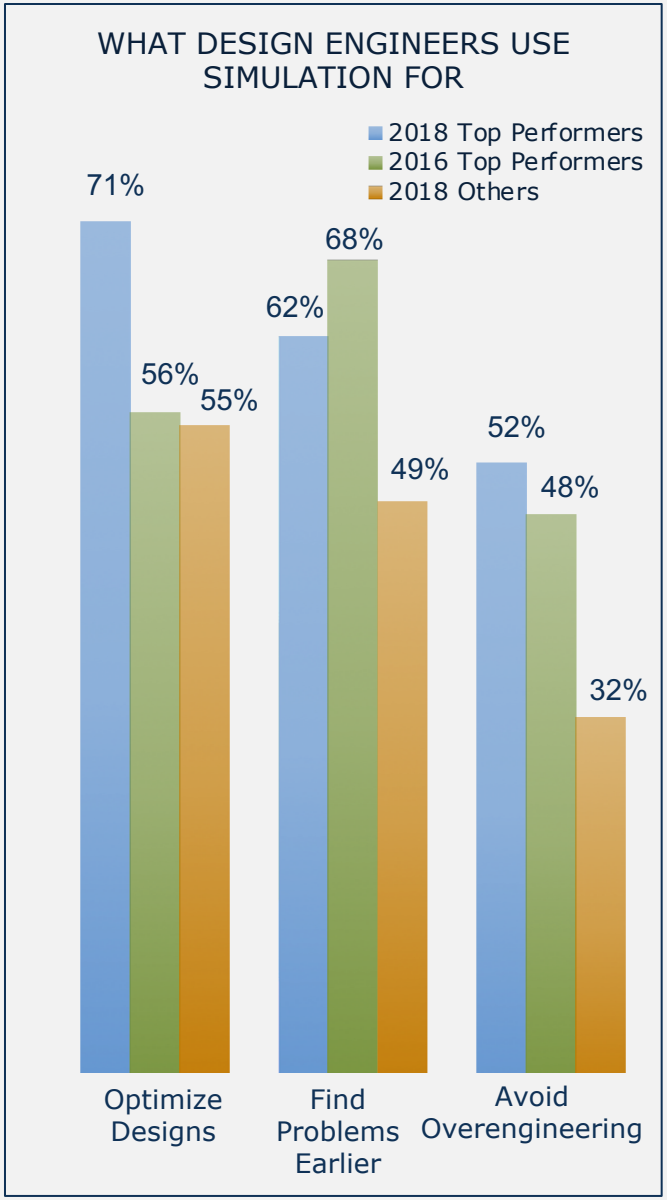


It makes sense that Top Performers rely on simulation to help them make better decisions. It is faster than waiting for physical test results and less expensive than overengineering. Also, the majority of companies, 65%, report that simulation helps them find problems sooner. This finding is consistent regardless of performance. However, Top Performers differ in that they are 88% more likely to report that they do less rework because of simulation. This indicates that they are more effective in how they use simulation. The difference is in when and how they use it.

Top Performer Use Simulation as a Design Tool

Top Performers are more likely than their peers to use simulation earlier in the design cycle (see upper graph).

Interestingly, how Top Performers use simulation has shifted over the last couple of years. In 2016, Top Performing companies were most likely to use it to find problems. Since that time, Top Performers recognize it as more of a design tool, and 71% of Top Performers now report they use simulation to optimize designs.



