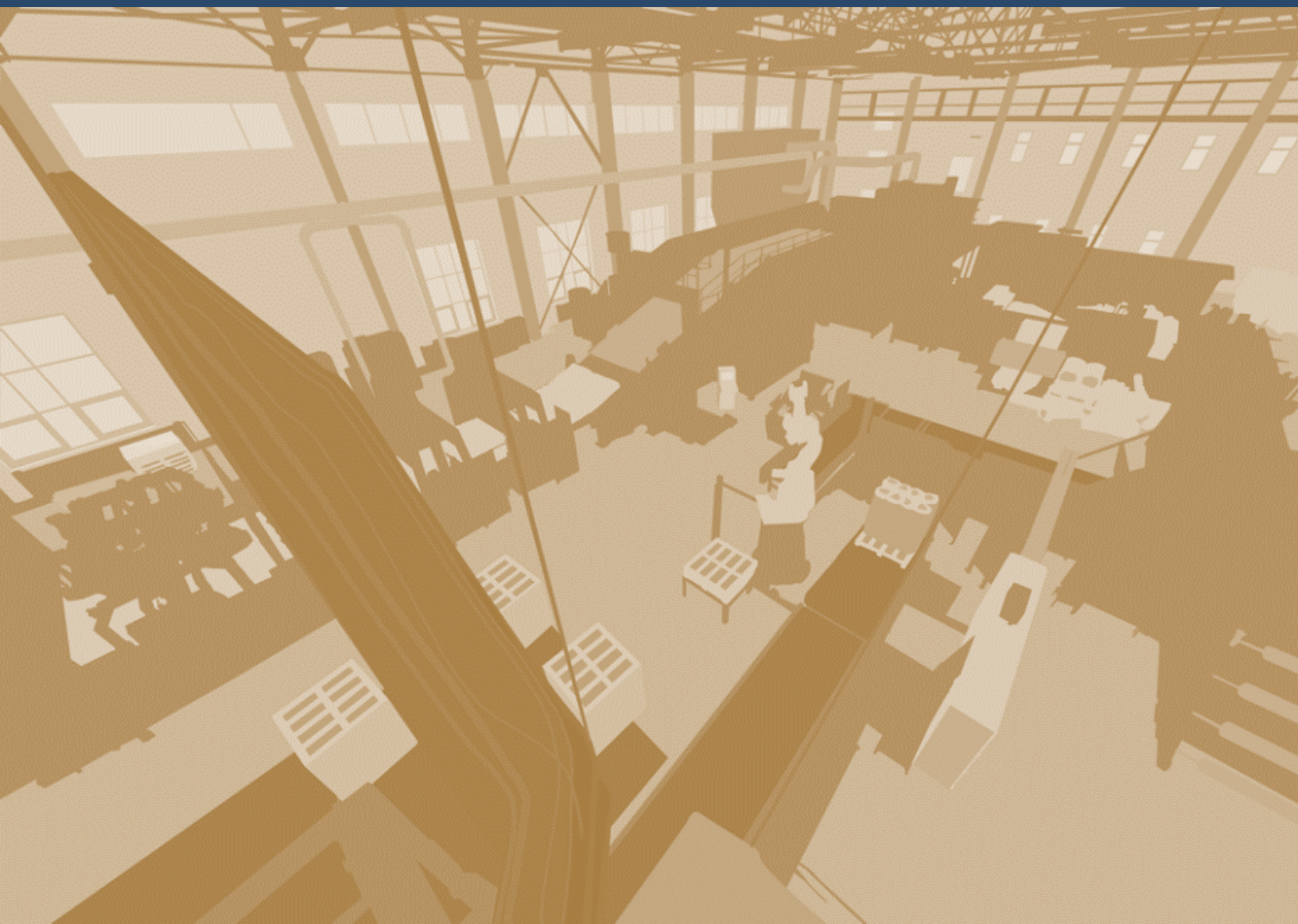
# CLOUD-ENABLED DIGITAL TRANSFORMATION OF PRODUCT DEVELOPMENT

LIFECYCLE INSIGHTS



# EXECUTIVE OVERVIEW

The pace of innovation proceeds at a fevered pitch, and companies in every industry are struggling to keep up. Products are awash in complexity, flush with sensors, electronics, and advanced software. These state-of-the-art technologies deliver the intelligence and performance that is the hallmark of modern offerings, from high-precision jet engines to simpler home thermostats. Products need a full complement of capabilities today to stand out in a tsunami of smart, connected offerings.

As part of the journey, manufacturers are modernizing core business processes through digital transformation, including those related to engineering and product development. It's no longer enough to build a great product with notable bells and whistles. In today's landscape, companies must create the best product for the right audience and release it in the right timeframe, well ahead of potential competition. The new requirements up the ante for innovation and collaboration, demanding that product development organizations challenge long-standing engineering paradigms and explore how digitization and a new generation of design tools can improve traditional workflows among dispersed teams and external partners.

