How to Reduce
Non-Value-Added
Work in Engineering

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The Value of Engineering Time

Engineering Time Is a Valuable Asset

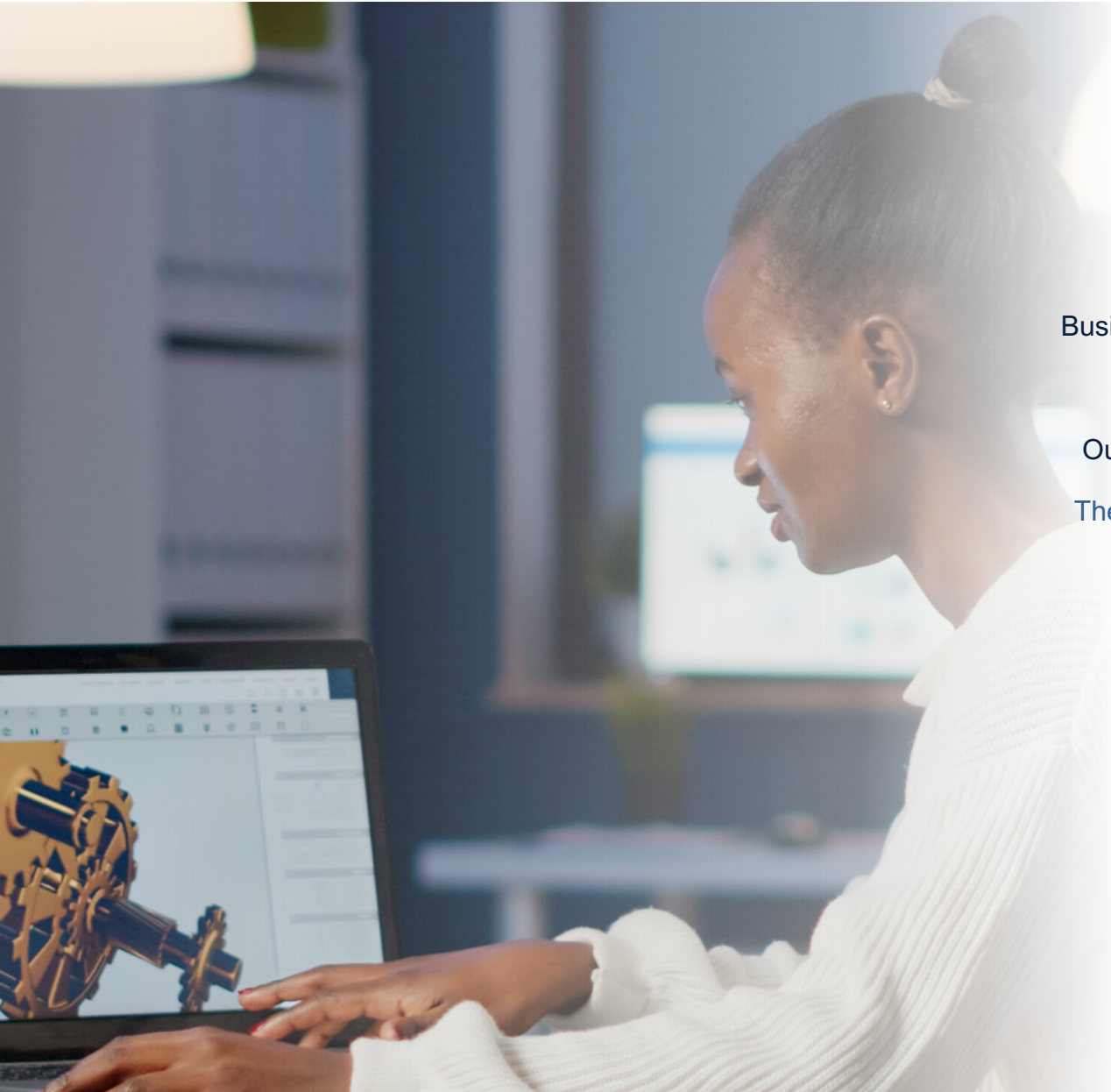How can you reduce non-value-added engineering work?

Engineers are under constant pressure to meet tight deadlines. They need time to balance quality, cost, and performance criteria as well as to innovate and solve problems. Unfortunately, they waste too much of their valuable time on non-value-added work. Imagine the opportunities if engineers could reduce those tedious activities to focus more energy on engineering work that leads to better designs.

This Research

Based on a survey of over 220 manufacturers, this research study examines how engineers spend their time. It identifies time-consuming activities that waste time and present opportunities for improvement. This research is an updated look at a study of 248 manufacturers conducted in 2014 and examines how trends have evolved over the last seven years.

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Executive Overview

Engineering Is Key to Competitive Differentiation

Today's market is so competitive; it is hard to stand out. To be successful, companies must empower their engineering teams to differentiate products on innovation, quality, performance, and cost. While finding the time to balance those criteria is challenging, many current processes make it even harder. Consequently, engineers report they waste a third of their time on non-value-added work, which is consistent with what we saw in 2014. Worse, 29% of their time is spent working with outdated information. It has become an even bigger problem than it was in 2014 when engineers reported working with outdated data 20% of the time. Unfortunately, this leads to even more wasted effort and rework.

Further, companies anticipate that going forward, 43% of engineering work will be done in flexible, work anywhere environments. This will only add to the complexity of engineering team environments, creating even more risk for outdated information and additional non-value-added work. Engineers need new ways of working.

One way companies can improve this situation is to provide engineers with real-time access to design data, in the right context. This keeps the data up-to-date and at their fingertips. The result should be increased engineering bandwidth, allowing more time to focus on making products more competitive. This approach also improves the growing need to improve collaboration beyond design engineers, with 83% saying it would be helpful if design data could be shared more easily with analysts and 86% wanting to share design data more easily with manufacturing.

Determining Best Practices

To determine best practices for accessing design information, Tech-Clarity analyzed survey responses from over 220 manufacturers to understand how they manage data, communicate engineering changes, and collaborate with both internal and external development team members.

The research shows that to improve efficiency, companies who are most successful, Top Performers, are 56% more likely than their lesser performing competitors to enable real-time access to design information and 52% more likely to adopt a platform of integrated engineering tools.

What Can You Learn from This Research?

This report explores best practices for streamlining access to design data in real-time. It also exposes some challenges manufacturers should be aware of as they strive to maintain a competitive edge in today's complex and cutthroat environment. The report also reveals how manufacturers can plan for a modern design environment that will support them through the 2020s.

