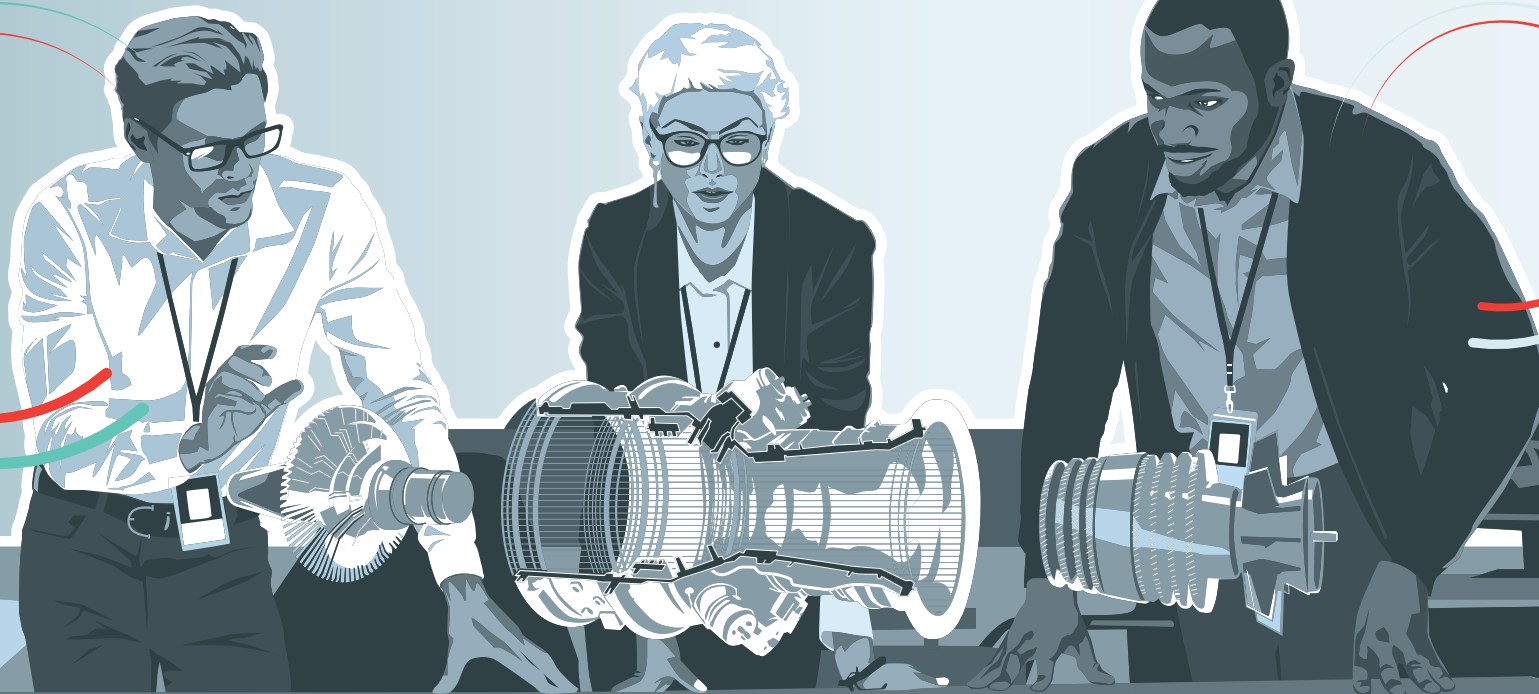


THE ENGINEER'S GUIDE TO NEXT-GENERATION CLOUD-BASED CAD COLLABORATION

AN OVERVIEW OF THE LATEST ADVANCES MODERN
COMPANIES ARE HARNESSING



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Introduction

Traditional mechanical products have changed completely over the last few years. Once, these products were standalone assemblies, primarily composed of mechanical components with some electronics. Now, mechanical products have evolved into complex and interconnected systems. They combine sensors, microprocessors, and data storage options, allowing them to interact and effectively “talk” to one another. A smart refrigerator can detect when it’s running low on groceries. A new era of autonomous vehicles is edging ever closer, where cars will drive humans.

For consumers, the opportunities are endless. But engineers and designers must grapple with new, significant challenges to their product development processes. These processes now require radical change to successfully and efficiently develop next-generation products while keeping pace with consumer and market demands.

