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# Are We Ready for Digital Twins?

## Engineering.com audience survey of perceptions and readiness


**This research has been sponsored by Dassault Systèmes**

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# EXECUTIVE SUMMARY

We've all heard of digital twins, the true-to-life virtual clone of an object in the physical world. Digital twins have the potential to offer valuable insight into the real-world performance of products and processes. Depending on who you're talking to, digital twins are either the next revolution in product development or an impossible ambition that can never truly be obtained.

We wanted to learn what you think. We surveyed over 250 engineers, designers, product managers and executives to discover if and how digital twins are being used today. In this engineering.com research report, we share the results of that survey. You'll learn about how different organizations have already begun using digital twins, and where digital twins still can't cut it.

For small and medium businesses, digital twins can seem like a huge overhead in the development process. This survey aims understand how SMBs see the digital twin in an era when companies are migrating from on-premise software to the new capabilities of the cloud.

You'll also learn:
- How different companies define the digital twin.
- The benefits that engineers expect from digital twins.
- The main obstacles to digital twin adoption.
- And more.

Thanks to all the engineers who participated in this survey, and thanks to you for reading.

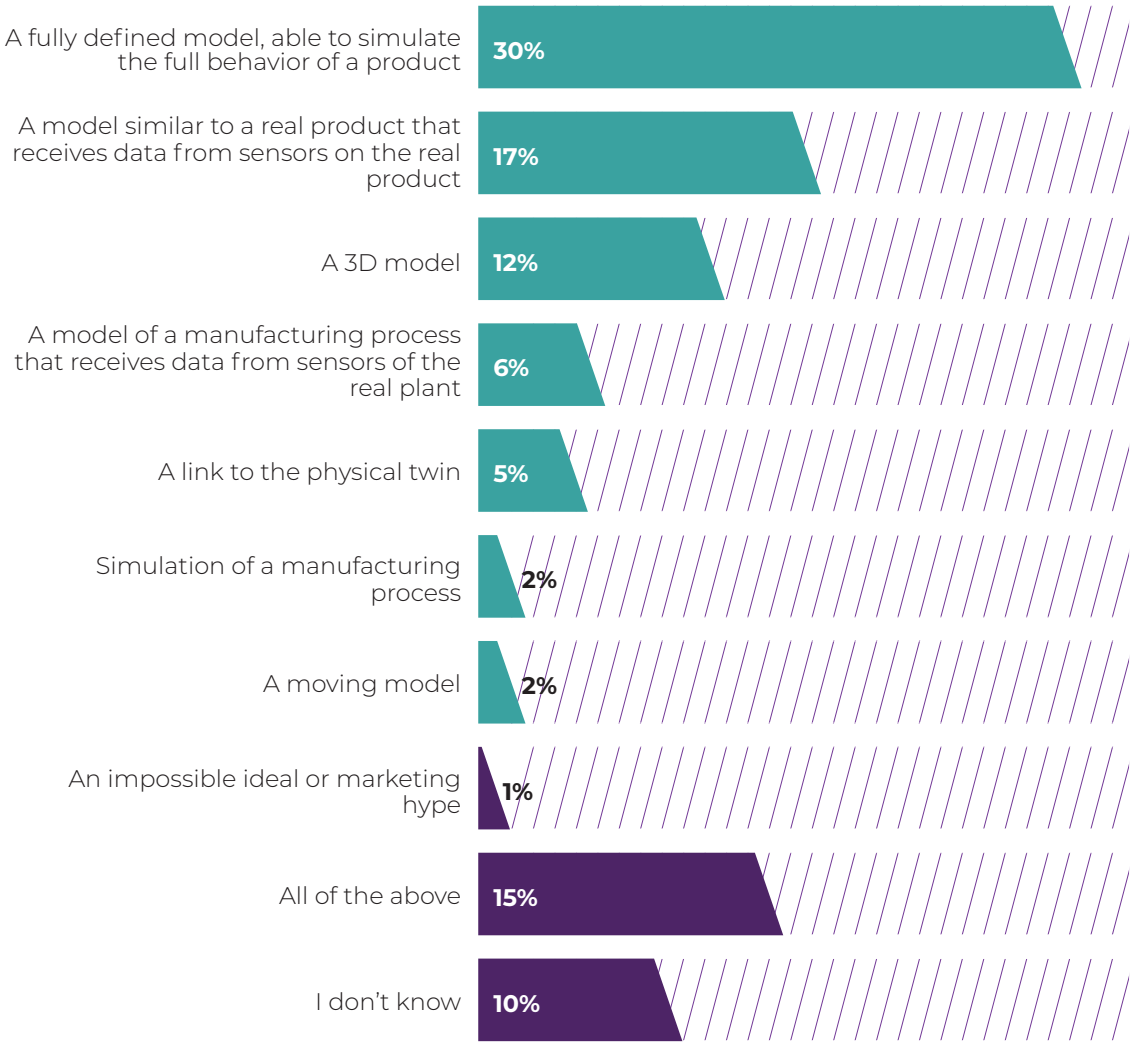
Roopinder Tara
Director of Content, engineering.com

# General Perceptions of Digital Twins

# HOW WELL DO ENGINEERS UNDERSTAND THE CONCEPT OF DIGITAL TWINS?

A third (30%) of survey takers consider digital twins to be *a fully defined model, able to simulate the full behavior of a product*. The next most common notion held by 17% of survey takers is that digital twin is a *model similar to a real product that receives the data from sensors on the real product*.

12% of respondents simply define the digital twin as a 3D model, while another 10% don't know what a digital twin is at all. A small number (1%) believe digital twins to be an impossible ideal or marketing hype.