Engineering organizations that have long relied on standalone 3D modeling tools such as MCAD and ECAD are extending the digital thread to all corners of the design phase and throughout the entire product lifecycle. Enabled by the Cloud, there is a swing away from siloed systems and design practices that hamper easy model sharing and collaboration towards platforms that facilitate workflow across a multidisciplinary team of electrical,

*This report assesses the implications and opportunities associated with adopting Cloud-based solutions in development. This report includes findings from the PLM study as well as the Cloud Adoption study, both research survey efforts completed by Lifecycle Insights.*

mechanical, and software engineers as well as with partners, suppliers, and customers. Companies need to embrace such multifunctional design platforms to establish a rich digital thread that connects myriad stakeholders in the process.

Instead of standalone simulation, systems modeling, and data management tools, and in lieu of hand-offs and manual data sharing processes, design teams are seeking an alternative approach that lets them fast-track development, improve product quality, and accelerate time to innovation.

The 2019 Lifecycle Insights' Cloud Adoption Study confirms that engineering organizations are spending too much time on non-value work like file management, fixing broken geometry, and cleaning up design data to exchange with their extended supply chain and partner ecosystems. At the same time, traditional tools and conventional workflows can severely hamper the iterative design cycle, restricting organizations from fully flexing their muscle to optimize product concepts, thus potentially falling short on innovation.

In the wake of the findings, the Lifecycle Insights research uncovered plenty of opportunity to improve existing engineering processes, and we'll share those results and recommendations throughout the course of this paper. We'll call out where and how established product development processes fall short and highlight the advantages of a new approach built on an integrated, Cloud-based design platform. We will also showcase how such a platform is the springboard for a new engineering paradigm that provides a direct and relatively painless path to digital transformation and ultimately, competitive advantage.

*Findings from the Cloud Adoption study are included throughout this report. Conducted in early 2019, this research reports on the current challenges in product development as well as the adoption levels of Cloud-based solutions.*

# TABLE OF CONTENTS

# IMPROVEMENT OPPORTUNITIES

While the stakes couldn't be any higher, the quality of product development practices at too many organizations remains surprisingly low. Most engineering organizations employ a variety of design tools, typically segregated by function—for example, MCAD for mechanical engineers or ECAD for electrical specialists—and too often, those tools gain traction as independent islands, making it difficult to collaborate across disciplines, let alone to promote seamless file exchange.

In addition, these interdisciplinary design silos foster an "over the wall," sequential workflow, which discourages early and fluid collaboration among all the relevant stakeholders. Without that upfront engagement, product teams are more likely to miss the boat on ideating optimal product designs. They may also be too late to ward off potential design errors that can significantly derail delivery cycles, or worse, lead to a critically flawed product release.

*This chapter details the current state of product development, diving into specific metrics representing areas of strong potential improvement.*

## THE POOR STATE OF PRODUCT DEVELOPMENT

A Lifecycle Insights' PLM study on product development success confirms that organizations are struggling with sub-optimal product development practices, as shown in Figure 1. The study found a scant 13% of all product design projects launch on time without significant changes to resource allocation. The reality is that 45% of all development projects are either cancelled or miss their product launch date due to any number of reasons—

among them, failed prototypes, incorrectly ordered parts, or manufacturing issues.

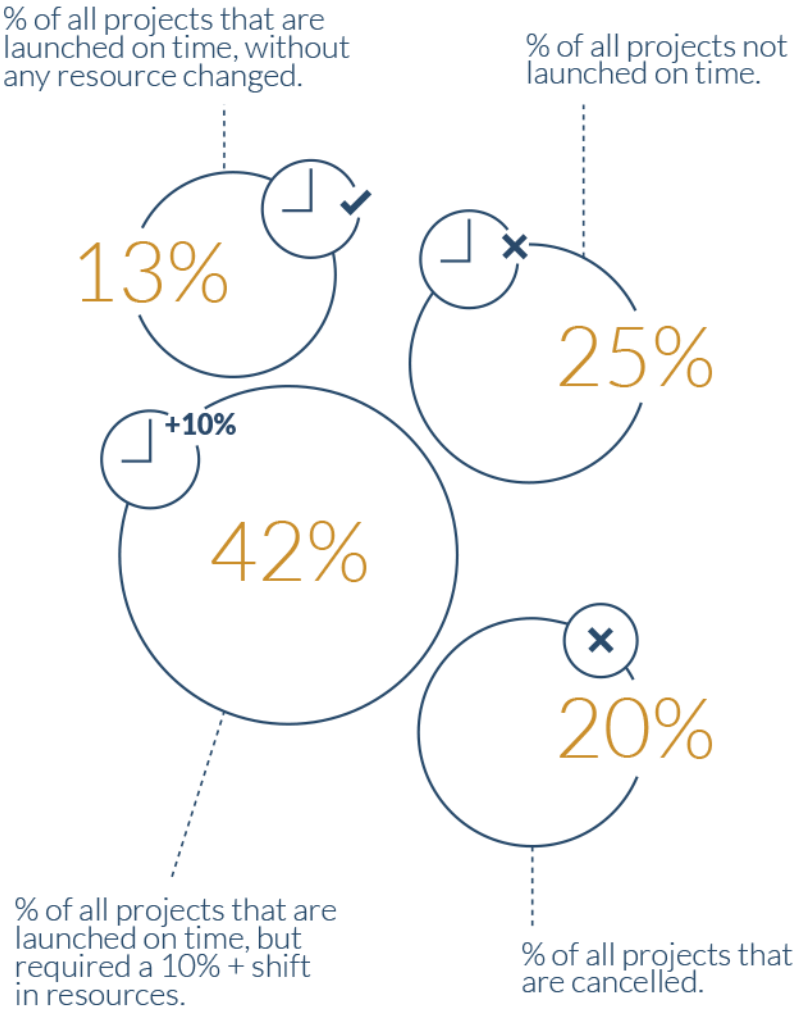



*Figure 1: Disposition Rates of Product Development Projects, The PLM Study, 760 Respondents*