Engineers report they waste a third of their time on non-value-added work. They need new ways of working.
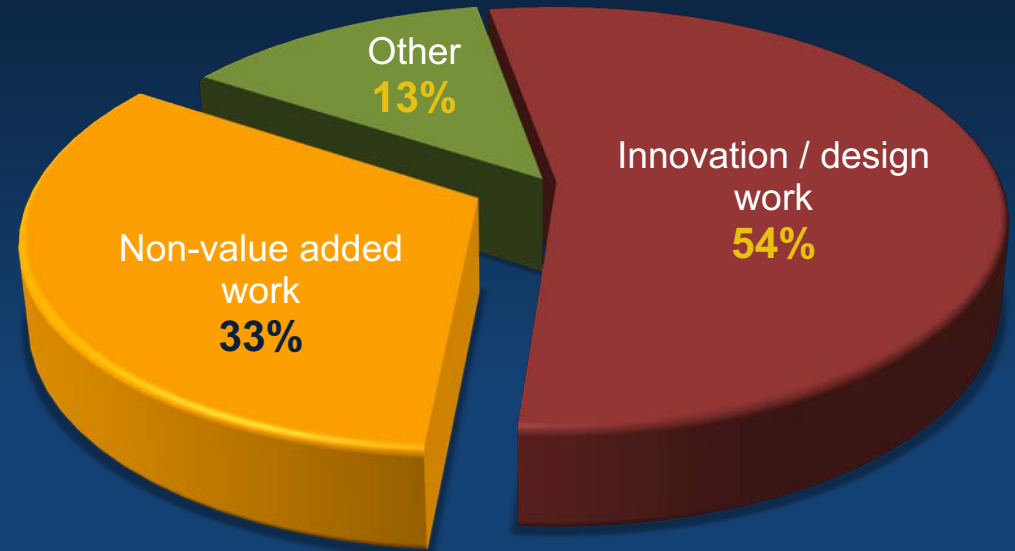
Identify Bottlenecks

Engineering Time

As we saw in 2014, engineers continue to spend a surprising 1/3 of their time on non-value-added work. Undoubtedly, there is much opportunity for improvement. By identifying where much of that wasted time goes, companies can focus their improvement efforts so engineers spend more time on work that adds value to the overall product development process.
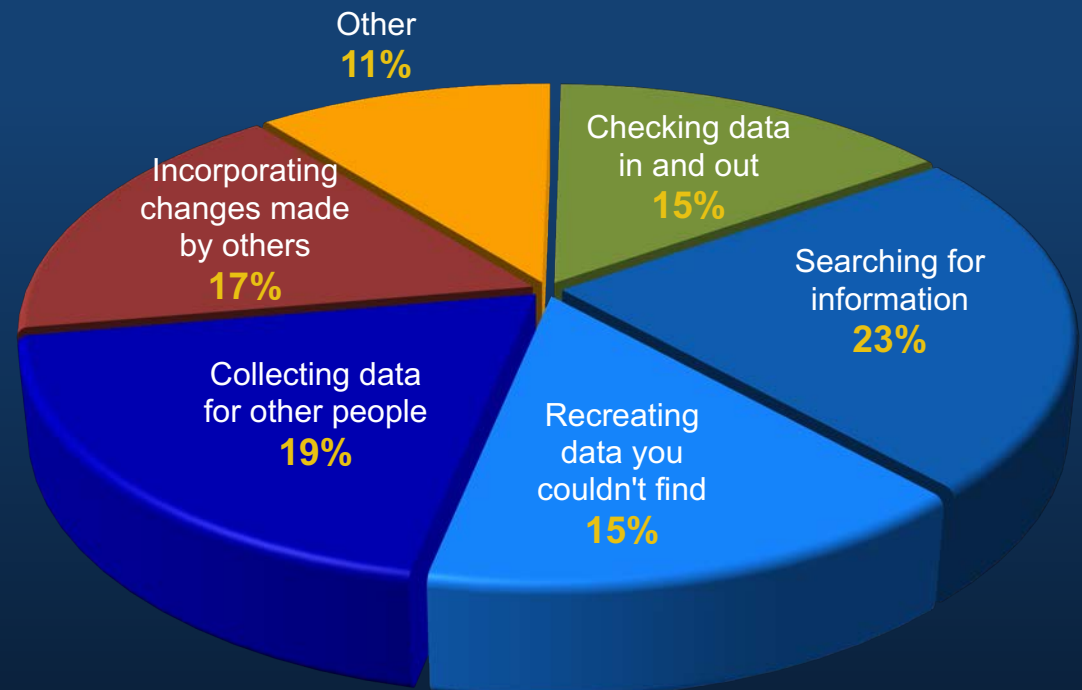
Non-Value-Added Engineering Time

A more in-depth analysis of that non-value-added time reveals that poor data management practices are a significant contributor (see lower chart). These challenges have continued to remain consistent since 2014. Interestingly, what is changing is that companies report that going forward, they expect 43% of engineering work will be done in flexible, work-anywhere environments, including working from home. This distributed environment can put engineering data at even more risk for becoming outdated. These distributed environments may also require additional steps to ensure IP remains secure. All of this creates further need for businesses to improve how they manage their engineering data so that the problems do not worsen.

HOW ENGINEERS SPEND THEIR TIME

Other
13%

Innovation / design work
54%

Non-value added work
33%

BREAKDOWN OF NON-VALUE-ADDED TIME

Other
11%

Checking data in and out
15%

Searching for information
23%

Incorporating changes made by others
17%

Collecting data for other people
19%

Recreating data you couldn't find
15%

Assess Non-Value-Added Time

Let's take a deeper dive into the data management practices that contribute to non-value-added work:

23% **Searching for information:** Engineers need access to a significant amount of product data to complete their work, beyond just CAD data. This includes product specifications, requirements, material specifications, engineering change requests, bills of materials (BOMs), supplier information, other components, and more. With so much to manage, it's not surprising that searching for data is a common bottleneck.

19% **Collecting data for other people:** Engineers are often asked to bring information to meetings for others or to prepare reports for management. Much time is needed to collect data for status updates, design reviews, and project meetings. With trends showing that engineers will spend more time working outside the office, collecting data could become even more time-consuming. Related to this, engineers also waste much time preparing data for others, such as analysts and manufacturing personnel. We will explore this in the next section.

15% **Checking data in and out:** Some companies use Product Data Management (PDM) or Product Lifecycle Management (PLM) systems to centralize data and make it easier to find and access. To continue design work or make changes, engineers must first check out and download the relevant CAD files. After making changes, the file must then be uploaded and checked back in so that others have access to it. This whole check-in/check-out process can be tedious and time-consuming, especially if CAD files are large. Data check-ins will be explored further in this report.

17% **Incorporating changes made by others:** With the fast pace of product development, changes can be constant, but they are not always communicated. For example, during a project meeting, an engineer may discover that a coworker changed the BOM. That change has to be reflected in the CAD model as it may impact other parts of the design. In another scenario, perhaps after a change is made to the PCB layout, the housing no longer fits. Seemingly small changes may significantly impact the rest of the design, especially if the design evolved a lot before others became aware of the change. Engineers waste much time when they do not immediately see changes made by others. In some cases, they may have to redo hours of work.