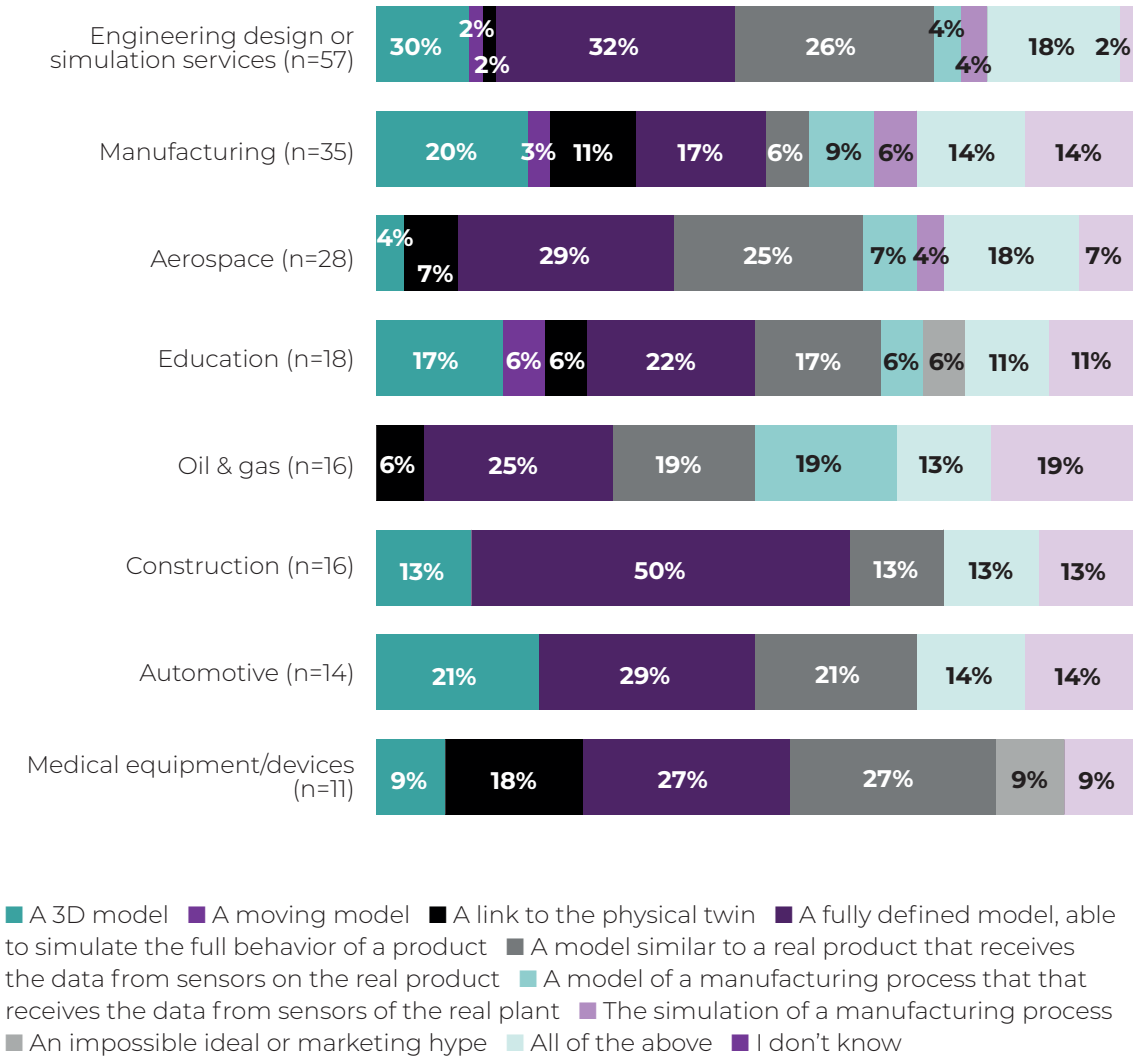

Q: What does digital twin primarily mean for you? N = 260

# HOW DO DEFINITIONS COMPARE ACROSS INDUSTRIES?

We observed a few predominant perspectives in certain industries. For example, 50% of respondents in the construction industry define digital twin as *a fully defined model, able to simulate the full behavior of a product*.

Most of those who don't know what a digital twin is primarily reside in oil and gas (19%), automotive (14%), manufacturing (14%) and construction (13%).

Those who consider digital twin an impossible ideal or marketing hype work in medical equipment/devices (9%), education (6%), manufacturing (6%) and engineering design or simulation services (4%).

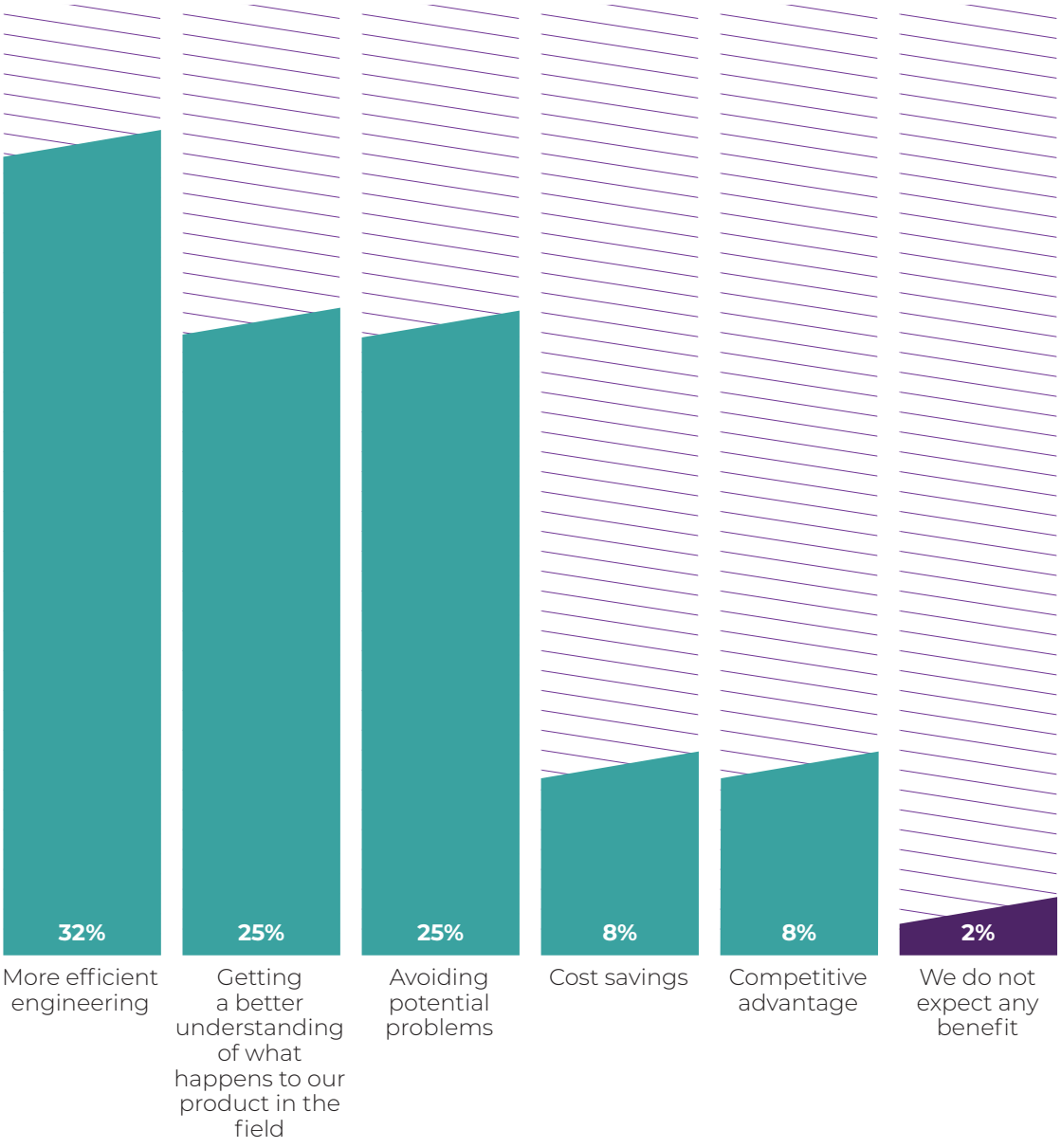



Q: What does digital twin primarily mean for you? What industry do you work in?

# WHAT BENEFITS DO COMPANIES HOPE TO REALIZE FROM DIGITAL TWINS?

Most respondents hope to use digital twins to improve their products and processes. The expected benefit of digital twins is primarily better engineering (32%) rather than cost savings (8%) or gaining a competitive advantage (8%).

Survey respondents expect digital twin to help them better understand how their products behave in the real world (25%). Avoiding potential problems is also a perceived benefit for 25% of respondents.