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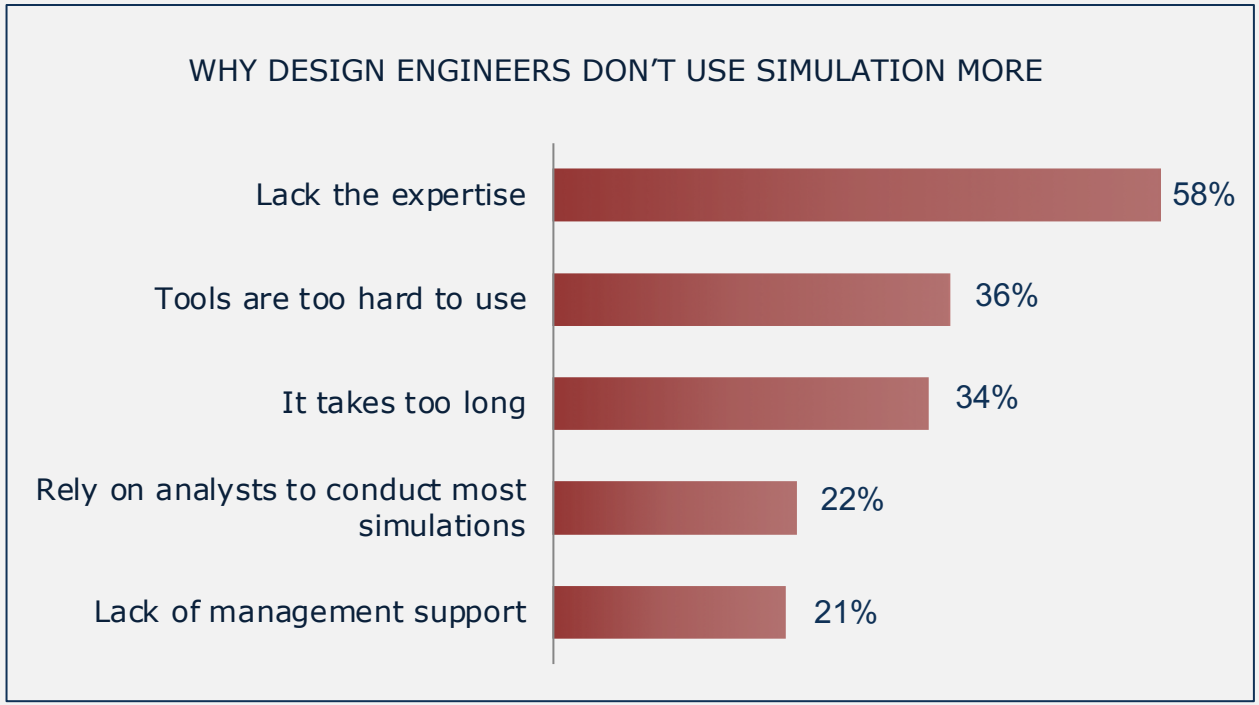
Getting Even More Value from Simulation

Design Engineers Would Like to Use Simulation More

While engineers, regardless of performance, see the value in simulation, many find they are not able to use it as much as they'd like. The majority of respondents, 65%, believe design engineers could see even greater value by conducting more simulations than they currently do.

The graph shows the reasons that hold them back, and it is primarily due to limitations in the tools. Engineers lack the expertise to use simulation tools, the software is hard to use, and it takes too long to conduct the analysis. Previous Tech-Clarity research finds that preprocessing (the process of setting up the analysis) is the biggest simulation bottleneck. All of these reasons point to a need for a different approach for design engineers. An overwhelming 97% agree that more can be done to help design engineers conduct simulations.