15% **Recreating data you couldn't find:** Recreating work can be incredibly frustrating. No one wants to redo work because the data was either lost or misplaced. This can happen when data is stuck on personal laptops or home computers, stored on external drives that others do not have access to, or no one can remember where it was stored. Additionally, search features on shared drives can't search metadata and may be insufficient to find specific files and information.

Preparing Data for Others
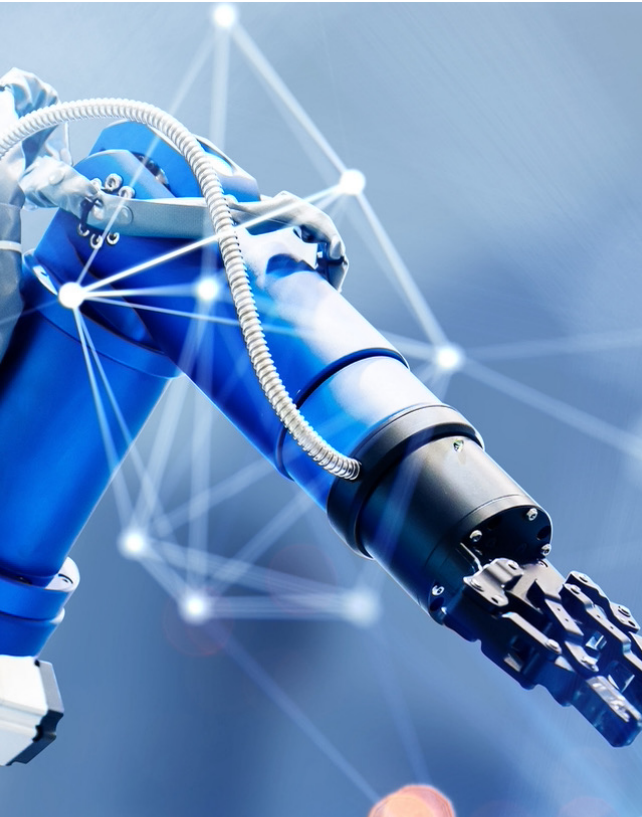
More Non-Value-Added Work

In addition to managing data, engineers also waste much time preparing data for others. Two common reasons involve preparing data for simulation analysts or handing it off to manufacturing.

Simulation: 10.7 Hours

Simulation continues to grow as an important engineering tool. Tech-Clarity's *How to Survive and Win New Markets by Getting Even More Value from Simulation*, reveals that 44% of companies find the most critical design decisions have gotten harder. Further, when comparing problem-solving methods, companies are 3.7 times more likely to point to simulation as the ideal way to solve problems. While simulation takes time, in the end, that time is worth it because it will lead to a better, higher-quality product. It saves time by finding problems sooner, when they are easier and less costly to fix. However, there are still opportunities to improve the simulation process, particularly when handing off data.

Companies using simulation report engineers spend 2.1 hours exporting, preparing, and sharing models with analysts. They also exchange models with analysts 5.1 times over the course of a typical development project. This means 10.7 hours are spent exchanging models

for each development project. As a result, it is not surprising that 83% say it would be helpful if design data could be shared more easily with analysts.

Manufacturing: 11.2 Hours

Engineers must also collaborate with manufacturing. Over the course of a product's lifecycle, they report they share data with manufacturing eight times on average. This includes requirements to send data to both internal production teams and third-party manufacturers. It also covers the multiple components that go into a product as well as iterations due to errors. Each time data is sent, engineers spend 1.4 hours exporting, preparing, and sharing it so that over the course of a product's lifecycle, 11.2 hours are wasted just exchanging data with manufacturing. Like with simulation, 86% say it would be helpful if design data could be shared more easily with manufacturing.

Opportunity to Save 21.9+ Hours

Just these two examples reveal an opportunity to save 21.9 hours if it was easier for engineers to share data. Now imagine all the other use cases engineers have to share data such as with each other, across disciplines, procurement, marketing, documentation, and more. It is a significant time sink that takes time away from valuable design work.

83% would find easier ways to share data with analysts helpful and 86% would like easier ways to share data with manufacturing.

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Business Value of Eliminating Non-Value-Added Work

Eliminating Manual Data Management Tasks Create Business Value

Manufacturers agree that if all the manual tasks associated with managing data were reduced, including searching for it, checking it in and out, and sharing it, their company would benefit. The findings are consistent with those in 2014 and reveal the significant business value of engineering time.

Business Value of Eliminating Manual Data Management Tasks

Interestingly, in 2021, 100% of manufacturers see business value in reducing this non-value-added work.

BUSINESS VALUE OF ELIMINATING MANUAL DATA MANAGEMENT TASKS

Category	Value
Faster time to market	58%
Lower product development cost	57%
Better product quality	47%
Reduced product cost	42%
Increased sales margins / profitability	28%

100% of manufacturers see business value in reducing this non-value-added work.

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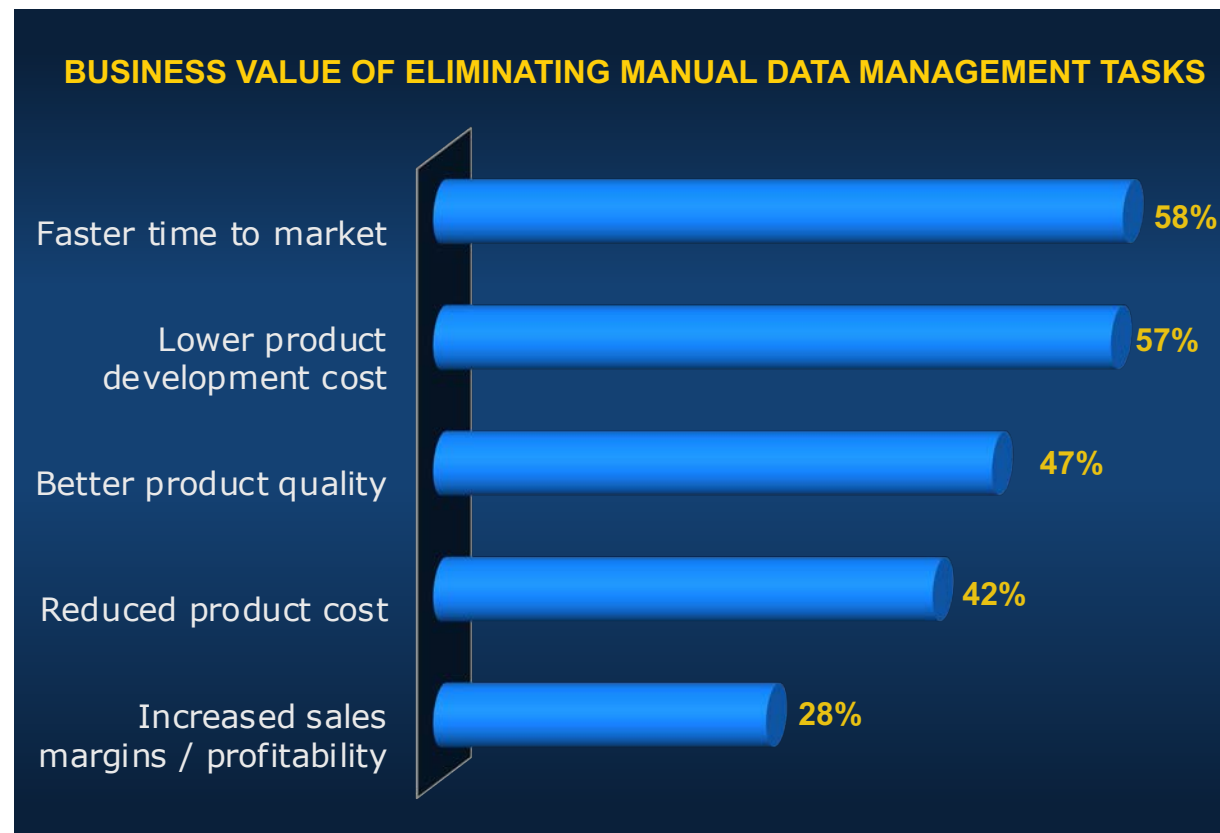
Recognize the Time Required for Check-ins