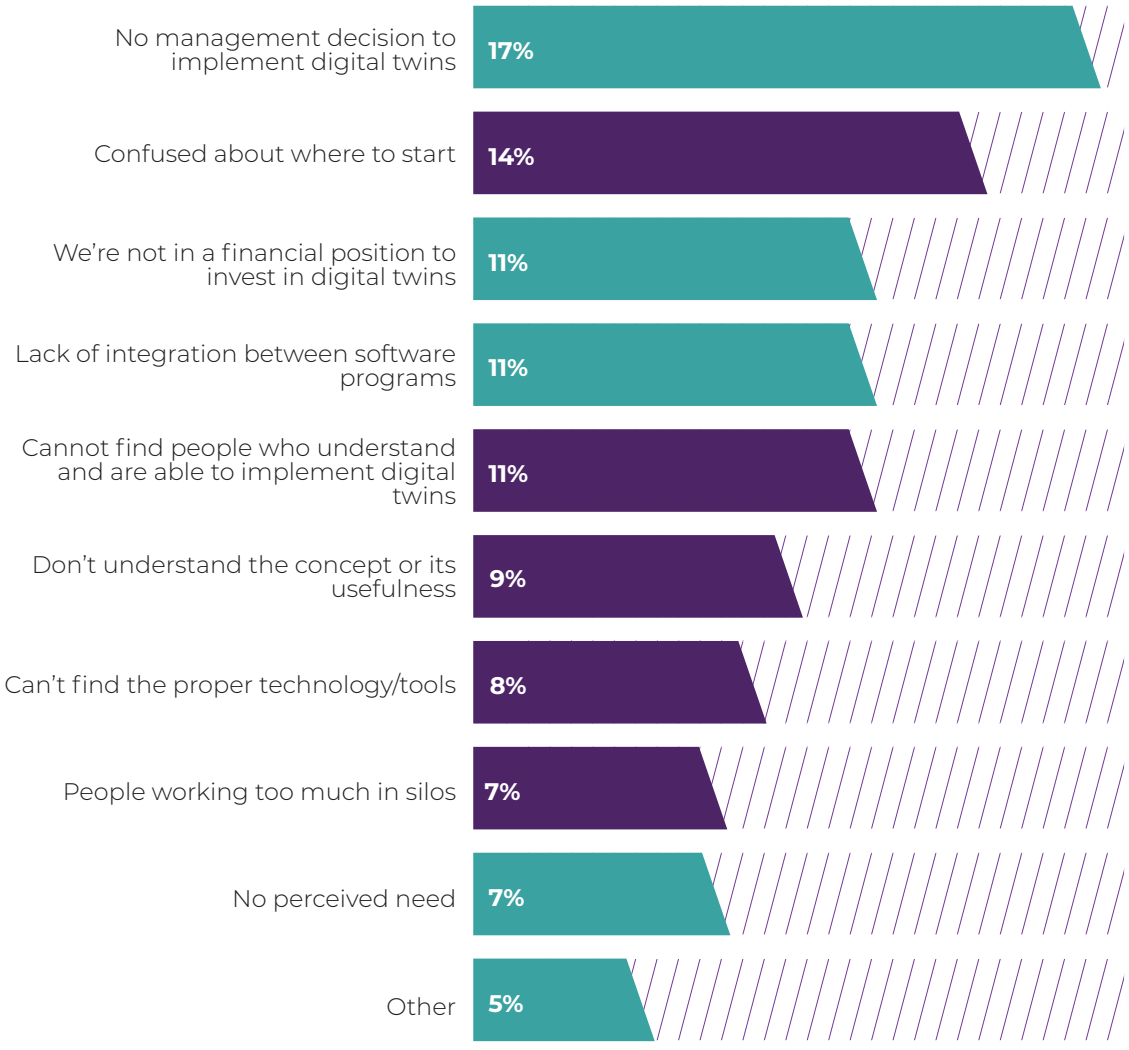



Q: What is the primary benefit that you expect from digital twins? N = 260

# WHAT ARE THE TOP BARRIERS THAT HINDER DIGITAL TWIN IMPLEMENTATION?

We asked survey takers to share the main reason why they aren't making more use of digital twins. Lack of management support rose to the top of the list for 17% of respondents.

Despite management support being a top barrier, it's important to look at how the other barriers fit together. Notably, nearly half of respondents (42%) are stifled because they either don't know where to start (14%), lack personnel to implement digital twins (11%), don't know how to select the proper tools (8%) or don't understand the concept of digital twins or their benefits (9%).



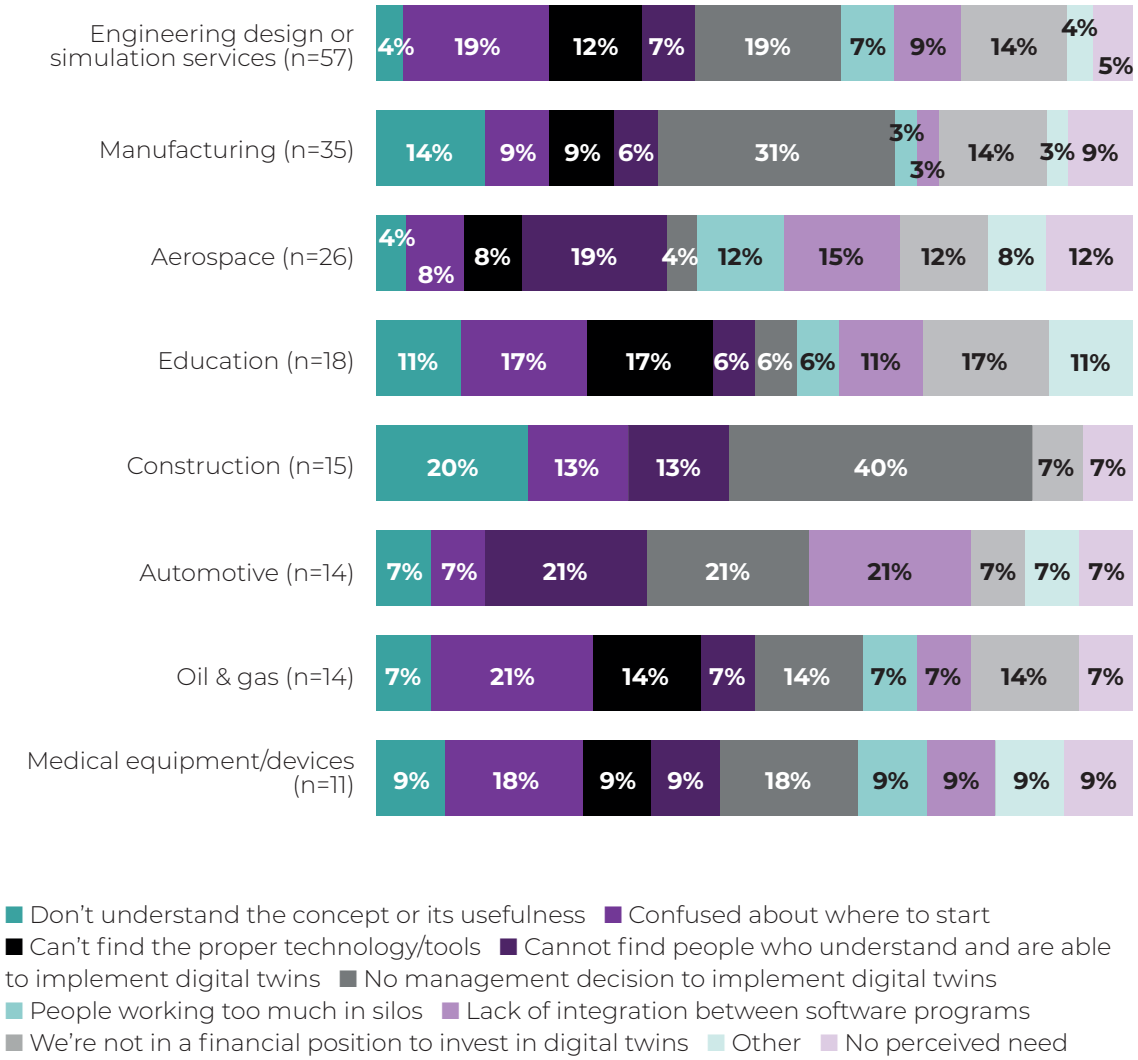

Q: What is the top reason that prevents you from using digital twins more? N = 257

# IS MANAGEMENT SUPPORT A TOP BARRIER TO DIGITAL TWIN USE ACROSS INDUSTRIES?

Is management more or less supportive in certain industries?

Industry comparisons suggest that management has yet to approve digital twin use for 40% of respondents in construction, 31% of those in manufacturing, and 21% of survey takers in the automotive industry.

In comparison, management was only selected as a barrier by 4% of those in aerospace and 6% in education.