This brief reviews those challenges and reveals the emerging cloud-based collaborative approaches and technologies that can minimize disruption during this period of ongoing product evolution. These collaboration methods provide engineers with a viable solution to ride this wave of change—while unlocking a competitive advantage.



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Industry Drivers

As next-generation products enter the market, complexity is the crux of the issue. Complexity rises significantly with each additional smart feature and connected device.

The traditional, mechanical lawn mower required a person to walk it outside, start it up, and push it along. Today, a new generation of autonomous lawn mowers are doing the job on their own. They initiate a mowing sequence independently. They use sensors to detect safety hazards. They return to their base when their charge is low. They notify the service provider when they need maintenance.

Engineers develop smart and connected products, such as the autonomous lawn mower, at the intersection of many engineering disciplines. They develop electronics, electrical distribution systems, sensors, actuated components, and software to work together as a single, intelligent system. As a result, engineers must collaborate more now than ever before. They must work together across diverse engineering domains and at every point in the supply chain.

That's not all. Such widespread connectivity, advanced functionality, and cross-device interoperability across today's mechanical products presents risk. Schedules and product requirements can slip during the development lifecycle. Increasingly tight budgets and deadlines compound the issue. Findings from Lifecycle Insights' Engineering Executive's Strategic Agenda found roughly half of engineers see the complexity of their designs increasing or increasing greatly (Figure 1).

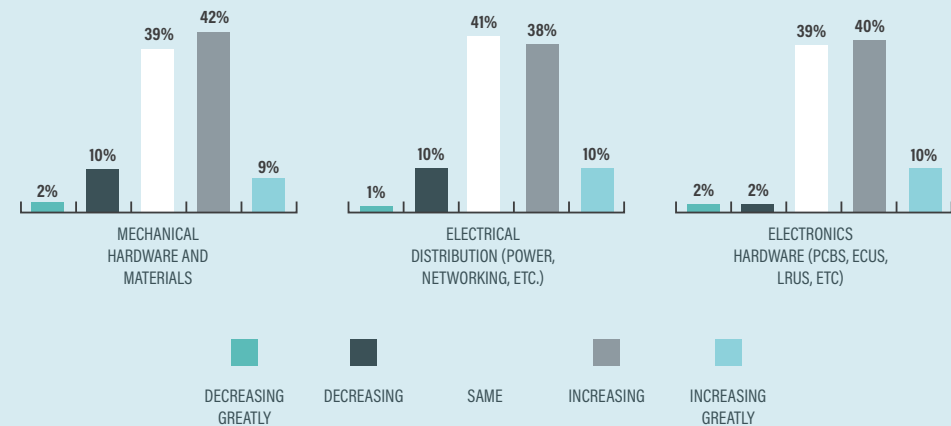
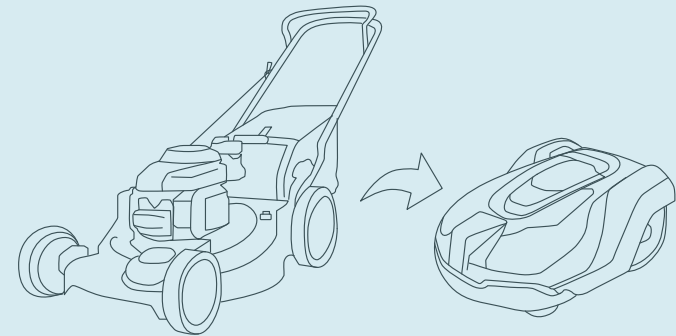


Figure 1

The complexity within mechanical, electronic, and electrical engineering domains is rising due to the transition to smart, connected products. Findings from the Engineering Executive's Strategic Agenda, conducted in June 2020, show the complexity of designs are increasing or increasing greatly.



Early and continuous collaboration is necessary to allow designers and engineers to get on the same page from day one.

A novel solution to this complexity problem is to extend collaboration on multiple fronts and across the product development lifecycle. In short, today's smart and connected products need smart and connected engineering teams.

Early and continuous collaboration is necessary to allow designers and engineers to get on the same page from day one. Engineering teams must analyze initial design ideas to ensure feasibility from a manufacturing and commercial perspective. Engineers must collaborate across domains even at the starting design stages. Mechanical engineers must work with electronics engineers to ensure circuit boards fit within the product casing. Electrical engineers must ensure cabling networks provide enough bandwidth for signal traffic. Software engineers must ensure that the logic of the code works with actuated components and sensors.