Check-ins Can Be Time-Consuming

Exploring the potential opportunity for minimizing manual data management tasks, checking data in and out can also slow things down. Thirty-three percent (33%) of survey respondents report they wait more than 10 minutes as data is checked-in. Product complexity has a significant impact on check-in time as seen in the table below.

Product Complexity	Average Check-In Time in 2014	Average Check-In Time in 2021
Simple (< 50 components, 5 or less configurations)	4 Minutes	7 Minutes
Medium (51 to 500 components, 6-50 configurations	18 Minutes	24 Minutes
High (> 501 components, 50 or more configurations	49 Minutes	53 Minutes

The Impact of Complexity

In a traditional data management solution, check-ins have been an essential part of keeping models up-to-date. However, as products increase with complexity, check-ins take more time. Check-in times are also taking longer compared to 2014. This likely another reflection of growing complexity. As time has progressed, and tools have improved, even more data is embedded in models. This trend is likely to continue, which means check-ins will continue to get even more painful.

Also, greater complexity usually means sharing changes with a larger development team. Consequently, the importance of keeping models up-to-date also grows with complexity. Engineers need methods to ensure models are kept up-to-date without disrupting their workflow with long delays due to check-ins. Tools that worked well ten years ago may no longer be enough to handle the growing complexity of today's products and design models.

33% of those surveyed report they wait more than 10 minutes as data is checked-in.

Outdated Information Impacts Engineering Changes

The Challenges of Engineering Changes

Engineering changes magnify the problems with outdated models. If data cannot be relied upon to be current, additional time is needed to search for the latest version. Worse, changes made using outdated data must be redone on the newest version, wasting even more time and effort.

The top challenges of executing engineering changes highlight these points (see graph). The challenges have remained relatively consistent, but now the time needed to find all the information to support a change has become even more of an issue. This is likely reflective of increasing product and environment complexity. With more components, engineering disciplines, and configurations, additional data is needed to make the change. Plus, as the engineering environment has become more distributed, it takes longer to locate all of the required data. This eats up time before you can even begin to think about the change.
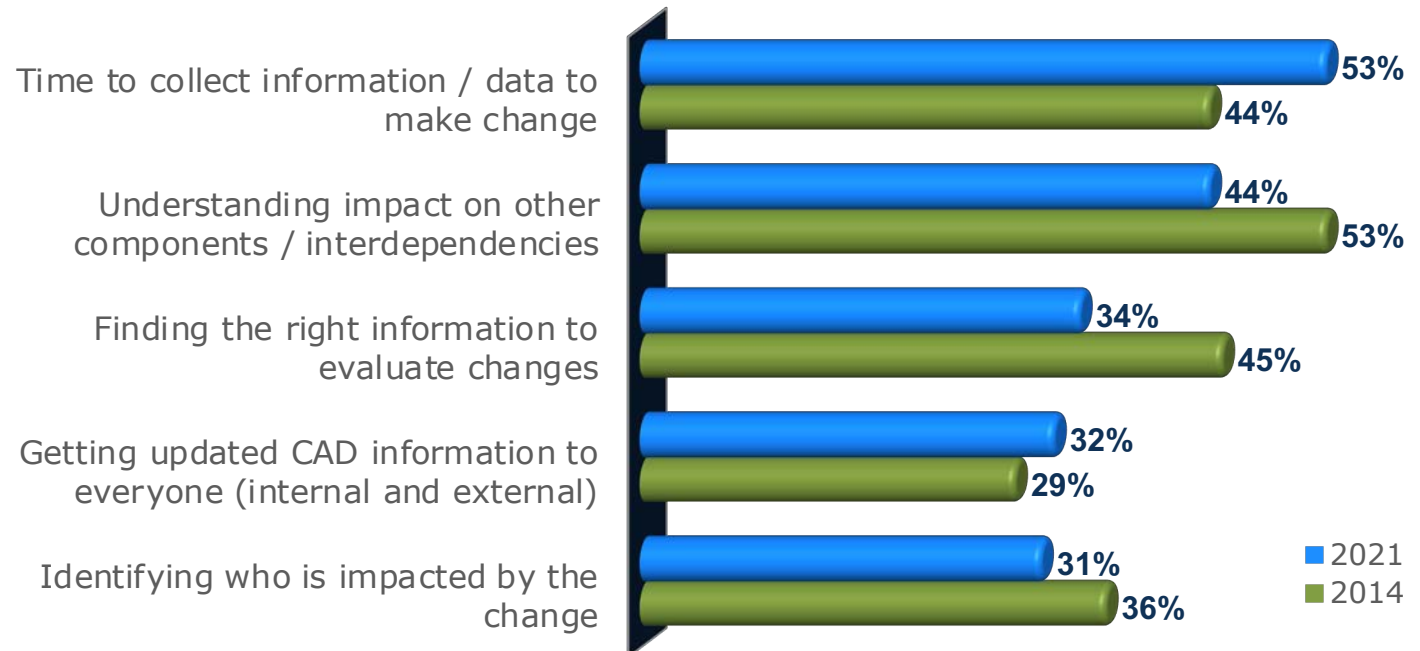
Engineers Need Up-to-Date Information

After implementing a change, respondents report that it can take 4.7 days to get changed information to the entire team for simple products and 10.3 days for complex products. Given the speed at which engineers must work today, this is too long and creates significant risk that engineers will work with outdated data. Emphasizing this pain, an overwhelming 94% report they want the data sooner, with 46% wanting it in real-time.