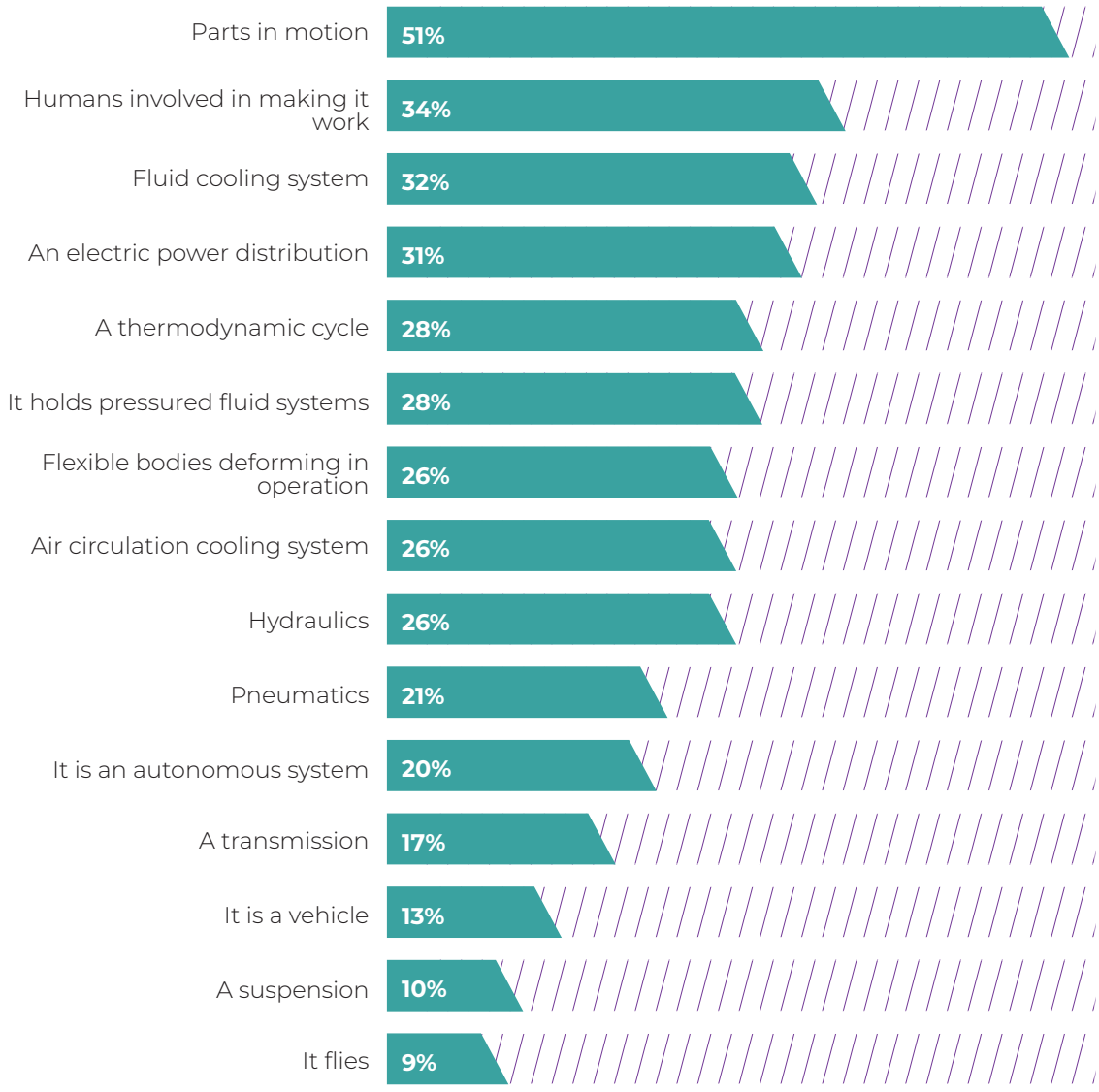

Q: What is the top reason that prevents you from using digital twins more? What industry do you work in?

# How Companies Incorporate Digital Twins Into Their Development Process

# WHAT ARE THE TOP PRODUCT FEATURES?

Survey respondents shared which feature(s) they typically add to their products.

Parts in motion are incorporated by over half (51%) of respondents. Close to a third of respondents have products that require human operators of some sort (34%), a fluid cooling system (32%) and/or an electric power distribution system (31%).

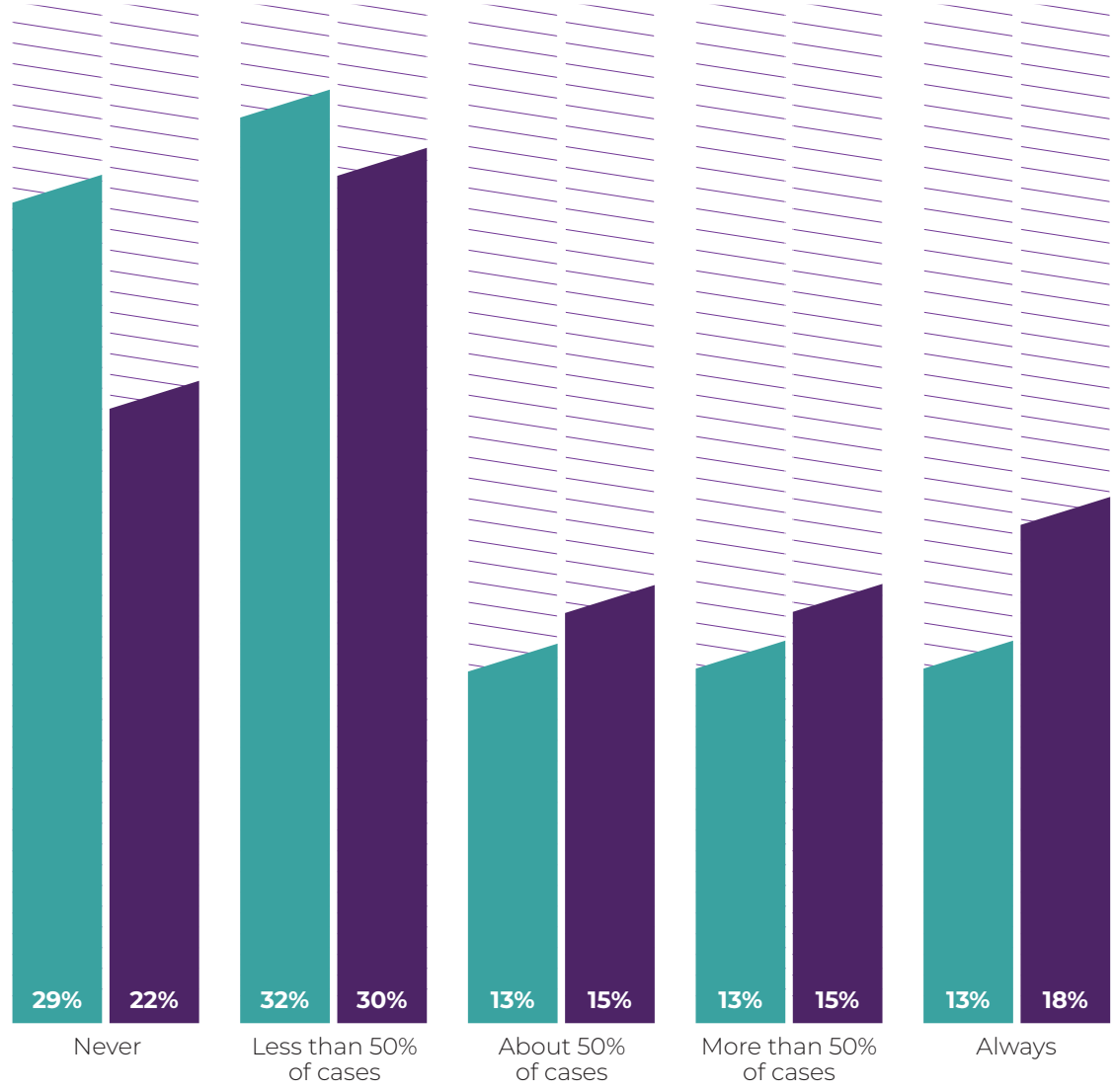



Q: What feature(s) does your product include? Select all that apply. N = 254

# AT WHAT POINT IS THE PHYSICAL PROTOTYPE CREATED?

Prototyping trends appear to be similar regardless of the project phase. Nearly a third (29%) of respondents never create a prototype in the concept phase, while 22% never create a prototype in the design phase.

For roughly a third of survey respondents, physical prototyping occurs less than half of the time.