*Hitting product development deadlines is key to the success of any company. Design release marks the date upon which engineering provides product documentation for manufacturing and procurement. Product launch or delivery marks the end of product development.*

Moreover, most engineering organizations are engaged in a mad scramble to meet their targets. The survey found that 42% of all development projects do meet their stated delivery dates, but only because the teams make significant changes to resource allocation—increasing staff by more than 10%—to get the job done. That singular finding illustrates the productivity gap as engineering organizations try to shore up inefficient design practices and workflows by taking manpower

away from other projects to meet aggressive time-to-market objectives.

The situation is even worse for other companies. The Lifecycle Insights research found that 25% of product development projects don't launch on time at all, despite resource reshuffling, and 20% suffer outright cancellation. While it can be healthy to cancel some projects as part of a portfolio management process, there is still a need to rethink existing product development strategies to get to the root cause of the dysfunction, whether it's related to system-level failed prototypes, overly aggressive planning, or undisciplined verification and validation practices. With real product development success proving so elusive, it's imperative that companies take digitization seriously and examine how new tool sets and design paradigms can bolster lagging efforts and deliver a competitive edge.

## THE COST OF NON-VALUE-ADDED TASKS

One of the biggest hurdles to engineering productivity is the simple fact that teams spend way too much time on non-value-added work. The current state of tools and engineering workflows often requires team members to conduct manual workarounds to solicit and manage feedback from project stakeholders, along with other time-intensive tasks.

According to another Lifecycle Insights survey, as shown in Figure 2, an engineer spends about 5.8 hours—or 15% of their work week—on merging review feedback from multiple people, whether that involves managing emails, integrating and updating 3D CAD files, or simply making the rounds to ensure they account for everyone's input. And that's just the start. The findings revealed that engineers are committing another 5.5 hours to executing design reviews with peers, accounting for 14% of their work week, and yet another 6.2 hours facilitating design changes with an extended ecosystem of suppliers—a 16% slice of their weekly agenda.

*For engineering and other product development teams, time equates to design bandwidth. Time spent on non-value-added tasks is time not spent exploring new design alternatives for innovation or missing key deadlines in product development.*

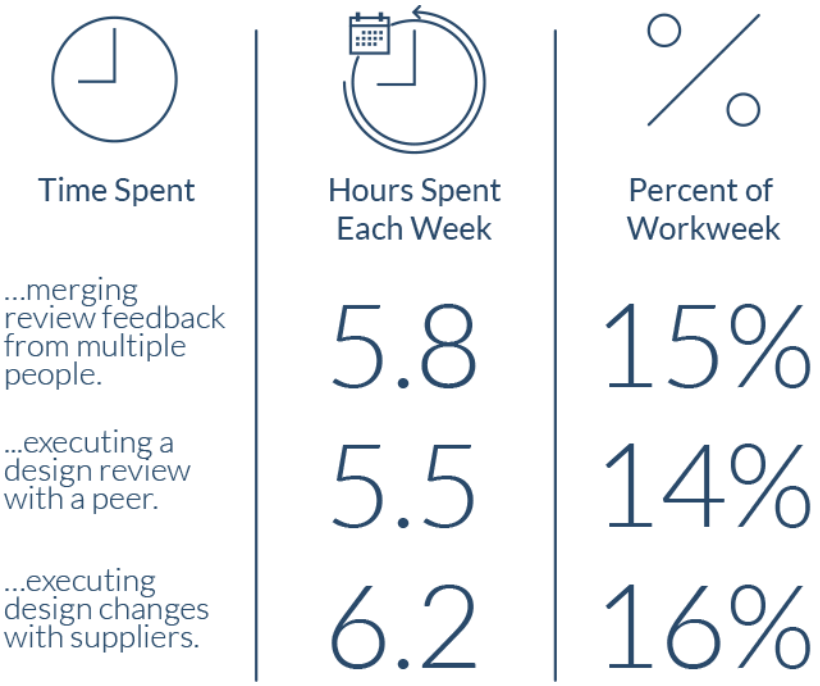



*Figure 2: Average Time Invested in Collaboration Activities, The Cloud Study, 187 Respondents*

In total, the results show an inordinate amount of time spent on laborious and manual housekeeping tasks that do nothing to advance design innovation or get products to market faster. By dramatically reducing or even eliminating such non-value activity, organizations pave the way for engineers to spend their time elsewhere on more productive and rewarding work, such as exploring more design iterations, catching design errors early on, or executing more projects per year, increasing revenues. Any of those scenarios would be a critical leap forward in improving product development practices.