For simple products, it takes **4.7 days** to get changed information to the entire team.

94% need the data faster.

TOP 5 CHALLENGES OF EXECUTING CHANGES

Challenge	2021	2014
Time to collect information / data to make change	53%	44%
Understanding impact on other components / interdependencies	44%	53%
Finding the right information to evaluate changes	34%	45%
Getting updated CAD information to everyone (internal and external)	32%	29%
Identifying who is impacted by the change	31%	36%

■ 2021
■ 2014

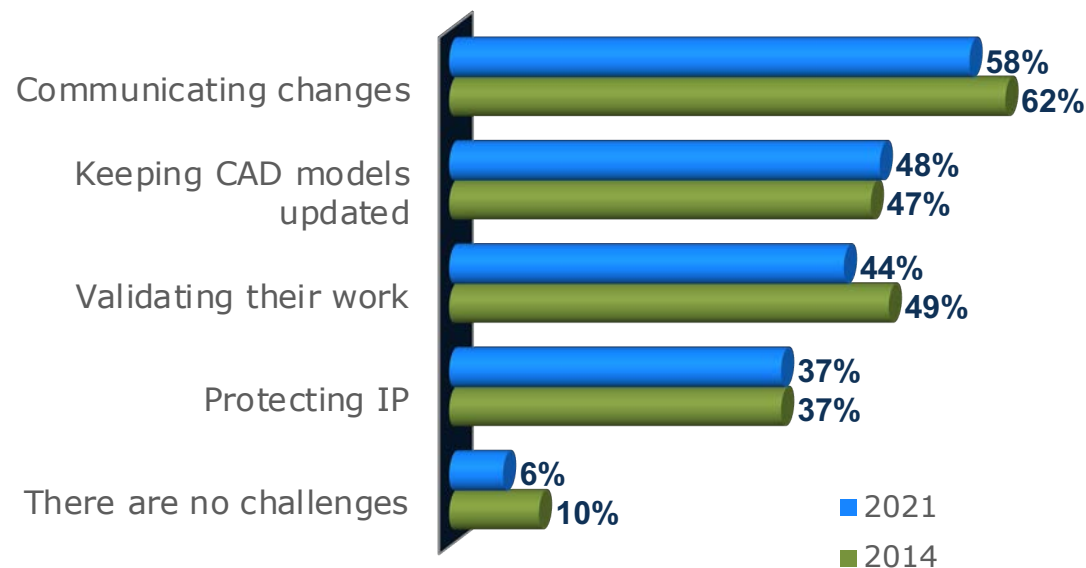HOW-TO REDUCE NON-VALUE-ADDED WORK IN ENGINEERING

The Impact of Outdated Information on Collaboration

Third-Party Collaboration Bottlenecks

Problems with communication and outdated information get even worse when working with third parties. As we saw in 2014, communicating changes, keeping CAD models updated, and validating their work, are the most common problems when working with third parties.
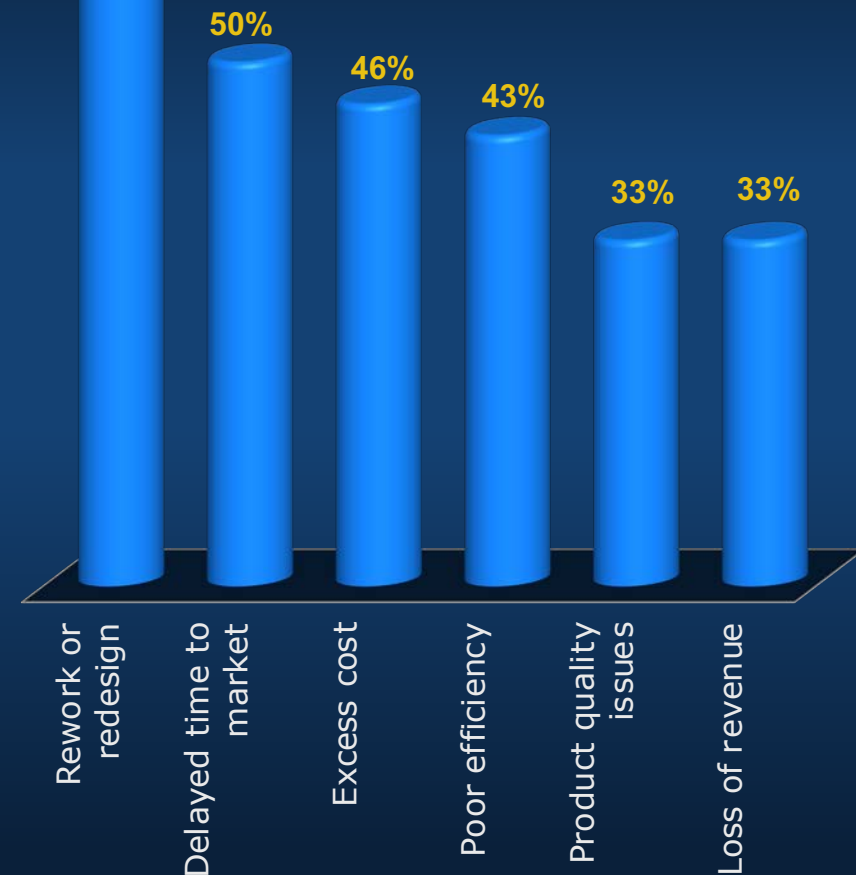
TOP CHALLENGES INVOLVING THIRD PARTIES

Communicating changes — 58% (2021), 62% (2014)
Keeping CAD models updated — 48% (2021), 47% (2014)
Validating their work — 44% (2021), 49% (2014)
Protecting IP — 37% (2021), 37% (2014)
There are no challenges — 6% (2021), 10% (2014)

■ 2021
■ 2014

The Cost of Collaboration Bottlenecks

Companies need better means for communicating, especially when third parties are involved. Unfortunately, third parties tend to be slow to share updates. On average, third parties wait 5.8 days to send updated information, forcing engineers to work with outdated information. With delays in communication from internal engineers and third parties, engineers will inevitably work with outdated information. In fact, they report that 29% of the time, their data is outdated. This is even worse than seven years ago when engineers said they worked with outdated information 20% of the time. The business impact is felt in many areas (see graph).