Moving further down the development lifecycle, designers and engineers must continue to collaborate frequently and at every stage. This includes during work-in-process design activities, which are liable to change regularly.

Every change, no matter how seemingly small and insignificant at the time, can ripple and propagate into other relevant areas of work. These proposed changes may come from an organization's designers or its engineers. So, engineers and designers must work together regularly to account for any product changes, to ensure all stakeholders fully understand their impact.

Multi-CAD Collaboration

Most of today's smart, connected products are not designed using a single mechanical computer-aided design (CAD) application. Organizations must work across different internal and external teams. Each group may use a different CAD application for their design work. Today's manufacturers must work with design data in a wide variety of formats. This results in issues with interoperability—a challenge that is unlikely to disappear anytime soon.

When working with design from across the supply chain, manufacturers traditionally export and import models using neutral formats. But this established strategy causes further issues. It inevitably results in broken geometries, which designers and engineers must fix using manual and time-consuming processes. This introduces further risk of human error into the development process. Every time new changes are made to those product designs, engineers and designers must manually fix the ensuing broken geometries. The cumulative effect is to slow down the entire development process.

But companies can approach this multi-CAD collaboration challenge by using the emerging cloud capabilities featured in today's progressive CAD applications. Designers and engineers can open design data in a native environment using either stand-alone or cloud applications. This dramatically reduces, and in some cases completely eliminates, broken geometries due to translation to a common format.

This capability also allows engineers and designers to make additional design changes within their native environment. Further, they can do so from any location and using any device with an internet connection because of the nature of the cloud application. Those amended designs are associatively updated, dramatically accelerating the entire development process. Recurring manual geometry fixes are a thing of the past. Both designers and engineers have more time for value-added activities. This unlocks innovation across the product development lifecycle.



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Superior Visualization

Designers and engineers working remotely across multiple organizations do most of the complex engineering design. Today's design team consists of diverse stakeholders—company designers and engineers, consultants, contractors, and customers. For the team to work together collaboratively, the stakeholders must understand the design thoroughly.

Traditionally, when the design team reached a milestone, it would create a physical prototype. This process worked well when the team members were in the same location, as each member would use the prototype to test their design aspect. With a dispersed team, creating and shipping physical prototypes becomes costly, cumbersome, and impractical. Designers and engineers need a new way of visualizing and analyzing their designs using virtual prototypes.

The new generation of cloud capabilities in progressive CAD applications enables product development participants to visualize their designs remotely using augmented reality (AR) and virtual reality (VR) techniques. Using these capabilities, stakeholders can comprehensively visualize virtual prototypes from any location and device. This ability allows for bringing the virtual prototype to the stakeholder instead of making them travel to the prototype. This way, design teams can reduce the number of physical prototypes, save time and money during the design process, and expedite innovation across the product development cycle.



With a dispersed team, creating and shipping physical prototypes becomes costly, cumbersome, and impractical.



Multi-CAD Data Management

Multi-CAD data management is another important issue affecting manufacturers. In an extended team scenario, design work is often carried out across different companies. These companies are likely to use different CAD solutions. So, regardless of the original CAD format, manufacturers must be able to effectively manage the design iterations at every stage of product development. Without a version history and a single source of the truth, designers and engineers can easily reference the wrong versions of component designs, leading to errors, unnecessary waste, and development delays.

To address this problem, manufacturers traditionally use a range of data management solutions that are tailored to each CAD application. But this established approach disperses the definition of the product across many separate, unconnected silos. Changes to each design are controlled and managed within their own siloes, which does nothing to help engineers stay on the same page and understand how those changes impact the entire product.

This discontinuity leads to errors, confusion, and a highly ineffective development lifecycle. Engineers and designers cannot complete their work with confidence. And when designers and engineers work in silos on different areas of the design, they may not notice any resulting errors until late in the product development lifecycle. This further complicates and delays the entire process.

An alternative, progressive approach is to employ multi-CAD, cloud-based data management solutions. These systems understand data structures and information in design data from many CAD applications.

