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The Digital Transformation of Product Design:
How are design teams using and planning for design technology fueled by data?

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EXECUTIVE SUMMARY

Digital transformation has already begun. The time of localized, fractured, siloed product development is coming to an end. Unified platforms and new technology that pool data, allowing for input from diverse stakeholders – from engineering, through supply chain, to operations, and even those external to organizations are already being adopted.

This research has shown that while this transformation is underway, it's still in its early days. Most development teams have access to their data (91%) but less than a third can easily access it. This is in part due to most teams relying on systems that lack integration (73%). Is it any wonder that 66% of teams admit that they don't have timely and accurate access to key-performance-indicator data?

Despite adoption challenges, the participants in this study clearly believe in the promise of data-fueled product development. When asked about the various ways cloud-based PLM will enhance product development, they said 10 out of 11 benefits will have a moderate to revolutionary impact on their business.

How exactly development teams will implement data-fueled technology like machine learning, AI, and the digital twin has yet to be precisely determined, but there is hope they'll help prevent product quality failures and improve service and maintenance.

What are teams sure about when it comes to digital transformation? They want to trace data from new product development through to commercialization. Lucky for them, that technology already exists. They just need to add it to their technology stack.

The remainder of this report details engineering.com's survey of 358 product design professionals and the investigation that led to the findings above. Written to help executives who oversee product design and product design practitioners, you can use these results to benchmark your own product design process and identify opportunities to better leverage data to achieve better business outcomes.

Thanks for reading.

Roopinder Tara
Director of Content, engineering.com
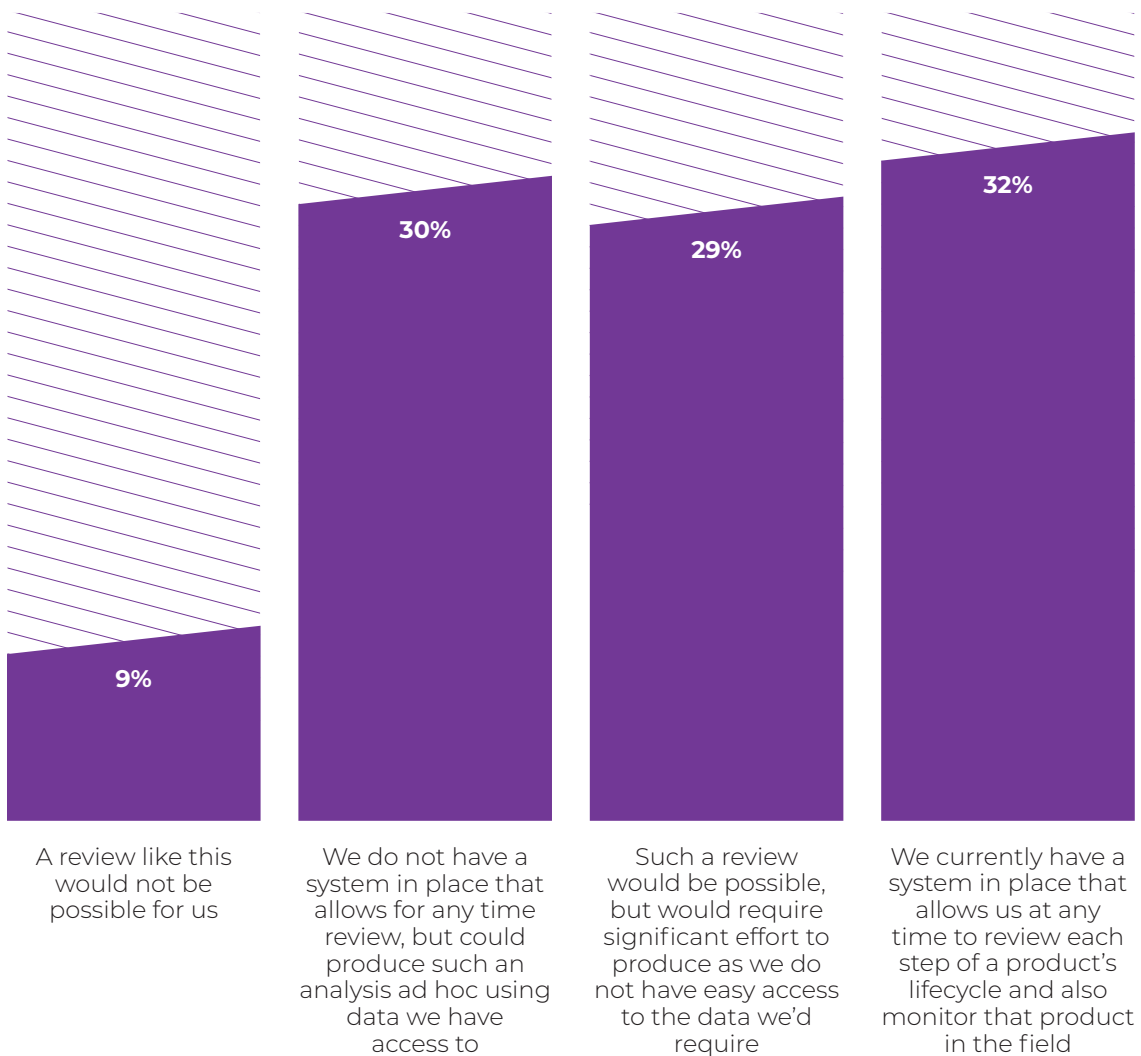
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How Well Are Product Development Teams Using Data Today?

MOST TEAMS HAVE THE ABILITY TO TRACE A PRODUCT THROUGHOUT ITS LIFECYCLE. HOW EASILY THEY DO THAT VARIES GREATLY.

Before you can draw insight from product development data, you have to have access to it. The good news is that 9 out of 10 teams have the ability to trace a product through its development cycle. How easily they manage that varies, however.

The table below lists the means by which teams trace a product through its lifecycle. The teams in this study were fairly evenly split between the three levels of access.

9%	30%	29%	32%
A review like this would not be possible for us	We do not have a system in place that allows for any time review, but could produce such an analysis ad hoc using data we have access to	Such a review would be possible, but would require significant effort to produce as we do not have easy access to the data we'd require	We currently have a system in place that allows us at any time to review each step of a product's lifecycle and also monitor that product in the field

Question: Do you currently have the ability to trace a product from ideation and requirements gathering through to design, and finally through to manufacturing and commercialization and servicing?