BUSINESS IMPACTS OF OUTDATED INFORMATION

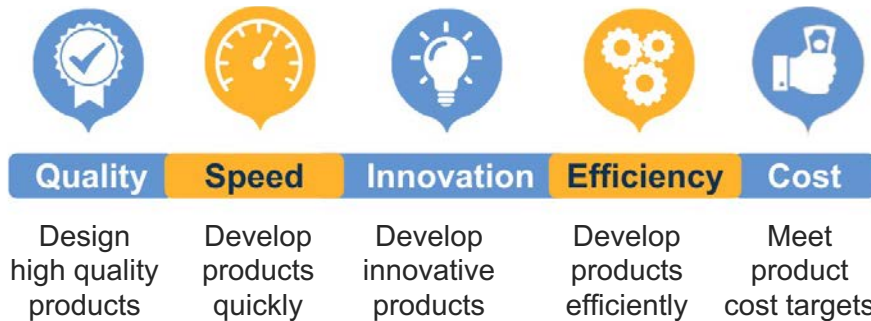| Category	Value
Rework or redesign	66%
Delayed time to market	50%
Excess cost	46%
Poor efficiency	43%
Product quality issues	33%
Loss of revenue	33%

Engineers report, on average, 29% of the time they work with outdated information.

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Identifying the Top Performers

Pillars of Profitability

Tech-Clarity analyzed five metrics to identify manufacturers that use their engineering resources most effectively and the top 20% best performing companies were defined as Top Performers. Participants evaluated their company's performance compared to their competitors on their ability to:

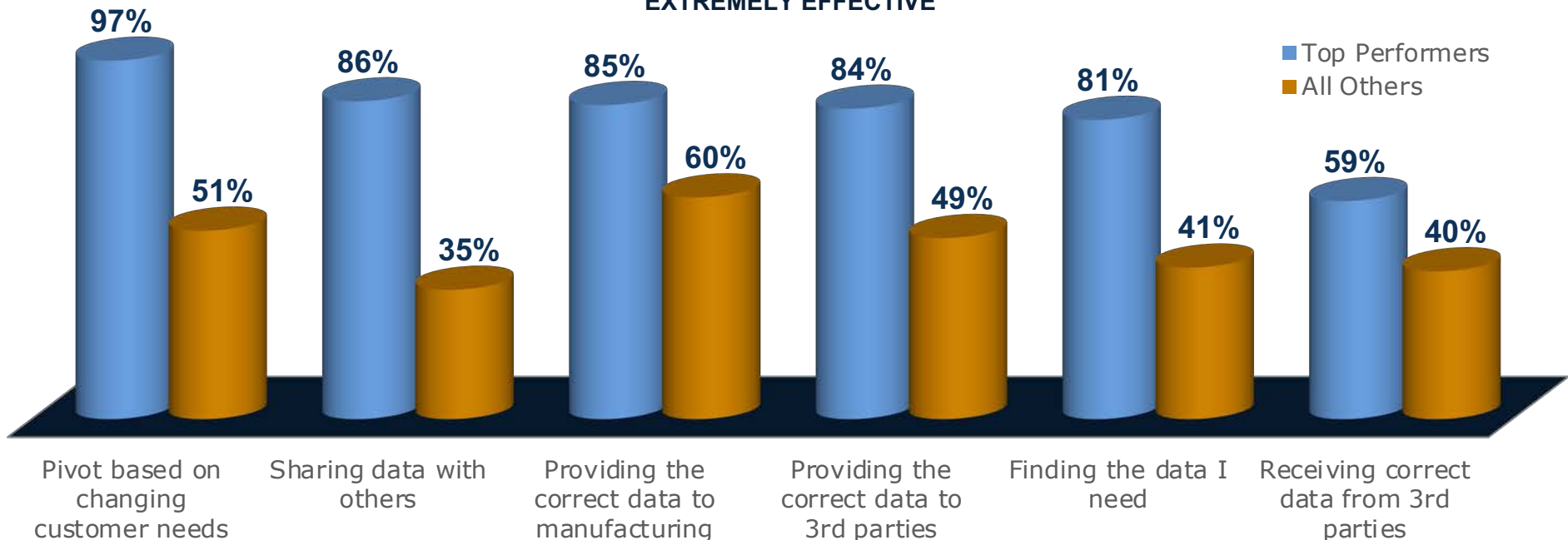| Quality	Speed	Innovation	Efficiency	Cost
Design high quality products	Develop products quickly	Develop innovative products	Develop products efficiently	Meet product cost targets

What Sets Top Performers Apart?

Top Performers are more effective at managing their design data and processes. When asked to score the effectiveness of their processes, Top Performers are far more likely to rate them as "Very Effective" or "Extremely Effective."

Top Performers are more agile so they can quickly respond to changing market and customer needs. They can also find the data they need, share it with others, and provide the correct version to manufacturing and suppliers. These results indicate that effective data management are an important enabler for designing and developing profitable products.

PERCENTAGE OF RESPONDENTS RATING PROCESSES AS "VERY EFFECTIVE" OR "EXTREMELY EFFECTIVE"

Legend:
- ■ Top Performers
- ■ All Others

Category	Top Performers	All Others
Pivot based on changing customer needs	97%	51%
Sharing data with others	86%	35%
Providing the correct data to manufacturing	85%	60%
Providing the correct data to 3rd parties	84%	49%
Finding the data I need	81%	41%
Receiving correct data from 3rd parties	59%	40%

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Strategies to Improve Efficiency
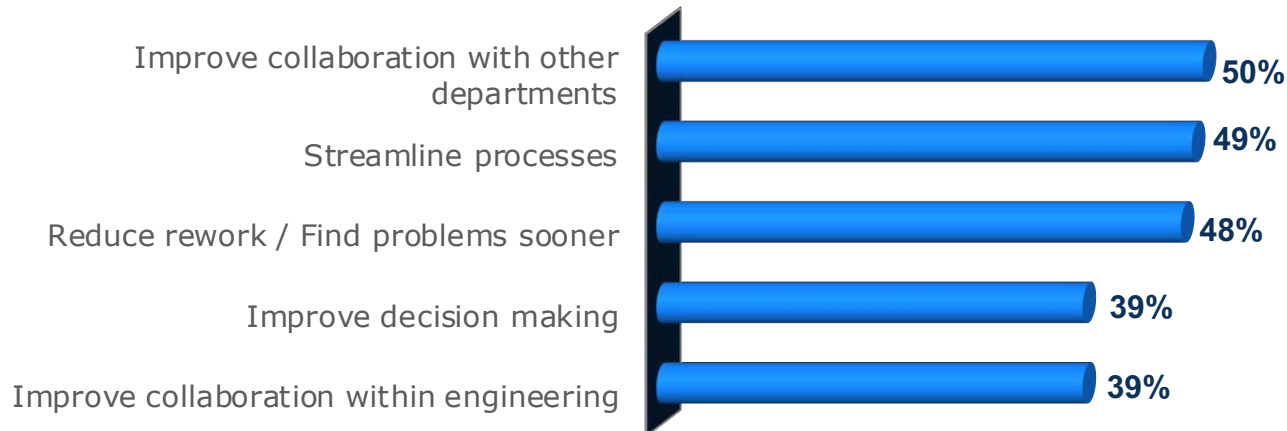
Top Strategies