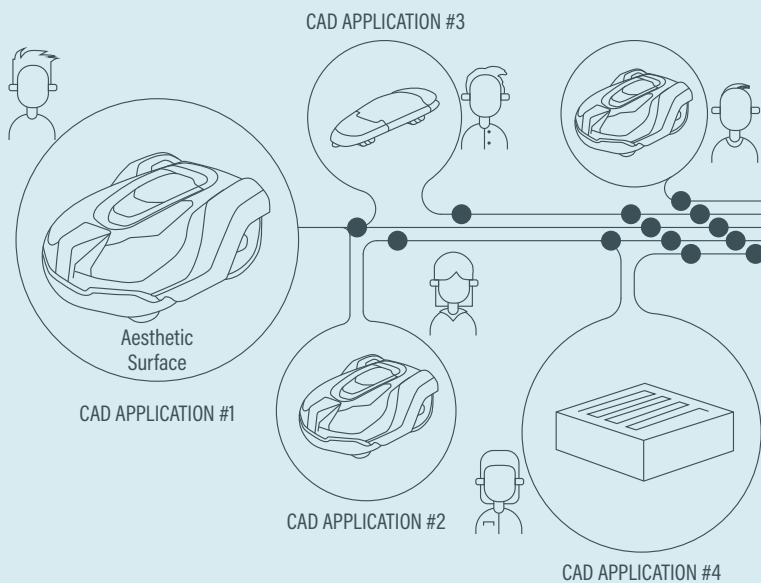
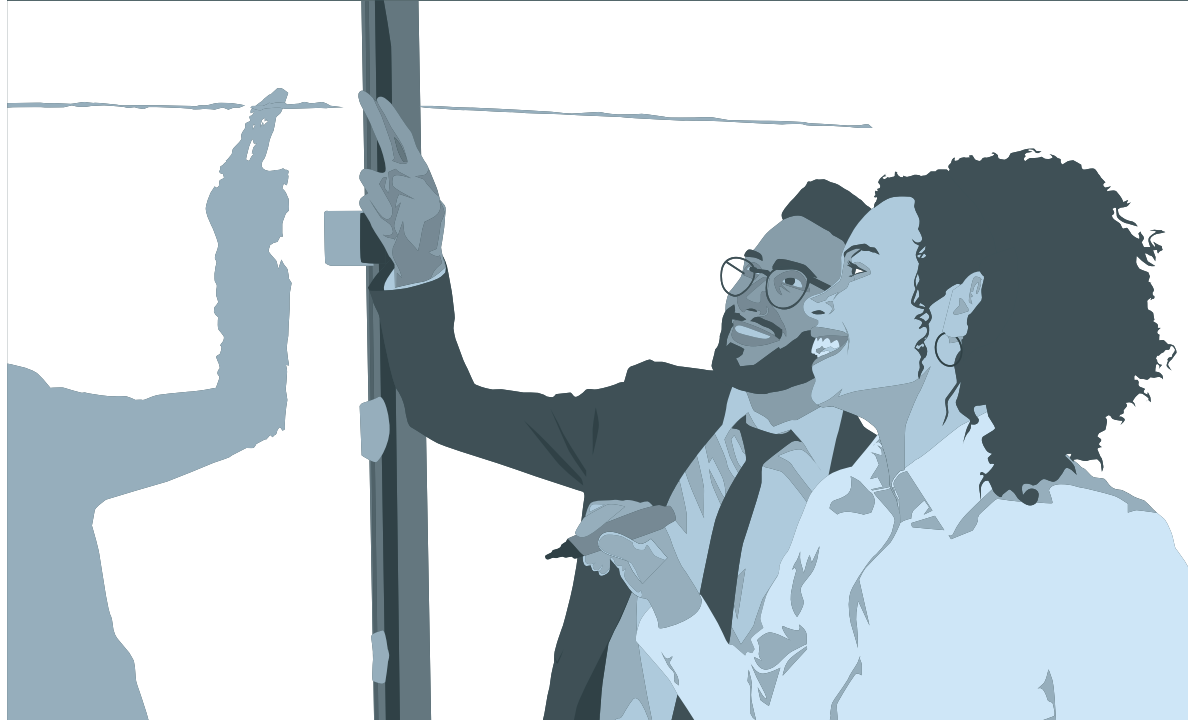


Figure 2
Design models of different components in a single product are interrelated. A change to one often has a ripple effect on others. Multi-CAD data management is a key system to manage this complexity.