At the same time, minimizing the time engineers spend executing design reviews with peers and coordinating changes among suppliers represents an opportunity to accelerate development schedules. A more frictionless form of collaboration could greatly speed up the design review and change management processes, significantly improving the percentage of projects that proceed as planned and the number of products that meet aggressive release targets.

*Design reviews are a crucial activity in the product development process. However, there are means to execute reviews efficiently and productively.*

## THE COST OF MULTIPLE ROUNDS OF PROTOTYPING AND TESTING

Product design is an iterative process, and the prototyping and testing phase is no exception. In traditional engineering workflows, engineering teams iterate early designs to a critical stage, winnow down the field, and then run a limited few through prototype and test procedures. Then they build a physical rendition of each potential design candidate and run through a series of test cases to prove its viability, whether it's to ensure structural integrity or that there are no part or assembly interferences.


*Figure 3: Average Prototyping Time and Costs in Development, The Cloud Study, 187 Respondents*

The traditional physical prototype process is long and costly. As shown in Figure 3, the 2019 Lifecycle Insights' Cloud Adoption Study shows most companies conduct

*Prototyping and testing represent a real, hard cost in development. More importantly, the time required to build an extra round of prototypes can be the difference between mitting and missing product development deadlines.*

around 2.6 rounds of prototyping and testing per project, on average, and the typical cost for just a single round runs around $46,720 and takes about 30 days to complete. In total, companies are shelling out $121,420 on prototyping and testing efforts and earmarking 79 days to the process.

Through digital transformation, engineering organizations can shift many of these processes to the virtual world, using 3D CAD and simulation platforms to test and iterate designs without having to build costly physical prototypes. The digital paradigm makes it easier for a multidisciplinary team of engineers to collaborate and coordinate efforts in parallel, which extends the number of design options they can explore. At the same time, vetting those options in a virtual world can significantly shrink the number of rounds of physical prototyping and testing per project, which translates into enormous cost savings and reduces possible delays, getting product to market faster.

# THE ESTABLISHED APPROACH

Digital technologies have become an integral part of the product design world, but not all tools are leveraged to their full advantage. In fact, many companies, large and small, still rely far too heavily on what could be considered outdated methods of running product development and managing product data.

*This chapter details the established approaches to executing product development as well as the traditional technologies that enable it. In this case, those technologies primarily include email, files, shared drives, documents, and spreadsheets.*

## THE TRADITIONAL TECHNOLOGIES

Sharing CAD models and other product-related documents such as BOMs via email attachments is a natural extension for anyone using standard productivity tools like Microsoft Office during the course of their work day. Shared drives, now popular as a way to improve collaborative workflows, are another familiar option for engineering organizations looking to centralize product data and make it readily accessible to different stakeholders.

Shared drives are often used in tandem with spreadsheets, another basic technology that persists in engineering data management. Spreadsheets remain popular because they are capable of handling both equations and tables of data and they are a familiar tool for most people.

Of course, many companies have moved beyond using basic digital enablers to specialized engineering data management systems like on-premise PDM. PDM centralizes engineering data such as CAD models, ECOs, and BOMs, It aids in version control through a check-in/check-out file system used to monitor file changes.

*Shared drive technology is widely available in development. There are serious drawbacks to using these tools in development.*

## USAGE OF TRADITIONAL TECHNOLOGIES REMAINS HIGH

These basic digital technologies remain the foundation for product data management within engineering organizations large and small.

As shown in Figure 5, Lifecycle Insights' PLM Study found that nearly three quarters of respondents (74%) at companies with less than $10 million in revenues still rely on a combination of desktops, laptops, and shared drives to manage their development data, but so do their much larger counterparts—specifically, 34% of companies with revenues greater than $1.25 billion. Enterprise software like PDM is used along with the less sophisticated methods at 34% of larger companies and only 15% of smaller firms. Only 31% of billion-dollar-plus firms rely on enterprise software exclusively, and that number shrinks to only 10% for businesses under $10 million.