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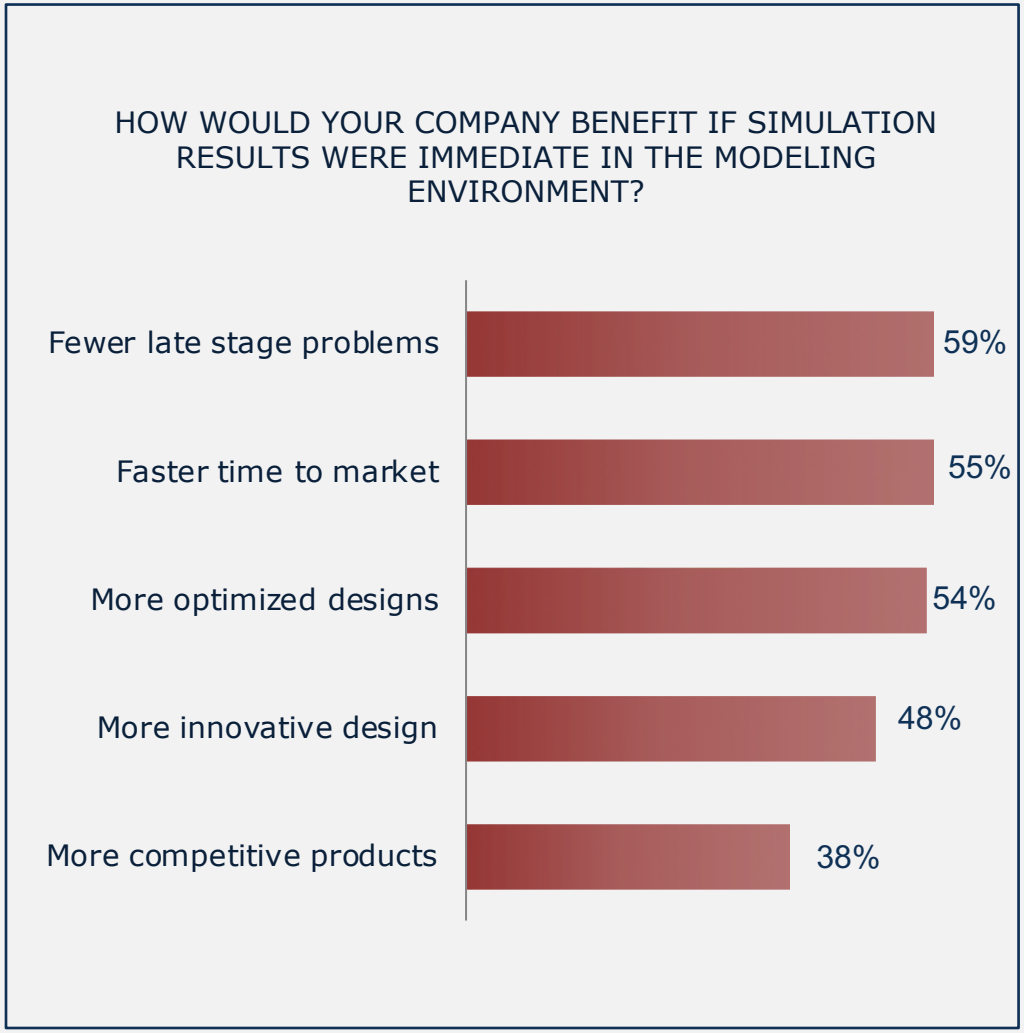
The Value of Instantaneous Insight



Making Simulation Pervasive

A potential solution is to integrate simulation more tightly with design. In fact, 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 (see graph).

A solution that provides instantaneous results can remove many of the barriers to simulation. If the results are immediate, the tool becomes far easier to use. Design engineers don't have to worry about their lack of expertise to setup an analysis, especially if the simulation solution has the embedded intelligence to do more of the work.

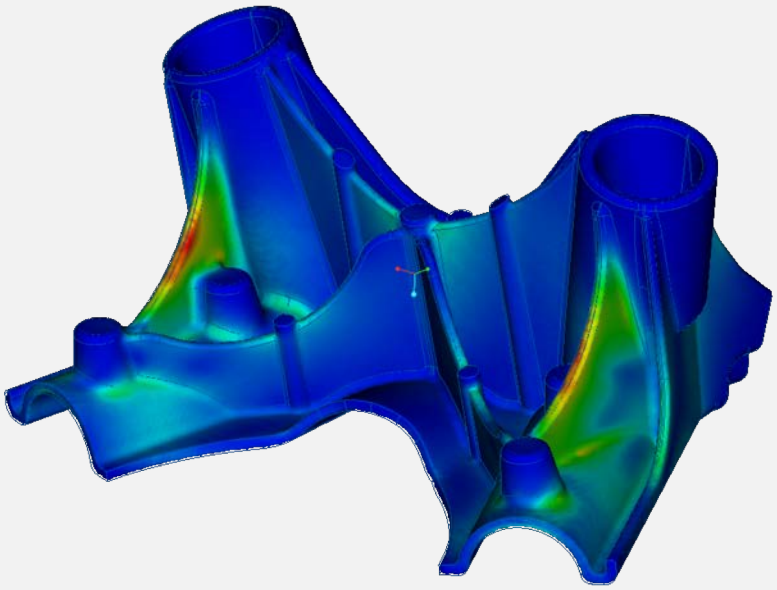
By removing the barriers to setting up a simulation, simulation would take far less time. If design engineers could review results directly in the modeling environment as they design, they could make more informed decisions as they work. Better decisions will lead to fewer problems during test and production, which result in late stage engineering changes. These changes take twice as long to implement and cause delays and increase cost. With immediate results, engineers don't have to wait a week to improve their confidence in their decisions. They will also be able to evaluate more options to balance requirements for quality, reliability, and cost. This will lead to a more optimized, innovative product. With better designs, in less time, the company will have the competitive advantage it needs.