In an extended team scenario, design work is often carried out across different companies. These companies are likely to use different CAD solutions.



They can track and manage changes to design data in a wide variety of formats. As a result, engineers and designers can work from a single source of the truth and access their colleagues' work even if they are using different CAD applications. Further, stakeholders from different companies can seamlessly collaborate using the cloud data management application without having to worry about installation, licensing, and software updates.

This eliminates the confusion that often results from using multiple disconnected data management solutions. This strategy also speeds the development process, as designers and engineers can easily identify and fix emerging issues in the product design. This novel, collaborative approach eliminates non-value-added tasks for designers and engineers, allowing them to focus on design activities. In this way, they accelerate innovation across the product development lifecycle.

Mechanical-Electrical Collaboration

The transition to smart, connected features is driving an increase in the number of electronics and electrical distribution systems found in today's products. Collaboration across diverse engineering disciplines is critical in the design of these products.

Electronics engineers must collaborate with mechanical engineers to ensure their circuit boards fit within product enclosures and are able to dissipate heat to prevent system overheating. Electrical engineers design the systems to route signals across a product's network and deliver power to its electronics. They must work closely with mechanical engineers to ensure that cables and wires are routed safely and effectively through the product's mechanical assembly. Collaboration is especially important during the highly dynamic work-in-process phase of the design lifecycle. Changes by one engineer can dramatically affect the work of the other engineering teams.

The established approach to enable collaboration relies on the export and import of design data. Engineers export a product's netlist or circuit board outline from an electrical CAD application and import it into the mechanical assembly of a mechanical CAD application. The problem with this approach is that all changes, not just the most recent ones, are communicated via a single, neutral data file. As a result, engineers cannot easily identify and understand what changes have been made since the last product iteration. This makes it incredibly difficult to monitor any changes to the product design across the development lifecycle.

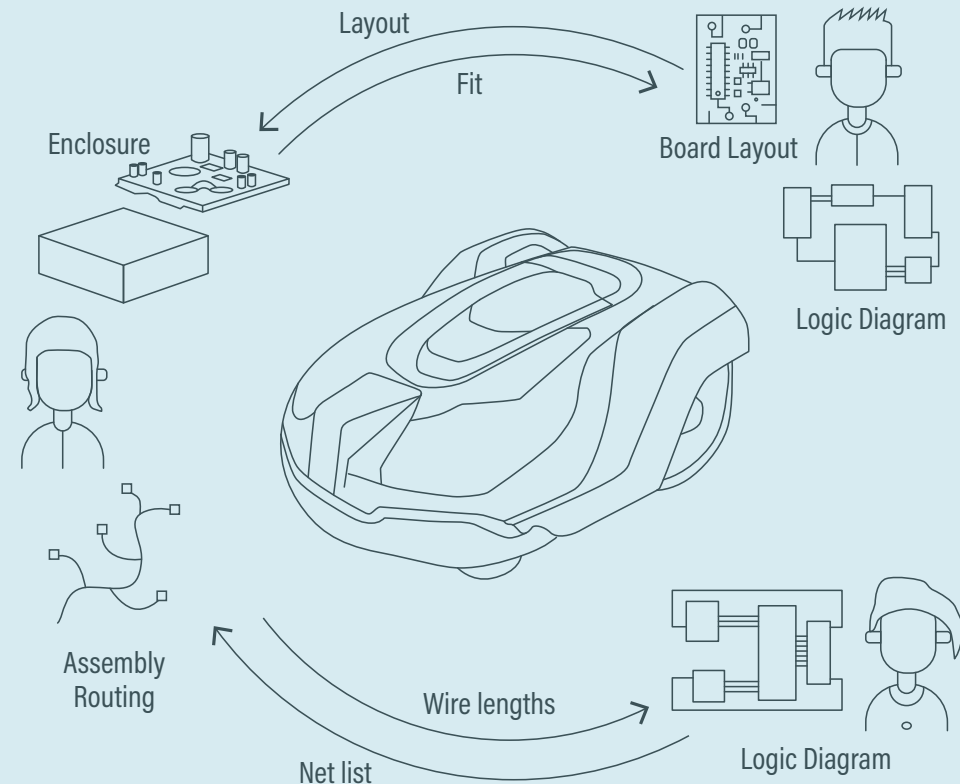
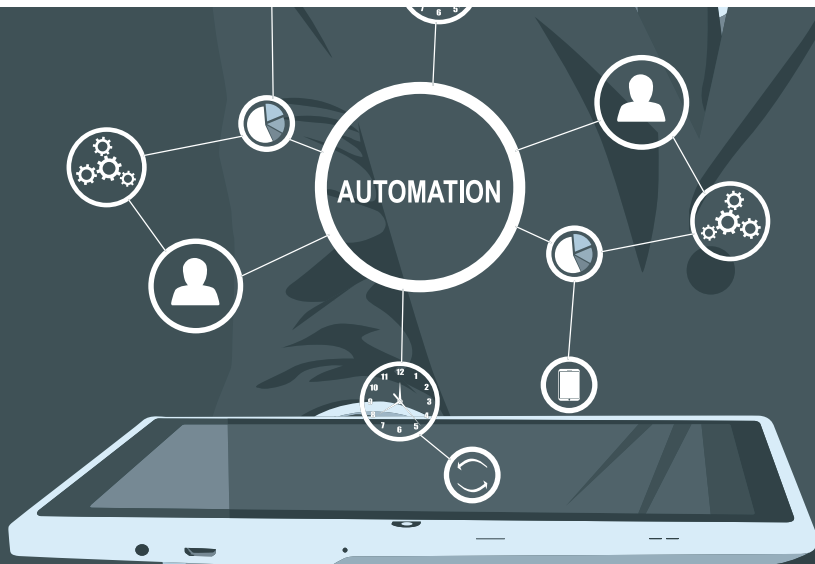