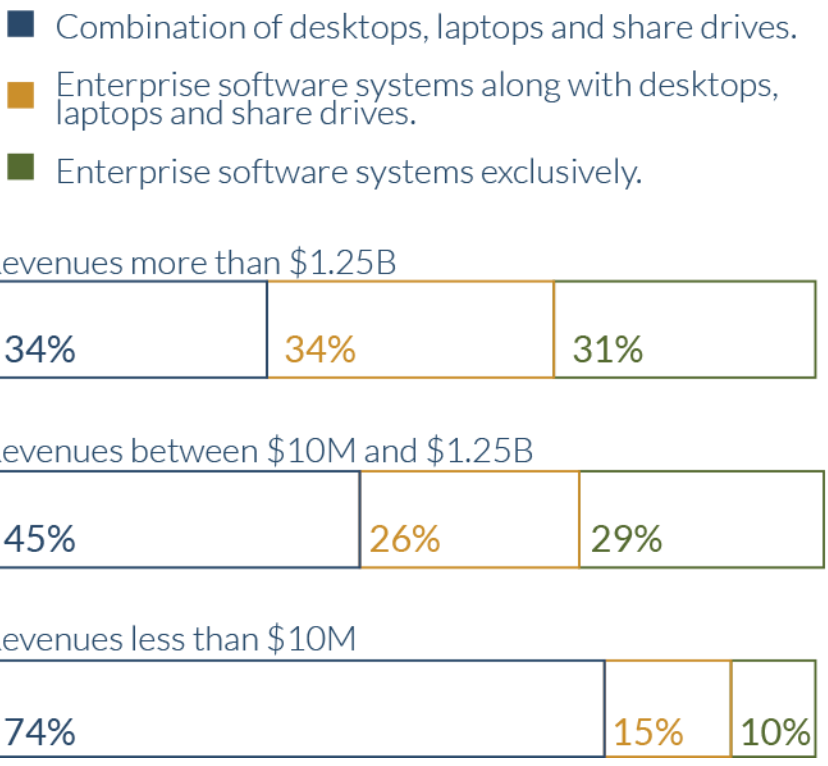



*Figure 4: Technologies Used to Manage Data in Development, The PLM Study, 760 Respondents*

*Email is a pervasive technology in all functional departments. Many companies rely significantly on email and file attachments for collaboration. These messages can be easily lost, deleted, or forgotten, delaying collaboration in product development.*

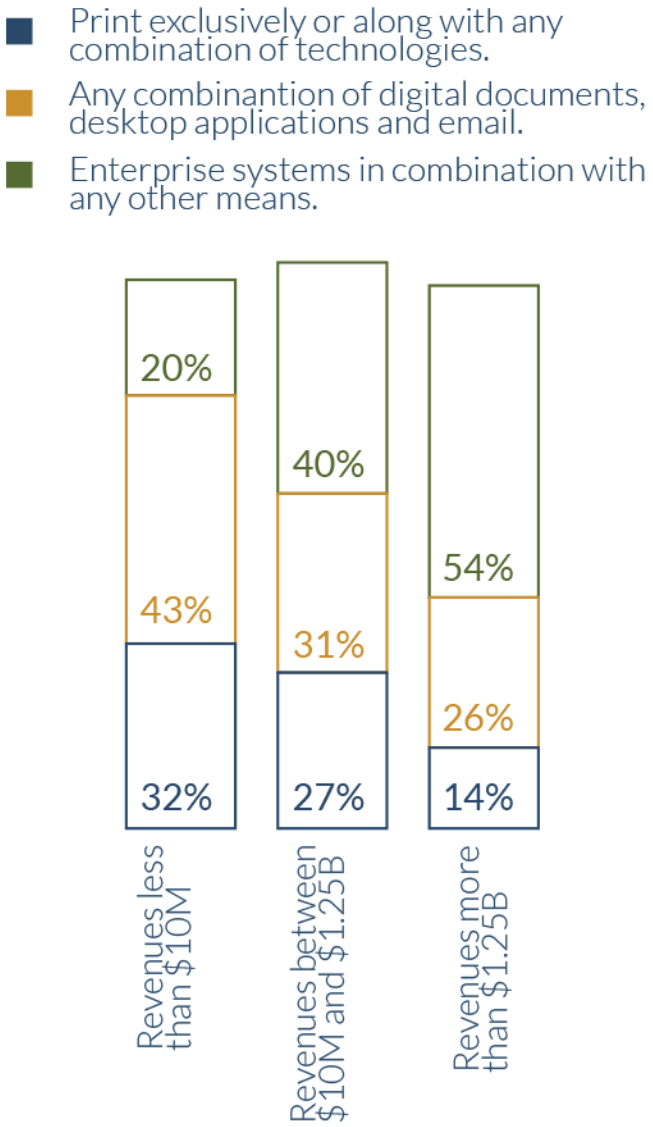



*Figure 5: Technologies and Approaches Used to Manage Projects in Development,*
*The PLM Study, 760 Respondents*

What's even more surprising is that fully one-quarter of companies are still using paper--sometimes exclusively, sometimes alongside digital tools--to execute development processes and projects. Documents and spreadsheets still play a pivotal role in shaping design decisions, the research found. As shown in Figure 6, fifty-three percent of respondents to the Lifecycle Insights survey employ documents and spreadsheets very frequently and very consistently during the product

development process to guide decision making while 30% do so frequently and consistently. Another 16% lean on the technologies frequently, but inconsistently, or consistently, but not as often, as part of their decision-making process.