Given how much time engineers waste on non-value-added work, an overwhelming 98% agree they need strategies to improve product development efficiency. Interestingly, companies agree with what those strategies should be, regardless of their performance (see top graph).
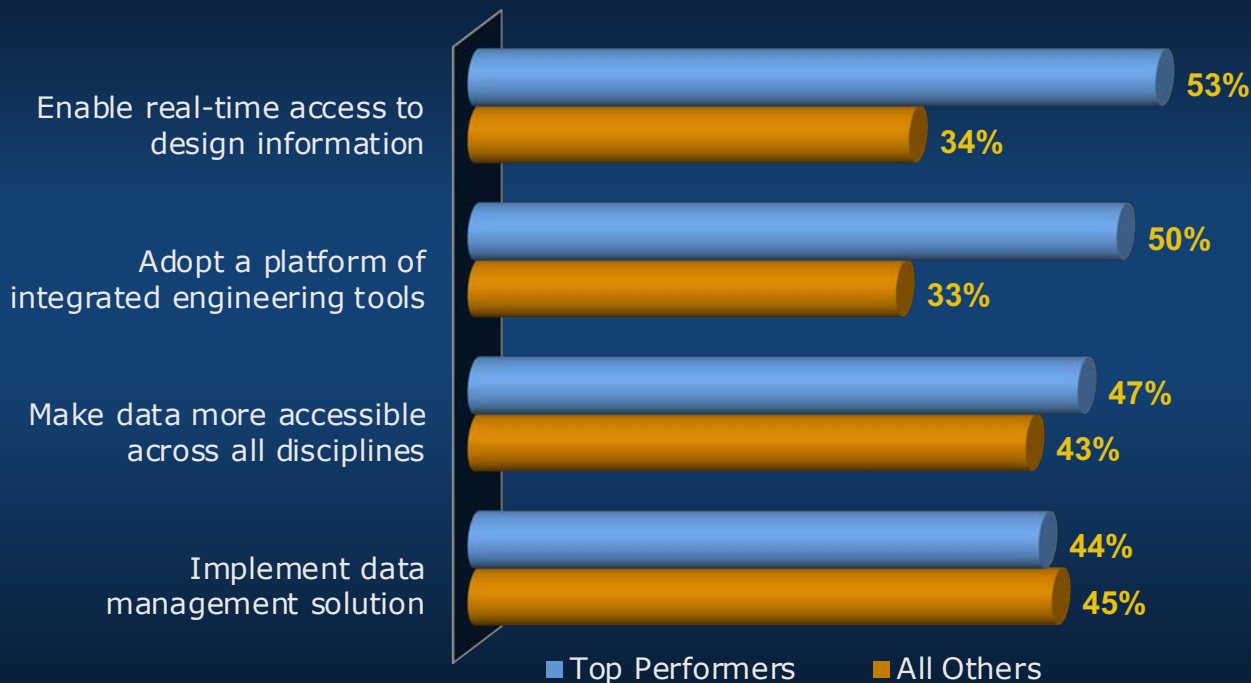
Difference in Execution

The performance difference is due to how they execute those strategies. Top Performers are 56% more likely than

TOP STRATEGIES TO IMPROVE PRODUCT DEVELOPMENT EFFICIENCY

Strategy	
Improve collaboration with other departments	50%
Streamline processes	49%
Reduce rework / Find problems sooner	48%
Improve decision making	39%
Improve collaboration within engineering	39%

HOW TO EXECUTE STRATEGIES

Strategy	Top Performers	All Others
Enable real-time access to design information	53%	34%
Adopt a platform of integrated engineering tools	50%	33%
Make data more accessible across all disciplines	47%	43%
Implement data management solution	44%	45%

■ Top Performers   ■ All Others

All Others to enable real-time access to design information. They also are 52% more likely to adopt a platform of integrated engineering tools. Having everything they need on a central platform that stays up-to-date in real- time means everyone has access to what they need, when they need it, without searching. Analysts and engineers can work off a single platform, and manufacturing accesses what they need. No one has to worry about outdated data.

Interestingly, just having a solution in place to manage data is becoming less of a differentiator for Top Performers so that now it is almost a requirement for today's product development. What sets Top Performers apart are the qualities of that solution, specifically the integration with other tools and real-time updates.

HOW-TO REDUCE NON-VALUE-ADDED WORK IN ENGINEERING

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Technology as a Collaboration Solution

Support Real-Time Communication

Following the strategies, the table to the right shows the three most common methods for sharing changes to CAD models with team members. Top Performers are more likely than peers to communicate changes as real-time updates to CAD models, an increase from 66% in 2014 to 73% now. They are likely to use PLM or PDM too, but the gap is closing. Email also continues to be a common method, which will be discussed further on the next page.

Collaborating with Third Parties

When sharing CAD models with third parties, the collaboration methods are much different, as seen in the lower table. Everyone is more likely to use email than any other method. However, compared to their lesser performing competitors, Top Performers are more likely to use PLM and 3.8 times as likely to have the CAD models update automatically. Since 2014, Top Performers have increased their adoption of real-time updates in CAD models from 35% to 45%. This trend is likely to continue as technologies, such as the cloud, make it easier to work with third parties.

INTERNAL COMMUNICATION

Communication Method	Top Performer	Others
CAD models update in real-time	73%	55%
Managed in PLM/PDM	53%	50%
Email	63%	52%

EXTERNAL COMMUNICATION

Communication Method	Top Performer	Others
CAD models update in real-time	45%	12%
Managed in PLM/PDM	32%	25%
Email	77%	70%

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Consider the Security Risks of Email

Email is Easy, but Puts Intellectual Property (IP) at Risk

While PLM and PDM are powerful tools, there are some limitations the latest generation of PLM tools seek to solve. Many using PLM or PDM still use email to communicate changes internally and externally. The simplicity and speed of email make it an attractive option.

In some cases, email is a helpful notification tool. However, when used as a mechanism for sending data, there are risks, including lack of security, limited visibility, and poor version control. The common use of email could suggest that engineers need an easier means to share data. The latest generation of PLM tools seeks to provide this better mechanism for sharing data.

Email and the Cloud

Tech-Clarity's *Empower Engineers with Cutting Edge Design Tools* finds that overwhelmingly, product development teams believe the ideal way to share design information is by sending a link to view the data in a web browser. This approach combines the simplicity of email, without losing control of your data and avoiding many of the security concerns created by email. The survey question used for the results on the previous page did not specify whether email was used to share models by sending a link or by attaching CAD files to an email. However, the increase in real-time CAD model updates combined with the continued use of email suggests that Top Performers are migrating to a cloud platform that would enable this so that they are able to email links rather than models.