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54% OF PRODUCT DEVELOPMENT TEAMS LACK PROPER TOOLS FOR TRACKING DATA SOURCED AS PART OF THE DEVELOPMENT PROCESS.

There are numerous sources of data that are fed into the product development process. Some of these are thoroughly entrenched and common sense, such as input from the design team. Others, rely on the latest technology, for example the automated monitoring of social platforms and forums.

In total, respondents were asked about how they track data from seven different sources. This data was pooled to produce the chart below. Amazingly, 54% of teams are either neglecting to track their data (no formal system, 18%) or relying on 30-year-old (or older) technology (emails/spreadsheets, 36%) to track critical inputs to the development process.
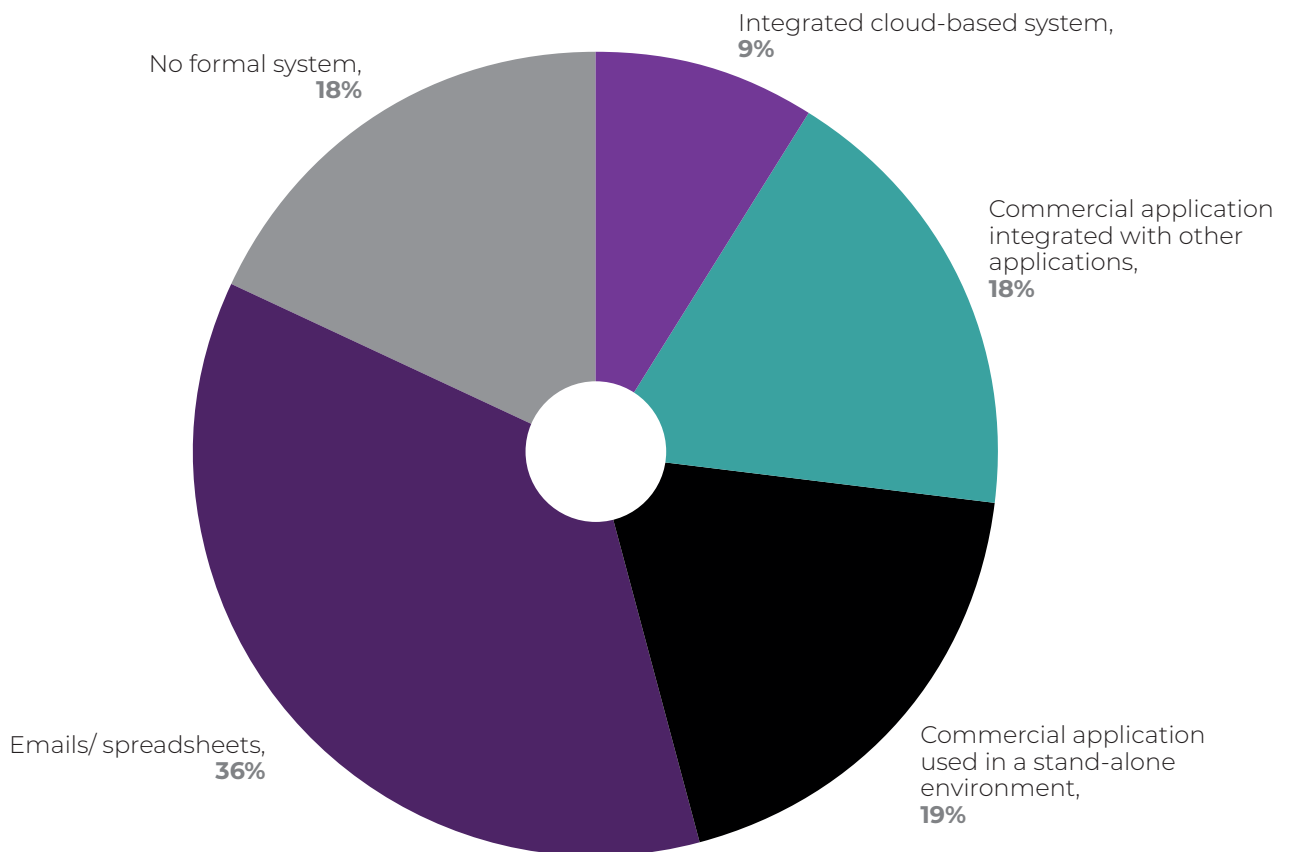
Question: How does your company track the data from each of the following sources as part of your product development process?

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PRODUCT DEVELOPMENT TEAMS PAY THE LEAST AMOUNT OF ATTENTION TO EXTERNAL DATA SOURCES.

Survey respondents identified the type of system used to track data from each of the seven sources below. The score to t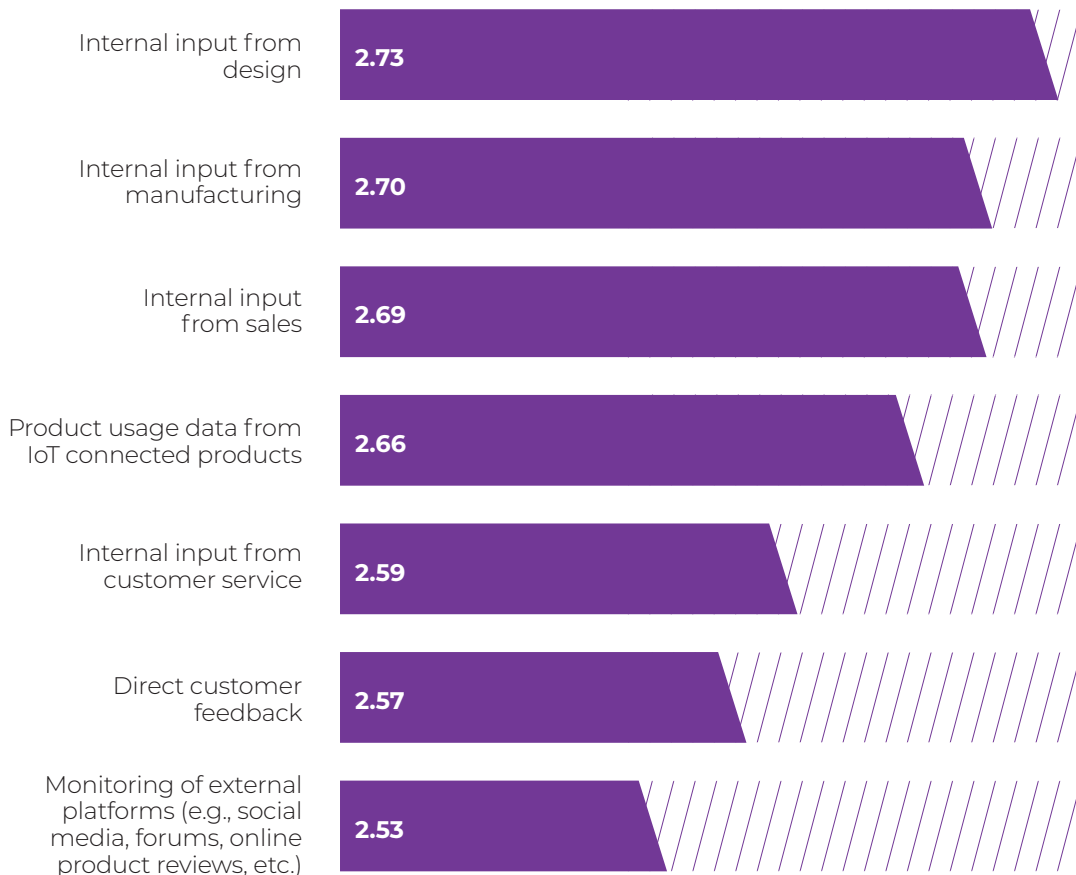he right is the average sophistication of data tracking across all respondents, where a score of 5 represents the most sophisticated system available (integrated cloud-based) and 1 represents the least (no formal system).