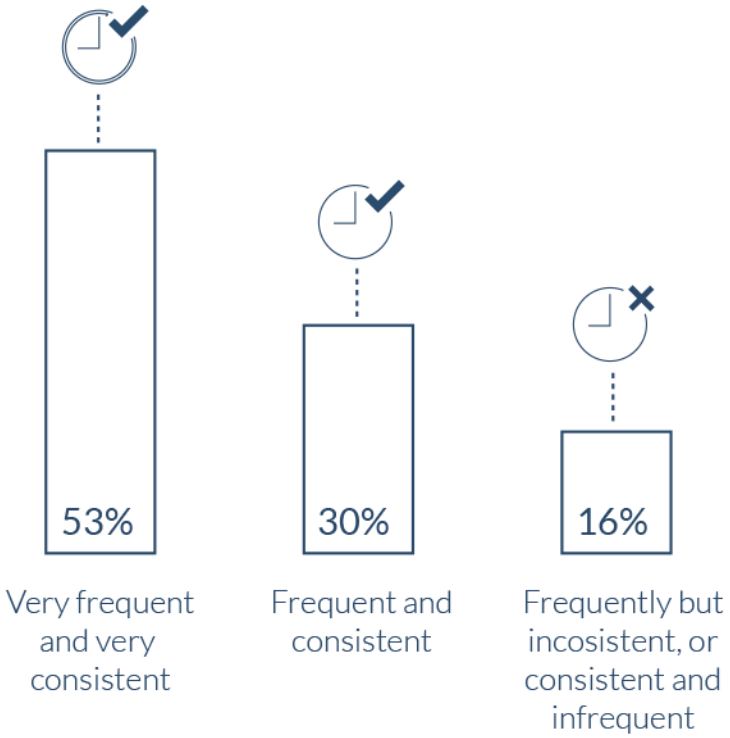



*Figure 6: Use Frequency and Consistency of Spreadsheets in Development,*
*The PLM Study, 760 Respondents*

What do these numbers tell us? The results paint a very clear picture of organizations, even those more than capable of adopting enterprise systems like PDM and PLM, struggling to find an ideal way to establish a single, secure source of truth for design and development data. It also shows a reticence to adopt more sophisticated technologies for data management, potentially due to the high-cost and long deployment reputations of enterprise systems. It also crystalizes the fact that there is ample opportunity for new digital technologies that can address many of these shortcomings to enable engineering organizations to finally wholly transform their processes

in order to bolster innovation and accelerate product delivery.

## THE SHORTCOMINGS OF TRADITIONAL TECHNOLOGIES

While traditional technologies like email, shared drives, spreadsheets, and PDM get the job done, they all have significant shortcomings. Take email, for example. It's certainly easy enough to route CAD models or engineering change orders around to team members or suppliers using email attachments, but that method leaves a lot to be desired when it comes to the integrity of the product record. The sheer volume of daily emails means critical engineering data can get lost or forgotten, and an ECO buried at the bottom of an inbox means a critical design flaw remains unaddressed, which could lead to product delays or, worse, quality problems in the field.

In addition, email provides no way for recipients to know if an attachment is out-of-date. This means teams too often rely on misinformation or incomplete data to make critical design decisions. Additionally, they spend too much time chasing down the right version, which becomes a significant source of non-value work and which could delay the development process. Besides being error-prone, design collaboration over email is inherently insecure, opening up critical intellectual property (IP) to misuse and increasing the risk of losing competitive advantage.

Documents and spreadsheets are a popular way to share engineering data and execute key processes such as design reviews and approvals, design releases, and change management initiatives, but they too are flawed. The biggest issue with using documents and spreadsheets in this manner is that, once they are distributed, there becomes no single source of the truth. A mechanical engineer working on one piece of an assembly might have a different version of the CAD

*Once sent as an email attachment, documents and spreadsheets are at risk of being immediately outdated. As a result, people in the development process are likely to be working against the wrong version of the file. At best, this represents wasted time reviewing the wrong material. At worst, this leads to incorrect decisions that can have a significant impact on the rest of product development.*

model or BOM than another engineer working in a different discipline or on a separate-but-related piece of the product. With the official product record diverging, it increases the possibility that team members make errors throughout the development process. Doing so could lead to design flaws, schedule delays, and ultimately, quality issues with the released and finished product.

Along with their various shortcomings, these basic digital solutions require a certain level of manual effort to maintain, whether it's updating a spreadsheet, coordinating disparate change orders, or chasing down feedback from stakeholders. As a result, design decision makers spend too much time on bureaucratic and manual activities that take focus away from more critical design efforts. The traditional tools and approaches also inject unnecessary steps in the design process, which impedes an organization's ability to accelerate product delivery.

The file-based foundation of shared files and on-premise enterprise systems like PDM also create hurdles. Check-in/check-out capabilities restrict engineers from accessing critical files and models whenever they need them—on the road, for example, at a client site, or working during off-hours. The systems can also be cumbersome to navigate, particularly employing search capabilities to locate specific files. As a result, engineers too often work around these systems, falling back to email and manual processes, which results in errors, inconsistencies, and time wasted on administrative processes as opposed to advancing innovation and collaboration.

# THE NOVEL APPROACH

*This chapter details the novel approach to product development that relies on Cloud-based solutions.*

As the Cloud continues to gain enterprise traction, engineering organizations are exploring how the paradigm can alleviate long-standing pain points, including creating a digital thread that connects design processes and key stakeholders. As opposed to standalone tool sets and data silos, an integrated Cloud-based platform provides access to the entire portfolio of tools used as part of the development process, including MCAD, ECAD, simulation, data management, process management, and automation.