Figure 3
Mechanical, electronic, and electrical engineers must collaborate early and continuously throughout the development process to resolve competing and sometimes conflicting requirements.

Many manufacturers avoid this issue by simply refraining from collaboration during product development. Instead, collaboration between these domains happens at the very end of the design process. But this leaves little room for error. There is limited time to address problems or conflicting cross-domain requirements that crop up at this late stage.

By contrast, the new, collaborative capabilities now available between different mechanical CAD and electrical CAD applications enable a novel approach. The two applications can connect and communicate changes back and forth seamlessly. Most importantly, engineers can identify recent changes, providing clear visual cues within the context of the design.

These capabilities enable an early and frequent exchange of ideas and design modifications across the product development lifecycle and between different engineering domains. This directly addresses the shortcomings of the established approach, quickening the product development process while avoiding disruptive late-stage issues.



The transition to smart, connected features is driving an increase in the number of electronics and electrical distribution systems found in today's products.

Summary and Recommendations

- Traditional mechanical products are transforming into smart and connected ones. This shift increases product complexity, presenting designers and engineers with new challenges. They must transform their communication and collaboration processes to overcome these obstacles.
- Today's smart, connected products are developed using a range of CAD applications. Designers and engineers must leverage software that opens models in a wide range of native formats. This novel approach eliminates broken geometries, drives time and cost savings across the product development process, and frees designers and engineers to pursue value-added solutions.
- Today's design teams must enable their stakeholders to visualize their virtual prototypes remotely. Further, stakeholders must be able to enhance their visualization using AR and VR techniques. This superior visualization enables remote participants to study, troubleshoot, and approve designs quickly and cost-effectively.
- Organizations must employ multi-CAD data management solutions. This novel capability provides engineers and designers with a single source of truth, allowing them to easily identify any changes across the product design process.
- Thanks to advancing electrification, collaboration is key between electronics engineers, electrical engineers, and mechanical engineers. Novel CAD applications achieve this with capabilities that enable early and frequent exchange of modifications.

Lifecycle Insights recommends the following:

- Companies should investigate the number of CAD applications and remote participants that they use within their organizations and across supply chains. They should consider CAD applications that work natively with design data from other CAD applications and enable cloud-based collaborative design work.





Accelerating Engineering
Transformation

Lifecycle Insights is a research and advisory firm that assesses the business impact of technology on the most pressing issues affecting engineering professionals and organizations.

The firm provides unique insight into how software applications and systems affect engineering strategies and initiatives as well as how they personally impact the engineer, manager or executive.

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✉ contact@lifecycleinsights.com

🌐 www.lifecycleinsights.com

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