As you can see, product development teams are using more sophisticated systems overall to track internal data, while using less sophisticated solutions for external feedback.

This result reveals a breakdown in product development data management. Incredibly valuable external data is often scattered and harder to analyze. A sophisticated system that makes the pooling and interpretation of this data easier would be a major boon to most teams. This reveals an opportunity for product development teams to gain advantages over their competition.

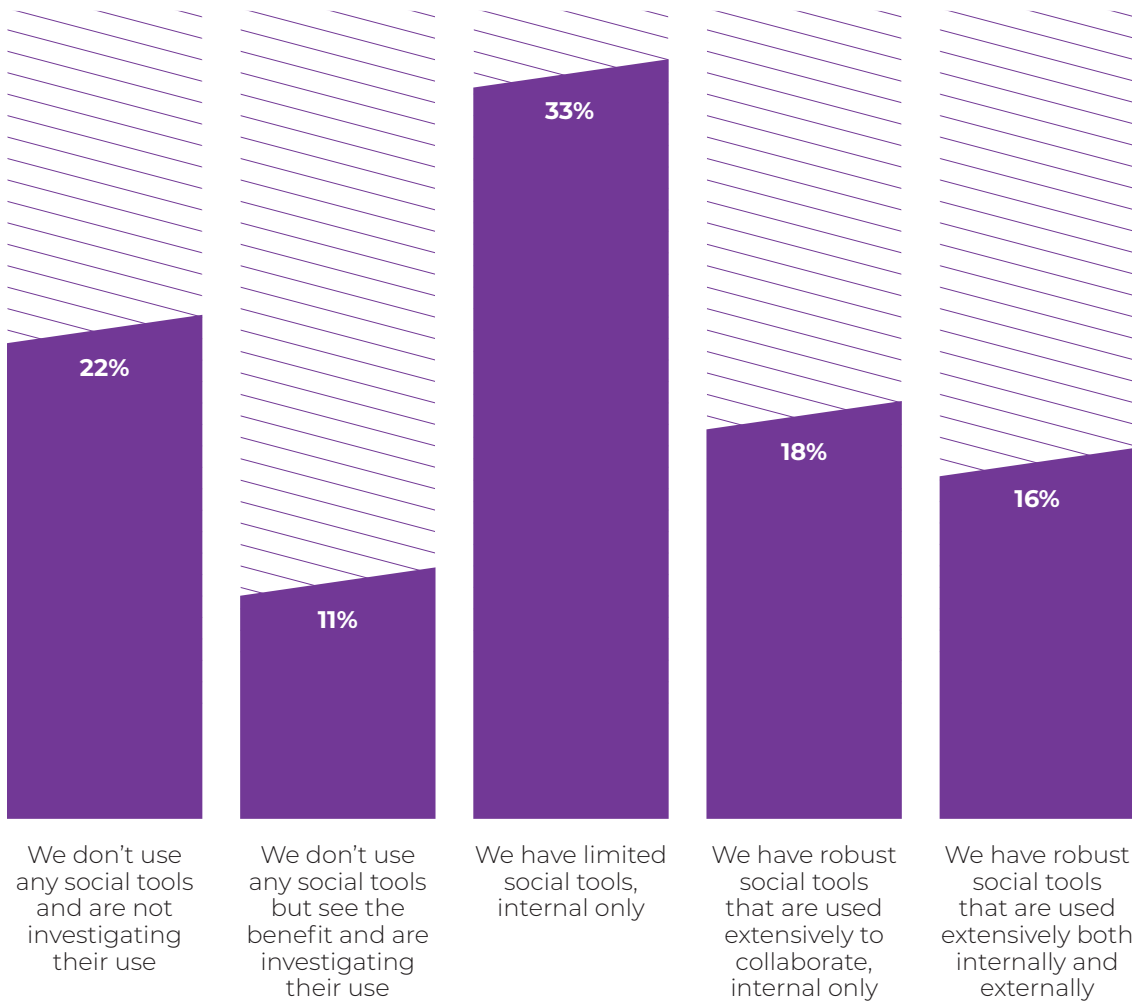| Source	Score
Internal input from design	2.73
Internal input from manufacturing	2.70
Internal input from sales	2.69
Product usage data from IoT connected products	2.66
Internal input from customer service	2.59
Direct customer feedback	2.57
Monitoring of external platforms (e.g., social media, forums, online product reviews, etc.)	2.53

Question: How does your company track the data from each of the following sources as part of your product development process?

TWO OUT OF THREE PRODUCT DEVELOPMENT TEAMS LACK ROBUST SOCIAL TOOLS FOR COLLABORATION.