Moreover, the Cloud paradigm opens up access to these critical tools to a much wider audience, simplifying collaboration and providing scalable capacity that can be dialed up or scaled back depending on requirements. At the same time, an integrated Cloud product development solution serves as an unambiguous source of the truth, eliminating the need to email files or spreadsheets around and helping to address the problem of out-of-date or error-prone files.

## ACCESSIBILITY FOR ALL

One of the biggest upsides to a Cloud-based product development platform is centralized accessibility from anywhere. Unlike traditional design tools that are a locally-installed solution, users can access a Cloud-based offering from any browser-based system, meaning a desktop, laptop, tablet device, or even a phone.

That flexibility provides a level of freedom not possible with traditional systems. An engineer could easily access a CAD model and provide input on design changes from

a client site, during the commute, or from home. This kind of anytime, anywhere, anyone access is essential for collaboration among a dispersed, sometimes globally, chain of design partners and suppliers, which is increasingly the norm for many manufacturers.

In addition, Cloud-based design tools often adhere to a subscription-based model, which is priced more flexibly than are traditional license fees, thus opening up the software to a wider number of users. Many Cloud-based product design tool platforms provide free, scaled-down capabilities intended to allow downstream users, suppliers, or customers to perform basic tasks and easily collaborate—again democratizing sophisticated digital capabilities to a wider audience.

## EASY INTERNAL AND EXTERNAL COLLABORATION

As most of us know from familiarity with Google apps and other Cloud-based software, It is far easier to share content in the Cloud than with traditional software. There is no need to email files or deal with cumbersome and inefficient check-in and check-out procedures common to traditional on-premise data management solutions like PDM or even shared file systems.

Users can access all data—MCAD models, ECAD files, or BOMs—securely from a single source of truth without any specialized viewers or unwieldy data translation procedures. This eliminates much of the friction with current systems, allowing anyone in the design chain to easily and securely share critical content. Because all feedback is merged to a single definition, there is no longer a need to manually chase down feedback and merge it into a single product model. Based on Lifecycle Insights research, that single task of merging review feedback from multiple peers can win back nearly six hours of time for the average engineer, restoring 15% of their work week, which enables them to focus more

*A significant advantage with Cloud-based solutions lies in the ability to quickly and easily share designs and other deliverables with anyone inside or outside the company. This accelerates collaboration in product development.*

intently on optimizing designs and other value-added tasks instead of on non-productive administrative work.

## LEVERAGING A SINGLE, UNAMBIGUOUS SOURCE OF THE TRUTH

Storing and accessing the latest version of design-related data and other relevant enterprise information from the Cloud eliminates one of the biggest bottlenecks in product development—having multiple, out-of-date files. A native Cloud architecture replaces the file-based structure of traditional PDM systems, which eliminates the cumbersome check-in, check-out procedures while still maintaining a single version of the truth. The ability to store and easily access design materials from a single place also eliminates the problem of having multiple out-of-date files floating around engineering circles. This reduces the possibility of errors and critical design flaws while eliminating extraneous time spent on manually merging and chasing down the most recent files.

## REDUCED IT SUPPORT

Traditional, on-premise systems require considerable handholding from IT. IT needs to take the lead on procuring, configuring, and managing the server hardware used to run the design software and play a hand in upgrading the software on individual systems on a yearly basis. In comparison, anyone can access a Cloud-based product development platform via a simple browser without any need for robust configuration. Updates, available on a much more frequent basis, are automatically distributed without IT intervention. Not only is there less work for IT, but users gain access to new design tool functionality far more quickly.

*Many Cloud-based solutions are maintained by the solution provider, relieving the onus of support from end customer companies.*

The Cloud's ease-of-deployment and ease-of-administration also helps engineering organizations recapture time to spend on design work, not on IT administration. In many companies, engineering serves as a rogue IT group, handling the administration work

related to its own software. With a Cloud-based system, that effort is unnecessary so engineers can focus on what they do best—designing products—not on extraneous housekeeping work.

## FASTER DEPLOYMENT

The Cloud enables individual users to get up and running on the design software more easily, and the subscription model also helps streamline what is typically a lengthy procurement process. Cloud-based software is available as a subscription service, meaning organizations pay for what they use. The model, while not always cheaper, eliminates the need for large-scale capital expenditures on costly server hardware to run the software and on upfront license fees. The Cloud model also means engineering organizations can dial up the number of licenses during peak periods of the design cycle and scale back when the need passes, which is a more flexible, efficient way of funding software expenditures.

*Updates to Cloud-based solutions occur on a certain frequency, often far more often than new software versions are released by solution providers. This provides faster access to new, and sometimes crucial, capabilities.*

## CLOUD-BASED PRODUCT DESIGN IS A REALITY

Just as other Cloud-based systems have gained traction in the enterprise, so too are Cloud-enabled product development platforms. Companies of all sizes and stripes are beginning to experiment and even standardize on Cloud-based design tools.

The 2019 Lifecycle Insights' Cloud Adoption Study found a significant uptick in use of Cloud-based product development platforms across the entire portfolio of capabilities. Document collaboration (viewing and markup) and design collaboration (viewing, interrogating, and markup) are by far the most popular, used by 46% and 45% of survey respondents, respectively. Engineers are also leaning heavily on Cloud-based MCAD and mechanical simulation tools, cited respectively by 32% and 31% of respondents. ECAD in the Cloud is slightly less established, cited by 27% of survey respondents.