Conclusions

New Approaches to Simulation Will Help Design Engineers

Engineering decisions are critical to product success, but a variety of factors, especially increasing product complexity, make it hard to make the right decision. Consequently, engineers often lack confidence in their decisions. Unfortunately, the cost of poor choices is high and often results in late stage changes. These changes take nearly twice as long to implement compared to changes made during the first 25% of the design cycle. Further, engineers are under constant pressure to meet tight deadlines. If engineers had better insight into the impact of their design decisions, they could catch problems sooner and save both time and money.

Simulation helps many engineers, and they would like to get even more value from it. To do so, they need a simulation tool that doesn't require a high level of expertise, is easier to use, and doesn't take too long. New approaches to simulation could help as engineers believe a simulation solution that can provide instant results would give them the immediate insight they need. With this capability, they could catch more problems earlier so that they can spend more design time on developing higher quality, more reliable, lower cost, innovative products.



Late changes take nearly twice as long to implement compared to changes made during the first 25% of the design cycle.

Recommendations

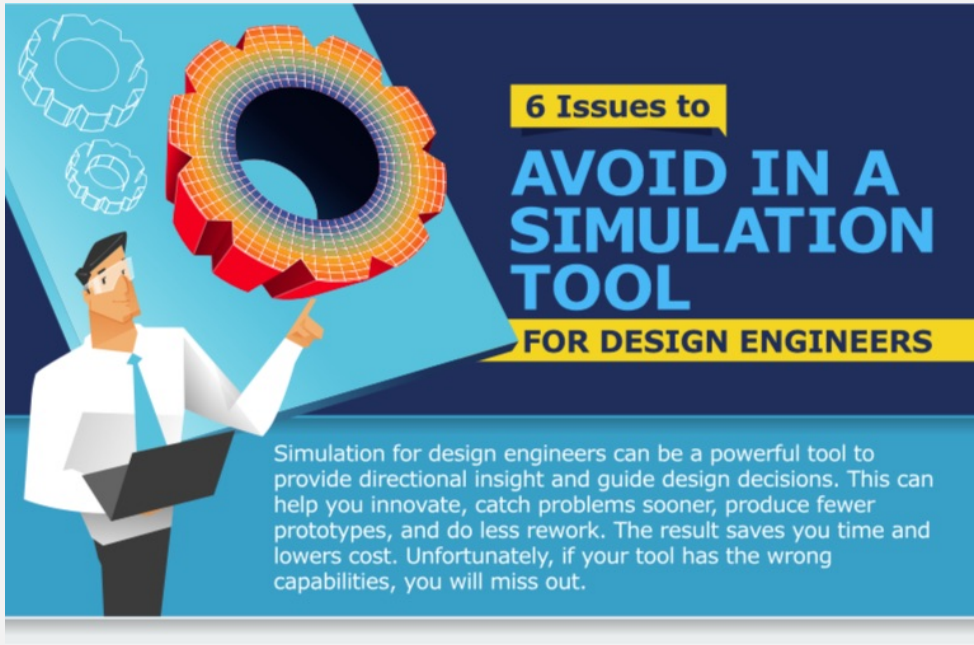
Recommendations to Improve Engineering Decisions

To help improve engineering decisions, Tech-Clarity offers the following recommendations:

- Empower design engineers with simulation tools to help guide their decisions.
- Use simulation as early as possible during concept and design.
- Rely on simulation as a design tool to optimize the design and provide directional guidance.
- Consider new approaches to simulation that are tailored for design engineers and make setting up an analysis easier.
- Look for a simulation solution that can offer instant results.

For more information, download Tech-Clarity's:

6 Issues to Avoid in a Simulation Tool for Design Engineers



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%) manager, 7% vice president or director level, and 10% who indicate they are 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

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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.

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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.

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