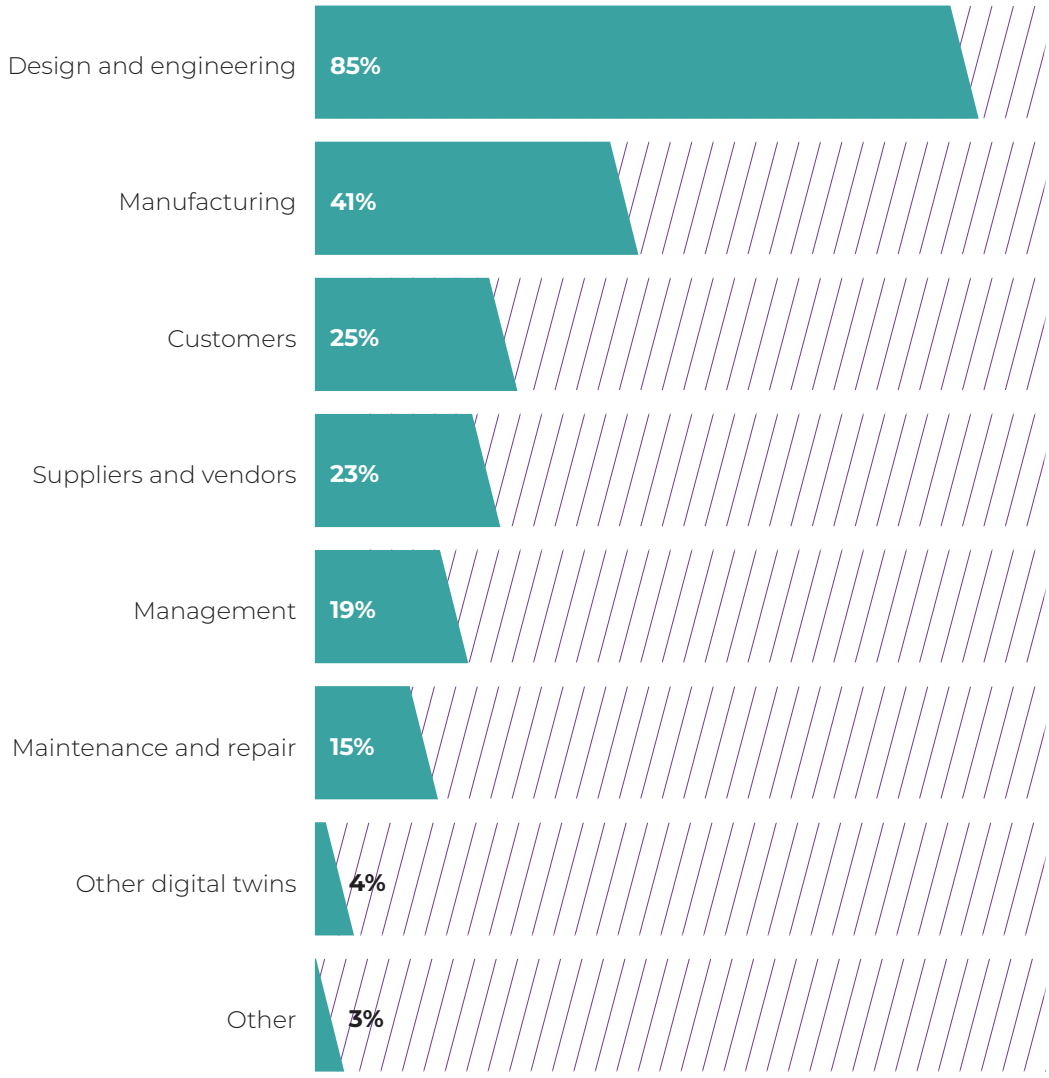

Q: How often do you create a physical prototype of your product in the CONCEPT phase?
How often do you create a physical prototype of your product in the DESIGN phase?

# WHO TYPICALLY WORKS WITH THE PRODUCT MODELS?

The majority of respondents (85%) note that their design and engineering teams are most actively involved with their product's 3D models.

Less than half (41%) indicate that those in manufacturing are the primary users. Some share their models with customers (25%), as well as suppliers and vendors (23%).

Only 4% of respondents reported that their models are primarily accessed by other digital twins.




Q: Who primarily accesses or interacts with your product's 3D model? N =260

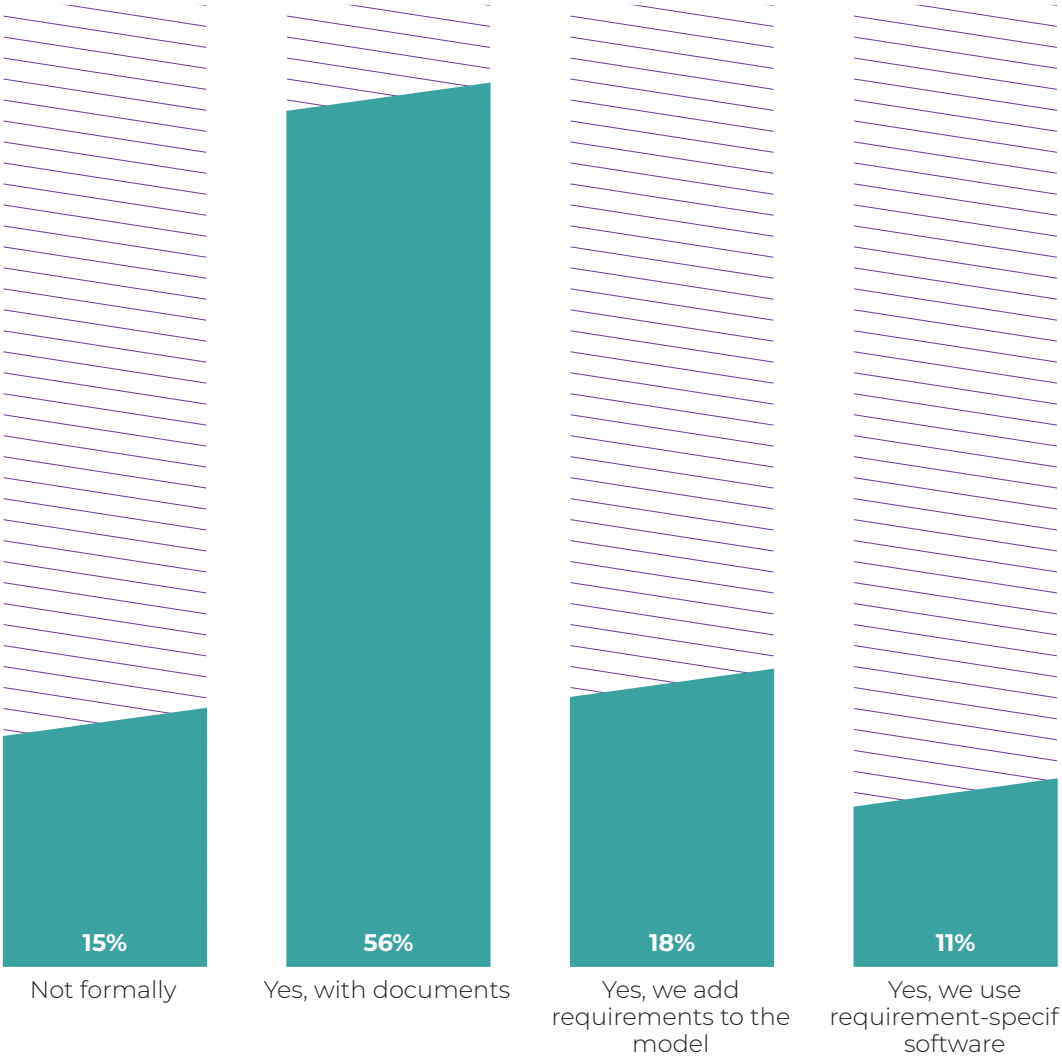
# How Companies Approach Product Design And Testing

# ARE FORMAL REQUIREMENTS STILL BEING USED TO GUIDE DESIGN?

Requirements are still a key factor in design and development for most participants (85%).

The leading approach is with documentation (56%), but some embed requirements within the model (18%) or rely on requirement-specific software (11%).

A small percentage of respondents (15%) do not formally specify requirements.