Products aren't developed in isolation. Today's product development teams need to take into consideration input from diverse stakeholders across their own organizations and beyond.

Despite this, 22% of teams don't have any social tools and aren't investigating their use. Another 11% don't have them today but are investigating their use. A combined 51% of teams have either limited (33%) or robust tools for internal collaboration, but lack a means to gather external feedback (18%). That leaves only 16% of development teams capable of easily gathering feedback from all stakeholders. In a collaborative world, that's a very low percentage.

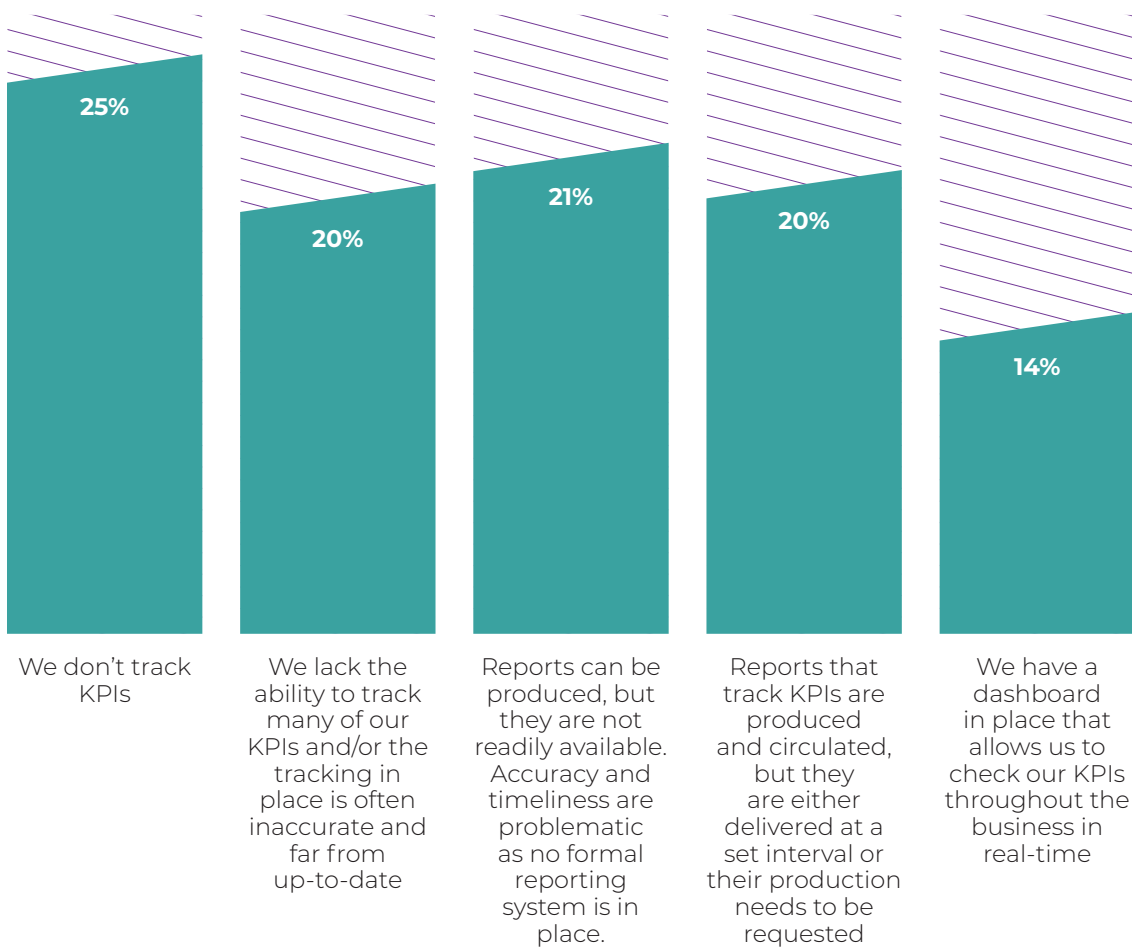|				
22%	**11%**	**33%**	**18%**	**16%**
We don't use any social tools and are not investigating their use	We don't use any social tools but see the benefit and are investigating their use	We have limited social tools, internal only	We have robust social tools that are used extensively to collaborate, internal only	We have robust social tools that are used extensively both internally and externally

Question: How easy is it to collaborate internally and externally for new product development, perform change management, and make changes based on the voice of the customer?

ONLY 34% OF PRODUCT DEVELOPMENT TEAMS HAVE TIMELY AND ACCURATE KEY PERFORMANCE INDICATOR DATA.

Key performance indicators (KPIs) provide quantifiable measures that a team can use to determine how well they're fairing against specific business objectives. Teams can then employ this feedback to inform their decision making process. With more accurate and timely the data, the better the decisions being made.

Despite the obviousness of the relationship between timely, accurate information and decision making, only 14% of teams report using a dashboard with real-time KPI data. Another 20% rely on reports that are produced and circulated either on a set schedule or are produced *ad hoc*. That leaves 66% of teams relying on old and often inaccurate data, or no data at all in the case of 25% of teams.