Of those using PLM or PDM to share changes to CAD models:

- 53% also use email internally
- 57% also use email externally

The Benefits of Real-Time Data Updates

Support Real-Time CAD Updates

Real-time updates are an important differentiator for Top Performers. They are 56% more likely to maintain up-to-date models than their peers. Because of this, Top Performers are less likely to waste time fixing models due to outdated information. An integrated design and development environment can support real-time updates.

Benefits of an Integrated Design and Development Environment

A cloud-based, integrated design and development environment allows engineers to design concurrently, in context, in real-time.

As a result, manufacturers overcome the data management challenges that contribute to non-value-added work, helping them:

- Improve productivity
- Shorten development time
- Reduce the cost of product development

Engineers don't have to worry about check-ins and check-outs as design data is available in real-time. They can see the impact of their changes in real-time, along with both internal and external development team members. They are not wasting time searching for data or recreating work. Instead, they can focus their efforts on innovation and other design criteria to make products more competitive.

> " The integrated design and development environment is the latest evolution of product innovation and engineering software. It offers the advantages of integrated design tools combined with product data and lifecycle management "

Integrating Product Design and Development Environments
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59% Percent of Top Performers updating models in real-time or hourly

31% Percent of Others updating models in real-time or hourly

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Recommendations

Recommendations and Next Steps

Based on industry experience and research for this report, Tech-Clarity offers the following recommendations:

- Understand how engineers spend their time and improve processes and collaboration to minimize time wasted on non-value-added work.

- Consider solutions such as PLM or PDM to centralize design information and support change management and collaboration.

- Evaluate options to design components in the context of the overall assembly. This will improve collaboration, make it easier to identify interdependencies between components, and provide a better understanding of the impact of changes.

- Consider technologies that enable real-time updates to keep CAD data up-to-date while minimizing or eliminating check-in times.

- Establish means for secure, real-time collaboration with both internal teams and third parties to minimize delays in getting updated CAD data from them and assuring your IP is protected.

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About the Research

Data Gathering

Tech-Clarity gathered and analyzed responses to a web-based survey from over 226 manufacturers. Survey responses were collected by direct e-mail, social media, and online postings by Tech-Clarity.

Industries

The respondents represent a broad cross-section of industries. 29% were from Industrial Equipment, 28% Automotive, 14% Aerospace & Defense, 16% High-Tech, 15% Energy, 11% Consumer Products, 10% Life Sciences, and others.*

Company Size

The respondents represent a mix of company sizes, including 59% from less than $250 million, 11% between $250 million and less than $1 billion, and 30%

greater than a billion. Company sizes were reported in US dollar equivalent.

Geographies

Responding companies report doing business in North America (51%), Asia (42%), Western Europe (26%), Eastern Europe (10%), Middle East (13%), Australia (10%), Africa (8%), and Latin America (7%).*

Title

The respondents were comprised of 12% Executive, 11% Directors or VP Level, 26% Manager level, and 51% individual contributors.
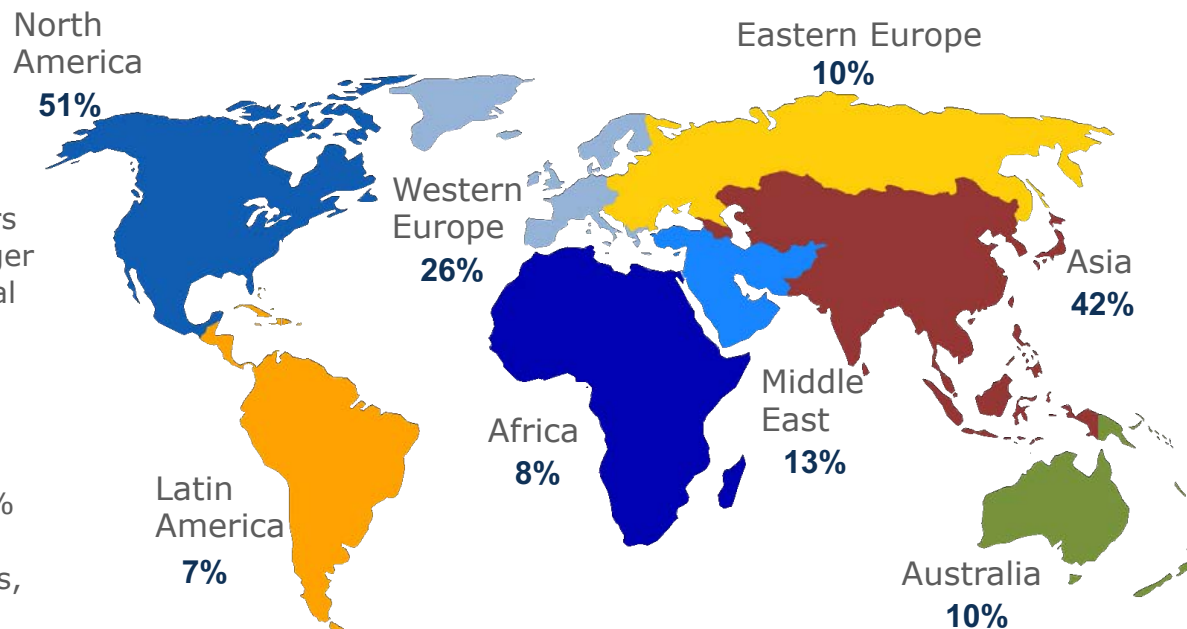
Organizational Function

Of the respondents, 50% were in Product Design/Engineering roles, 13% Manufacturing

Engineers, 14% Manufacturing, and the remainder were from a variety of other roles including Industrial Design, Analysts, IT, Quality, Service, Marketing, and more.

* Note that the values may total greater than 100% because companies reported doing business in multiple industries and geographies.

The respondents represented a mix of industries, company sizes, and geographies.

North America
51%

Western Europe
26%

Eastern Europe
10%

Asia
42%

Middle East
13%

Africa
8%

Latin America
7%

Australia
10%

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Acknowledgments

About the Author

Michelle Boucher is the Vice President of Research for Engineering Software for Tech-Clarity. 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. We analyze how companies improve innovation, product development, design, engineering, manufacturing, and service performance through the use of digital transformation, best practices, software technology, industrial automation, and IT services.

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About this eBook This is an update to our report *Reducing Non-Value Added Work in Engineering: Improving Efficiency with Real-Time Access to Design Information, originally published in 2014* and the updated eBook, *How-to Guide: Increase Profitability By Reducing Non-Value Added Work in Engineering* published in 2018.

2S SOLIDWORKS

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