Cloud-based product data management is also slightly behind, with only 28% of engineering organizations reporting current use of this functionality as part of a Cloud-based platform.

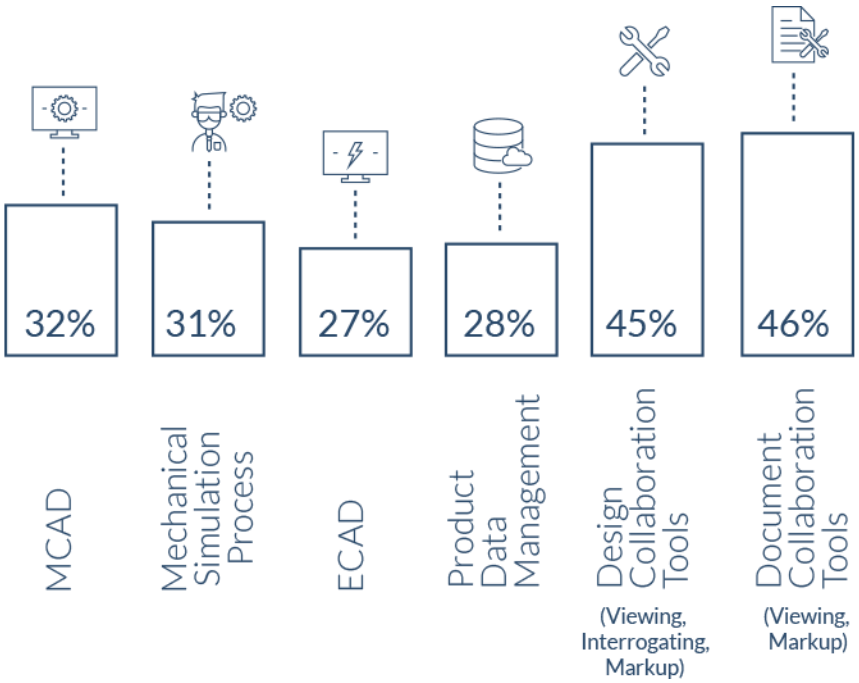



*Figure 7: Percent of Respondents using Cloud-Based Applications by Type,*
*The Cloud Study, 187 Respondents*

The push towards a Cloud-based development platform is real and much needed for digital transformation. Engineering organizations intent on advancing innovation will find that Cloud-based platforms help streamline processes and eliminate much of the non-value work that currently bogs down development efforts. Not only will Cloud-based solutions increase productivity and return a focus to value-added work, they also make it easier to iterate more designs in a much shorter time frame.

As a result, engineers are empowered to explore a greater number of design alternatives, more effectively and more quickly. This, in turn, leads to better products that are expressly tuned for specific audiences and that can be released to market in a timelier fashion.

*Many companies are either exploring or have already migrated to Cloud-based solutions in product development. It is far more prevalent than was previously conceived.*

# SUMMARY AND RECOMMENDATIONS

Engineering organizations are struggling to keep pace with the increasing complexity of product development. The products themselves are far more involved, combining sensors, electronics, and software to deliver intelligence and higher performance. At the same time, competition is steep, and companies are scrambling to define new categories with innovative solutions that are first to market.

While modern-day product development demands an accelerated track, traditional engineering processes aren't cut out for the task. The bulk of product development organizations still rely heavily on basic digital tools like spreadsheets, emails, and shared drives to exchange pertinent design data and materials and to facilitate key design processes. Some are using PDM systems.

Whichever the case, these established approaches have serious shortcomings. This often leads to projects that don't launch on time, take resources away from other important efforts, or miss target dates completely.

Among the problems with established product development practices:

- There is too much time spent on non-value tasks such as merging review feedback, manually inputting data, or chasing down relevant material from suppliers and partners. This puts engineers' focus on non-productive work instead of on optimizing designs and advancing innovation.
- Executing processes via email leads to a host of problems. Emails can be lost or ignored, and

*As shown by the PLM Study and the Cloud Adoption Study, there are significant improvement opportunities in product development. Cloud-based solutions offer tangible advantages over their on-premise peers.*

attachments become out of date. There is no single source of product data, and tracking down information leads to delays and non-productive busy work.

- Without a single source of the truth, engineers rely on incomplete data, which can lead to errors throughout development and cause product delays.

An alternative approach is an integrated Cloud-based platform that covers all the core functions of design, including MCAD, simulation, ECAD, product data management, design collaboration, and document collaboration. Such an approach offers significant benefits, including:

- A single source of truth
- Centralized accessibility from anywhere
- Easier internal and external collaboration
- Faster deployment
- Reduced need for IT support

Instead of struggling with existing design tools, engineering organizations should consider Cloud-based product development platforms as a springboard to digitally transform processes and accelerate innovation.

Chad Jackson is the chief analyst and researcher at Lifecycle Insights, providing insights on a range of technology-led initiatives across mechanical, electrical, embedded software, system, and IoT engineering.

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