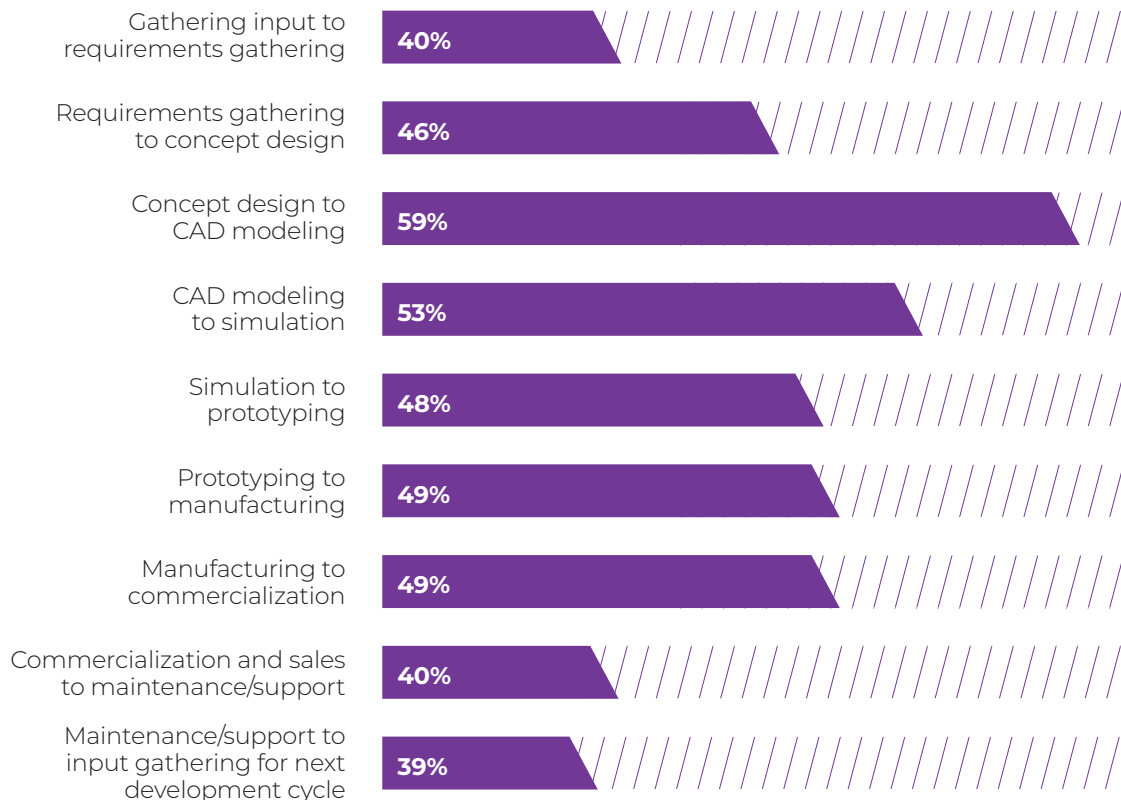| 25%	20%	21%	20%	14%
We don't track KPIs	We lack the ability to track many of our KPIs and/or the tracking in place is often inaccurate and far from up-to-date	Reports can be produced, but they are not readily available. Accuracy and timeliness are problematic as no formal reporting system is in place.	Reports that track KPIs are produced and circulated, but they are either delivered at a set interval or their production needs to be requested	We have a dashboard in place that allows us to check our KPIs throughout the business in real-time

Question: What best describes your company's ability to measure key performance indicators (KPIs) for cross-functional PLM processes (e.g. time-to-market and product life lifecycle cost)?

LESS THAN 50% OF PRODUCT DEVELOPMENT TEAMS BELIEVE THEY'RE EFFICIENT AT PASSING DATA BETWEEN STEPS OF A PRODUCT LIFECYCLE

We broke down the product lifecycle into nine steps and asked the study's participants to rate their organization's efficiency in passing data between each step. Across all steps, the number of teams that rated their organization as efficient or very efficient was 47%.

The table indicates what percentage of teams said they were efficient at transferring data between each step.

That the least efficient flow of data occurs at the beginning and end of a product's lifecycle should trouble product development professionals. These periods are critical for ensuring product development heads down the right path, with internal targets (e.g. KPIs) being attenuated to and external needs (customer requirements) being incorporated into the design process.

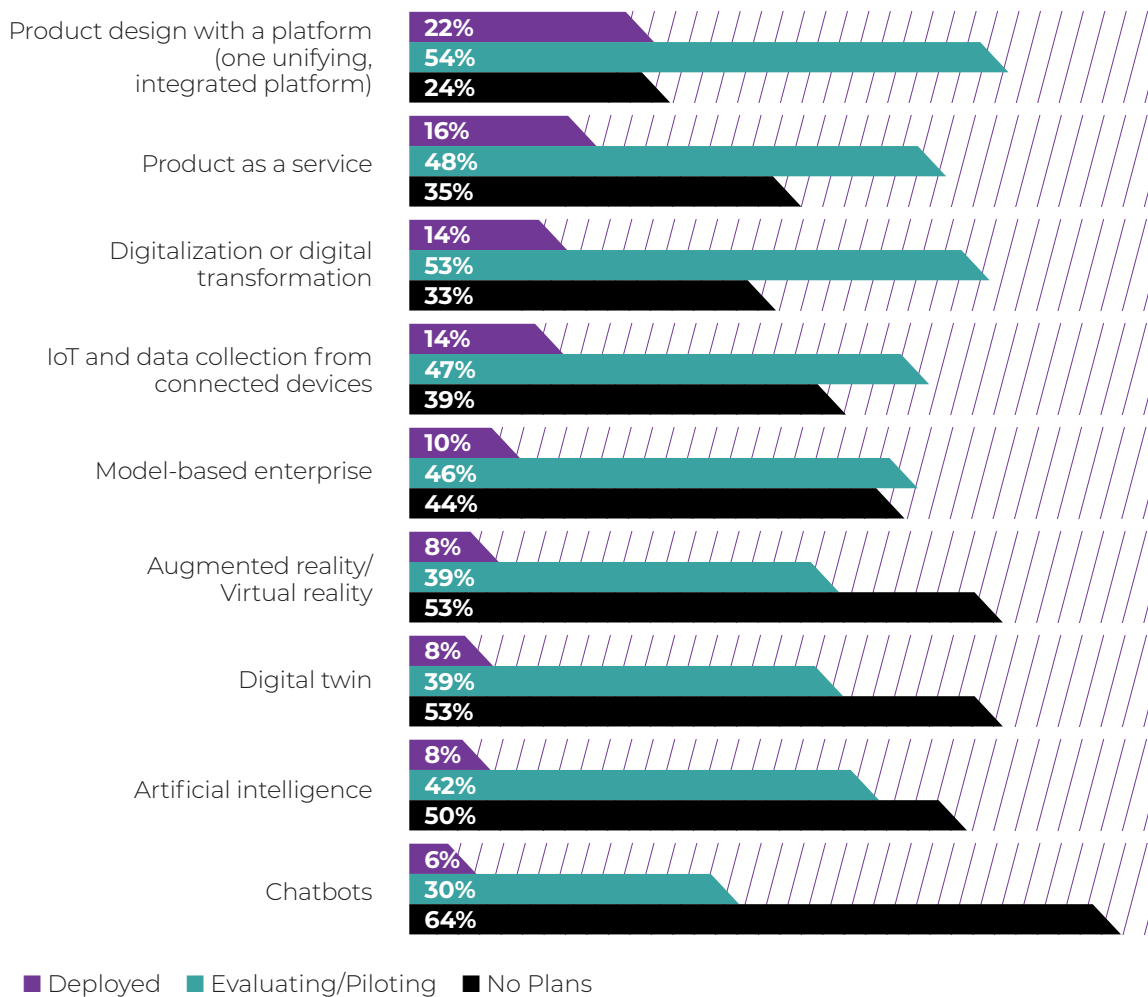|	
Gathering input to requirements gathering	40%
Requirements gathering to concept design	46%
Concept design to CAD modeling	59%
CAD modeling to simulation	53%
Simulation to prototyping	48%
Prototyping to manufacturing	49%
Manufacturing to commercialization	49%
Commercialization and sales to maintenance/support	40%
Maintenance/support to input gathering for next development cycle	39%

Question: There are many steps in the lifecycle of a product. How efficient is your organization in passing information from each step in the process to the next, as defined here?