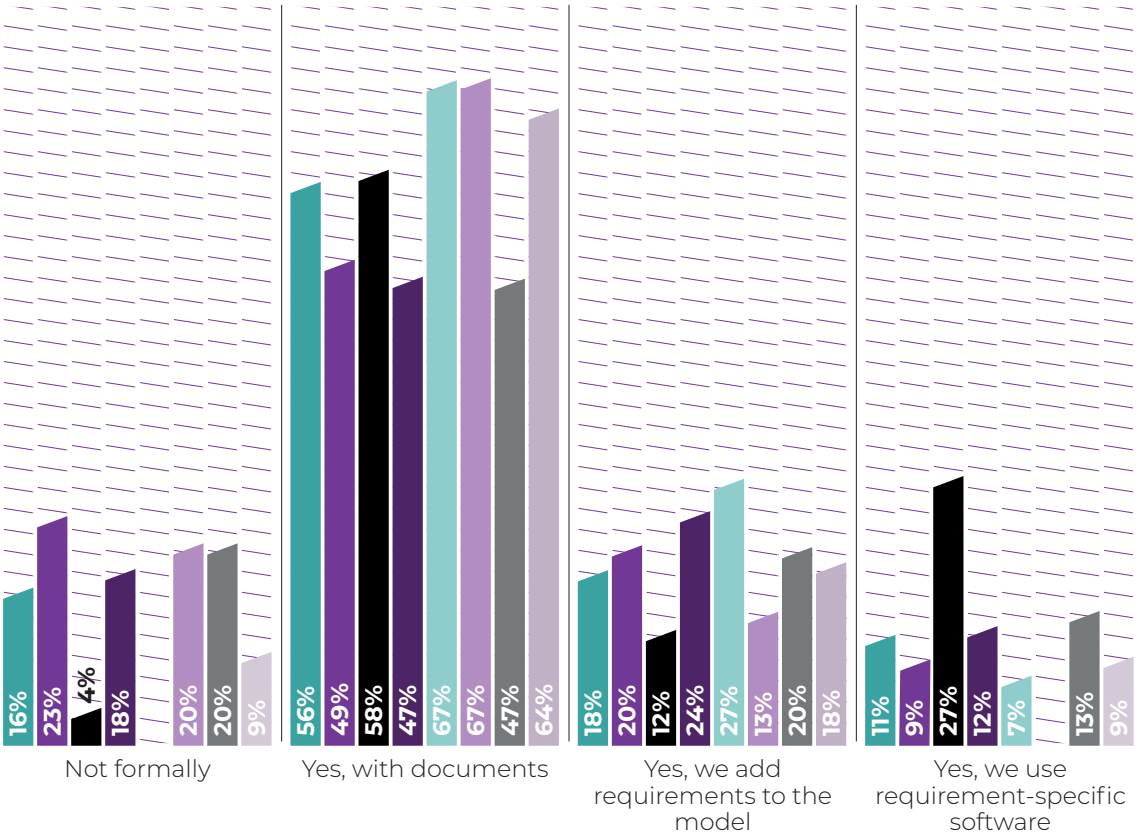

Q: Do you specify your product with requirements? N = 257

# WHICH INDUSTRIES LEAD IN SPECIFYING REQUIREMENTS?

Who takes the time to define requirements and who skips the formal process altogether?

Documentation is used by 67% of those in the automotive and education industries, 64% of those in medical equipment/devices, 58% of aerospace respondents and 56% of those in engineering design or simulation services. Following closely behind are manufacturing (49%), education (47%) and oil and gas (47%).

Requirements are not formally specified by 23% of those working in manufacturing, 20% of construction, 20% of oil and gas, 18% of education, 16% of engineering design or simulation services, 9% of medical equipment/devices industries and 4% of aerospace.

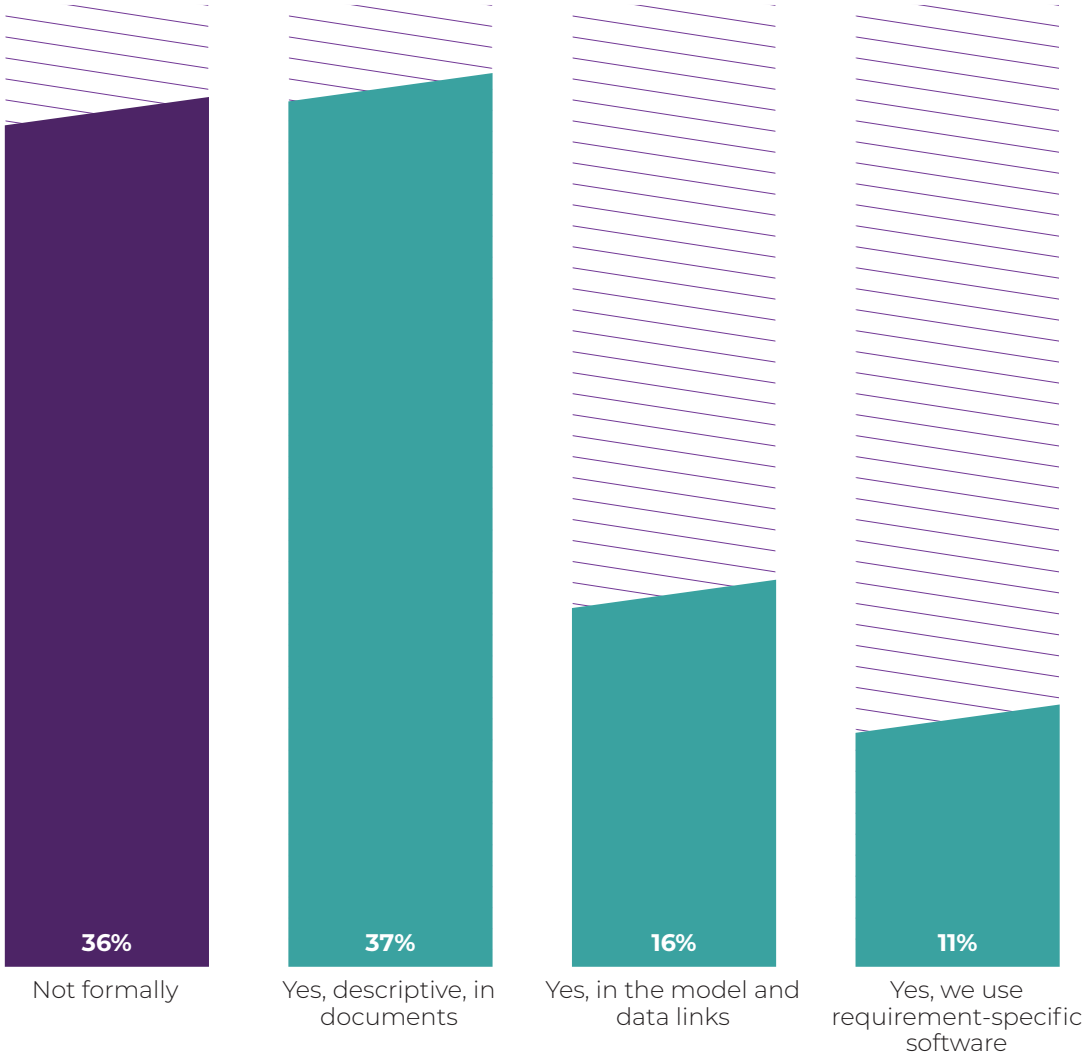



Q: Do you specify your product with requirements? What industry do you work in?

# IS DOCUMENTATION SOLID ENOUGH TO MAP PRODUCT FEATURES TO THE INITIAL REQUIREMENTS?

Despite the general use of documentation and other methods to define product requirements, the ability to link the original requirements to the final features remains an issue.

Compared to the 85% who set out formal requirements for their products, only 64% are able to trace their features back to the requirements they originally laid out.