PRODUCT DEVELOPMENT TEAMS ARE CURIOUS OF NEW APPROACHES AND TECHNOLOGY ENABLED BY DATA, BUT FEW FULLY DEPLOY THEM

The previous pages have shown that most product development teams are still in the early days of adapting to the wealth of data now available to them. Given this, the results in the table below are not surprising. Teams are trying a great deal of new approaches/technologies enabled by data, but few are fully deployed.

It's a good sign that product design with a single unifying, integrated platform is the most deployed technology. A single platform makes data integration much easier, thus enabling the other technologies listed in the table that much easier to try and deploy.

Technology	Deployed	Evaluating/Piloting	No Plans
Product design with a platform (one unifying, integrated platform)	22%	54%	24%
Product as a service	16%	48%	35%
Digitalization or digital transformation	14%	53%	33%
IoT and data collection from connected devices	14%	47%	39%
Model-based enterprise	10%	46%	44%
Augmented reality/ Virtual reality	8%	39%	53%
Digital twin	8%	39%	53%
Artificial intelligence	8%	42%	50%
Chatbots	6%	30%	64%

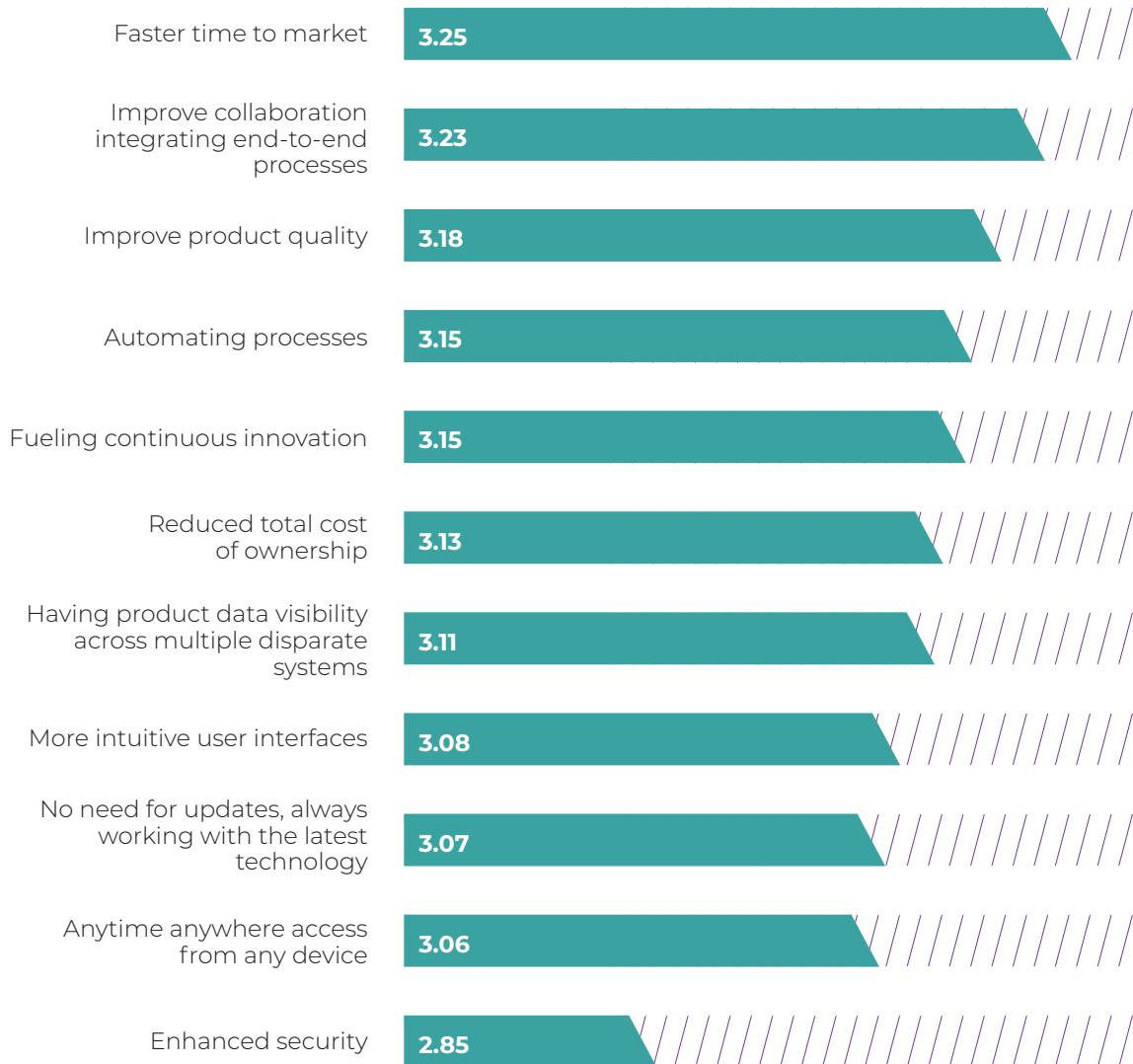■ Deployed   ■ Evaluating/Piloting   ■ No Plans

Question: What approaches and technologies are your company considering for product development?

What data-driven technology are teams looking forward to tomorrow?

TEAMS ANTICIPATE PLM IN THE CLOUD TO HAVE A MAJOR IMPACT ON THEIR PRODUCT DEVELOPMENT SUCCESS.