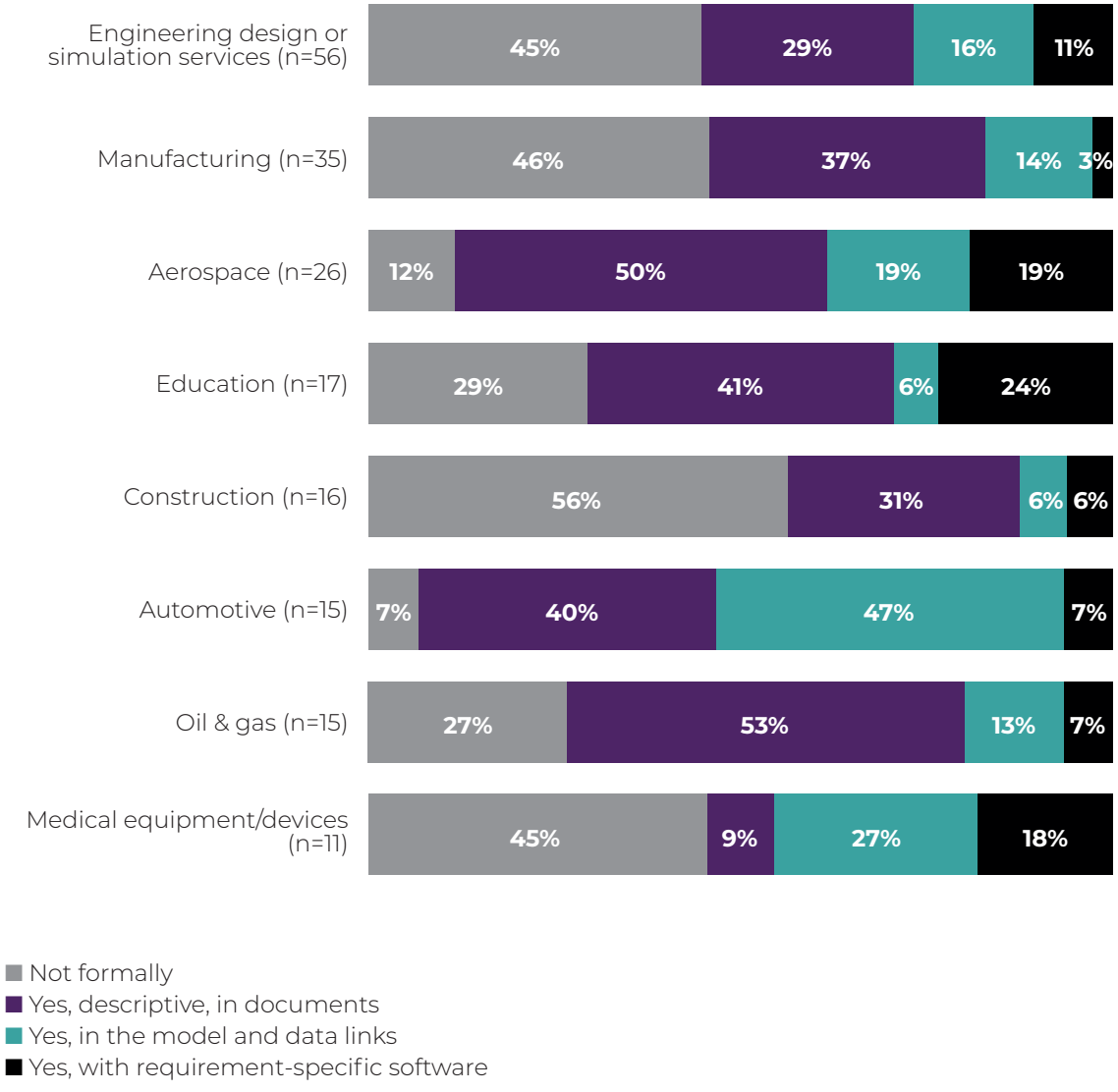



Q: When designing the physical product in 3D, are you able to trace how product features satisfy each requirement?

N = 257

# WHICH INDUSTRIES ARE FINDING IT DIFFICULT TO TRACE PRODUCT FEATURES TO REQUIREMENTS?

Over half (56%) of survey takers in construction are unable to formally map the connection between the original requirements and product features. Close to half (46%) of manufacturing, 45% of engineering design or simulation services and 45% of medical equipment devices are in the same position.



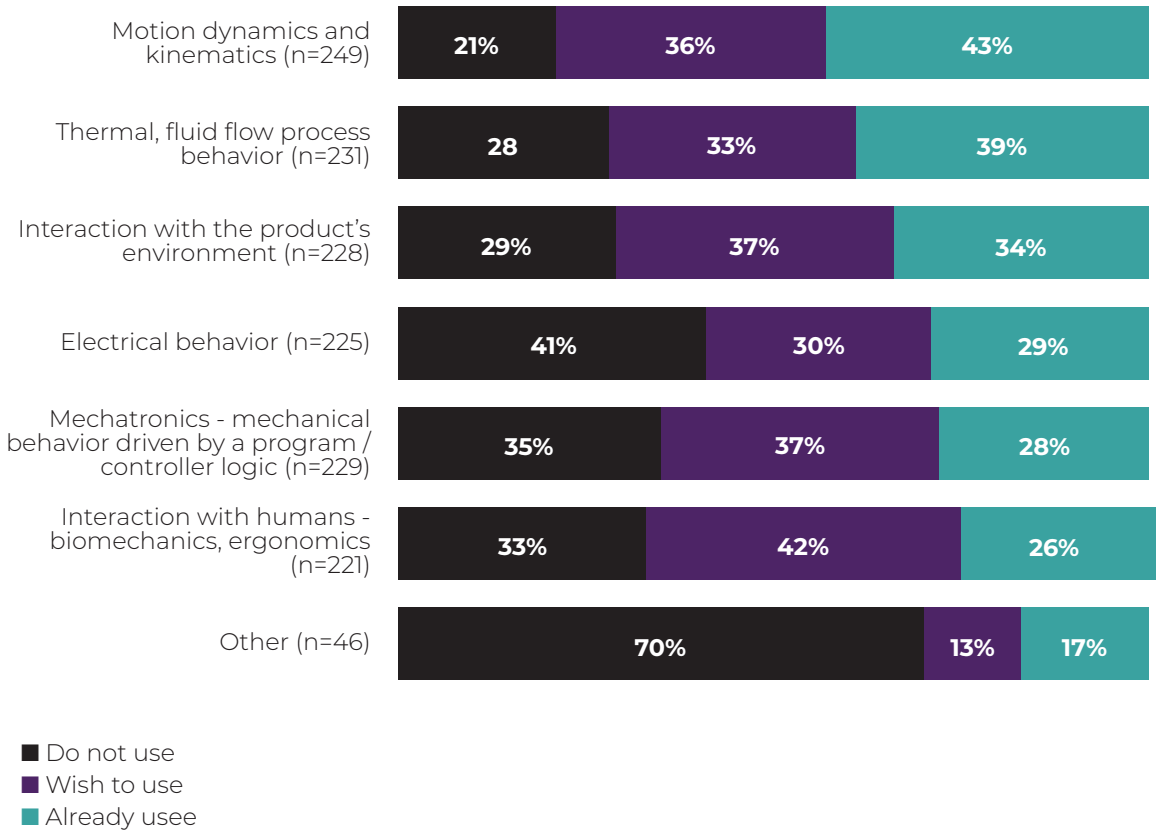

Q: When designing the physical product in 3D, are you able to trace how product features satisfy each requirement? What industry do you work in?

# HOW DOES YOUR TESTING PROCESS COMPARE?

We provided survey takers with a list of several methods for virtually testing the behavior of their product designs. For each method, we asked them to share whether they use that method currently, want to use it in the future or if they do not use it at all.  Motion dynamics and kinematics (43%) appears to be the most popular method used to test the behavior of designs, followed by thermal, fluid flow process behavior (39%) and interaction with the product's environment (34%).

As for the wish list, interaction with humans (42%), mechatronics (37%), interaction with the product's environment (37%) and motion dynamics and kinematics (36%) were at the top of the list.

Looking across categories, the most popular method that respondents either already use or wish to use is motion dynamics and kinematics (79%). The least used method that is also not on the wish list is electrical behavior—only 59% currently use or want to use it.