PLM in the cloud is expected to benefit the product development process in numerous ways. Respondents were asked to what extent PLM in the cloud will impact their own business. They were given a five point scale ranging from "no impact at all" (1) to "revolutionary impact" (5).

The table below shows the average scores across all respondents. As you can see, teams are expecting benefits across the board, with 10 of 11 benefits expected to result in "moderate" (3) or greater impact to the business' success.

Benefit	Score
Faster time to market	3.25
Improve collaboration integrating end-to-end processes	3.23
Improve product quality	3.18
Automating processes	3.15
Fueling continuous innovation	3.15
Reduced total cost of ownership	3.13
Having product data visibility across multiple disparate systems	3.11
More intuitive user interfaces	3.08
No need for updates, always working with the latest technology	3.07
Anytime anywhere access from any device	3.06
Enhanced security	2.85

Question: Here is a list of the anticipated benefits of PLM in the cloud. For each benefit, how great of an impact would it have on the success of your product development?

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THE TOP PRIORITY FOR AI AND MACHINE LEARNING IS NEW PRODUCT DEVELOPMENT TO COMMERCIALIZATION.

Product development teams answered resoundingly that when it comes to prioritizing applications in need of artificial intelligence (AI) and machine learning (ML).

In ranking the six priorities below, the difference in average ranking from #1, new product development to commercialization, was greater than the distance from #2, governing data and managing change control, to #6, digital manufacturing.

1 New product development to commercialization

2 Governing data and managing change control

3 Risk management

4 Predictive maintenance

5 Products as services

5 Digital manufacturing

Question: Rank the following primary uses for machine learning and artificial intelligence as they may apply to your business.

PRODUCT DEVELOPMENT TEAMS HOPE TO USE AI AND MACHINE LEARNING TO PREVENT FAILURES AND BREAKDOWNS.

Respondents were asked to rank six uses for AI and machine learning as they applied to each respondent's business. Predicting quality failure to improve product development was the most popular response, ranking as the first or second for 42% of all respondents in the survey. "Predicting product launch success" was ranked first or second by 25% of the respondent.
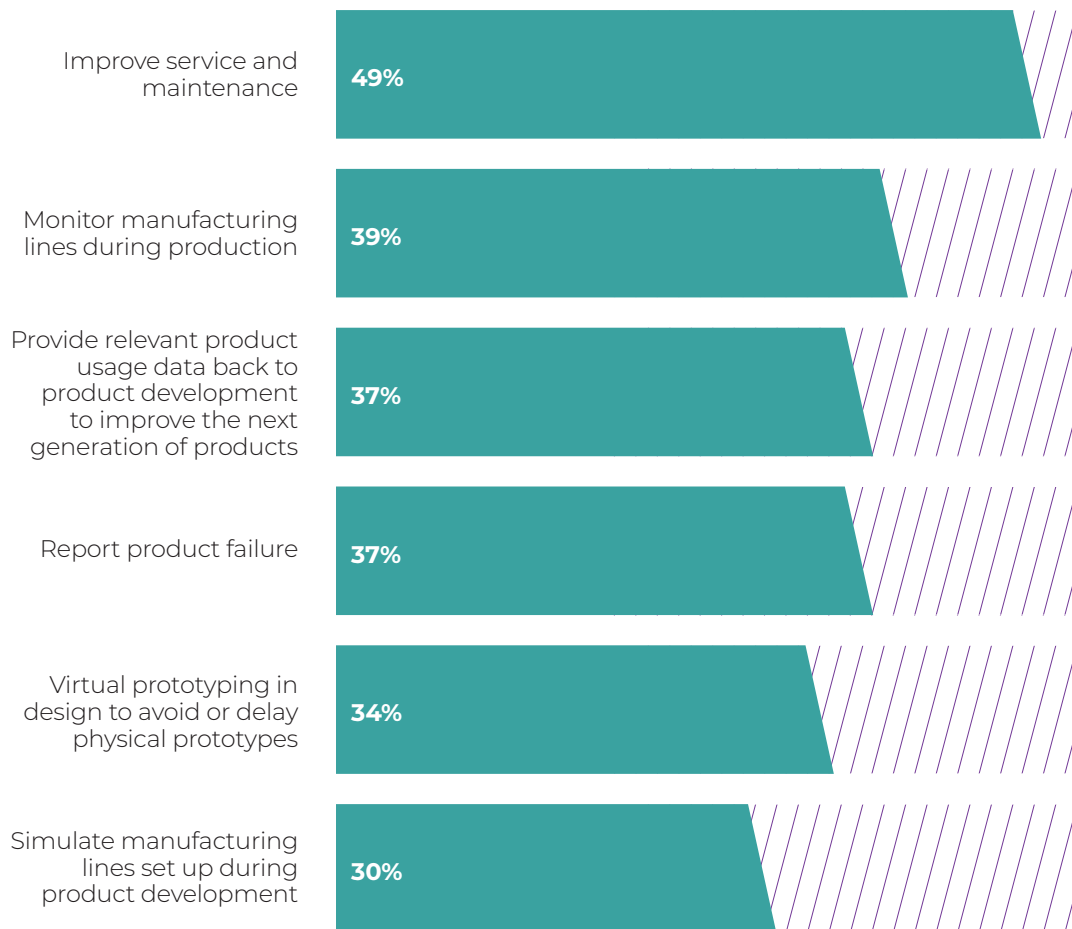
1 Predict quality failure to improve product development

2 Predict and improve manufacturing uptime and throughput

3 Target specific design activity based on feedback

4 Improve predictive maintenance

5 Create product(s) as a service offering

5 Predict product launch success

Question: Rank the following primary uses for machine learning and artificial intelligence as they may apply to your business.

LARGER ORGANIZATIONS PLAN TO LEVERAGE DIGITAL TWIN SOONER THAN SMALLER ORGANIZATIONS.

Sensors enable connected products to generate massive amounts of data for analysis. This data can be fed to a digital twin of the physical device. Digital twins allow for a number of benefits, ranging from the simulation of manufacturing lines to improved service and maintenance. The larger your organization and market share, the more data you have access to.

Only 53% of small organizations (<$100M in revenue) currently have plans for the digital twin compared to 65% of larger companies (>$100M in revenue). Small or large, the objectives planned for the digital twin vary greatly as shown in the data below. This suggests that product development teams have not yet settled on the best applications for digital twins. This will likely change as their adoption increases and best practices are revealed.

Improve service and maintenance	49%
Monitor manufacturing lines during production	39%
Provide relevant product usage data back to product development to improve the next generation of products	37%
Report product failure	37%
Virtual prototyping in design to avoid or delay physical prototypes	34%
Simulate manufacturing lines set up during product development	30%

Question: Rank the following primary uses for machine learning and artificial intelligence as they may apply to your business.
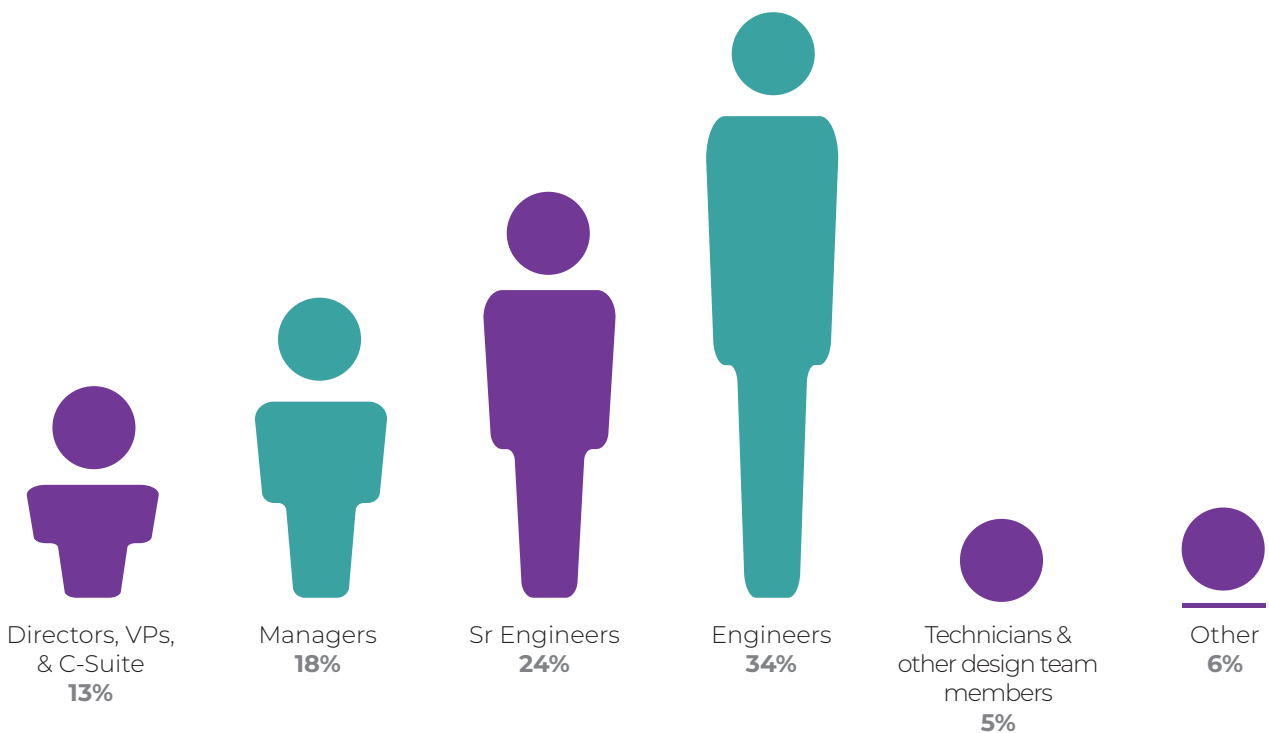
Demographics

INDUSTRIES
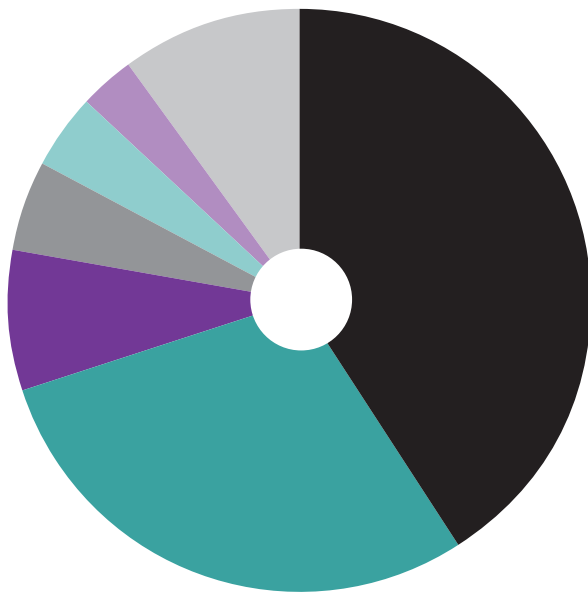
- Industrial **41%**
- High Tech **29%**
- Aerospace and defense **8%**
- Consumer Goods & Retail **5%**
- Services **4%**
- Life Sciences **3%**
- Other **10%**

N = 358

JOB ROLES

Directors, VPs, & C-Suite
13%

Managers
18%

Sr Engineers
24%

Engineers
34%

Technicians & other design team members
5%

Other
6%

N = 358

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CLOSING COMMENTS

The goal of this study was to determine how product development teams are currently managing their data and how they expect to put that data to use as the digital transformation of product development intensifies.

Regarding data management and utilization today, it seems most teams are finding it a bit of a challenge, as the following findings showed:

• Only 32% of teams have access at any time to product data across the product lifecycle and when deployed in the field

• 54% of product development teams lack proper tools for tracking data sourced as part of the development process

• Only 34% of product development teams can check their performance against key performance indexes (KPIs) in real-time.

Despite current struggles, or maybe because of them, product development teams are positive on the future of integrated product lifecycle management (PLM) in the cloud. When asked about how the anticipated benefits of PLM in the cloud will affect their businesses, the respondents said 10 out of 11 benefits will result in moderate to revolutionary impact on their product development.

Engineering.com would like to thank the participants of this study. By sharing their knowledge and allowing others to see how they compare, they have enriched the entire product development community.

Thanks for reading.

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This research has been sponsored by Oracle
Product lifecycle management (PLM) is no longer a discipline hidden in the product engineer´s garage. Given today's complex business environment, modern companies need a fresh approach to quickly improve product development functions and integrate them across the end-to end supply chain. To learn more, visit oracle.com/plm.