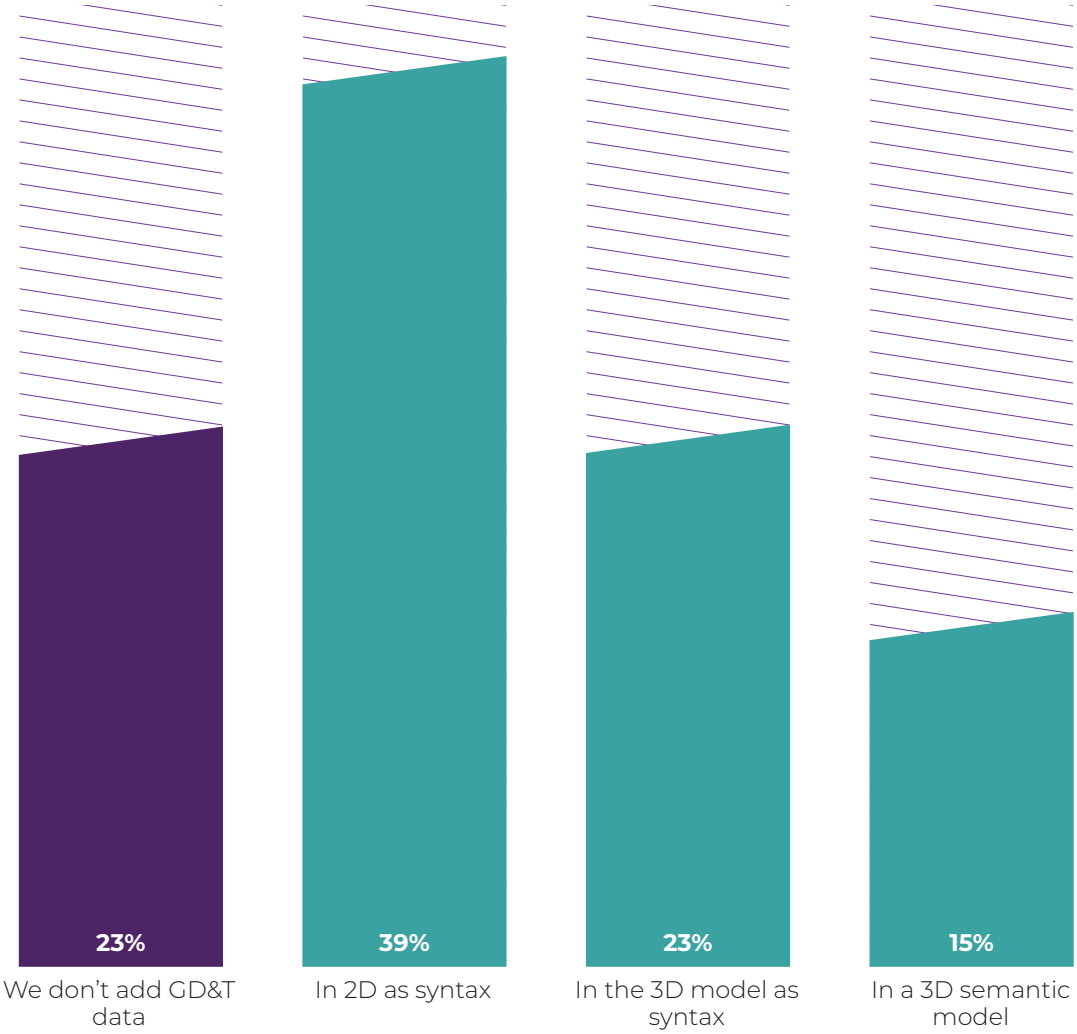



Q: Select the option that best represents how you virtually test behavior of your product design, including moving parts in CAD.

# WHERE IS GEOMETRIC DIMENSIONING AND TOLERANCING DATA TYPICALLY POSITIONED?

Geometric dimensioning and tolerancing (GD&T) is critical to the development of digital twins. The more detail that is included, the more realistic the final product will be.

Over a third of respondents incorporate GD&T data into their 3D models by adding it directly to the syntax (23%) or semantic model (15%), though GD&T is also used in 2D syntax (39%).



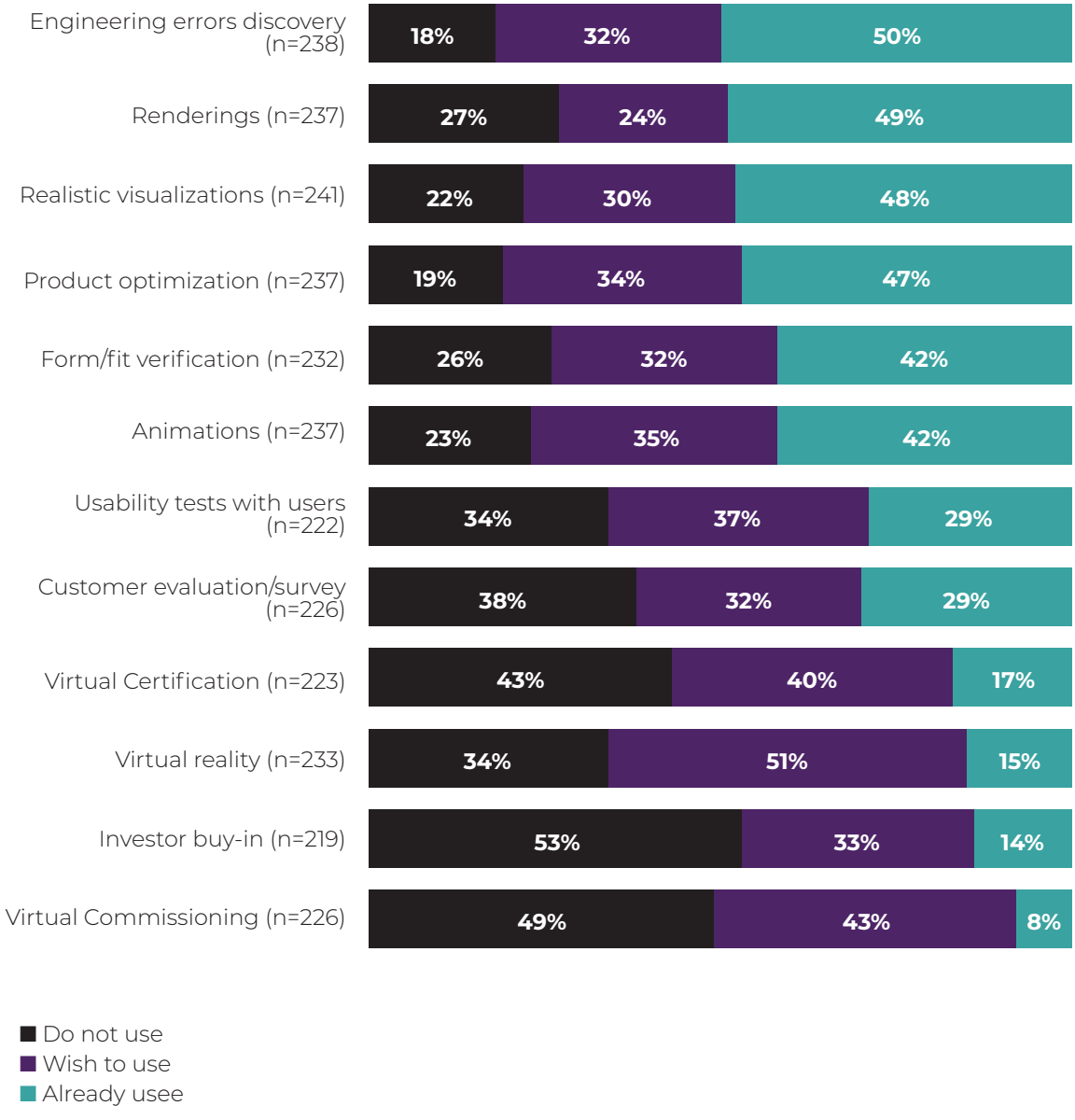

Q: How do you add geometric dimensioning & tolerancing (GD&T) data to your design? N = 256

# Are Digital Twins Within Reach?

# WHAT ARE THE MOST COMMON USES FOR DIGITAL TWINS?

Most respondents already use or wish to use digital twins to discover engineering errors (82%), to optimize products (81%), to have realistic visualizations (78%) and for animations (77%).

Less than half (47%) use or wish to use digital twins as a means to gain investor buy-in.



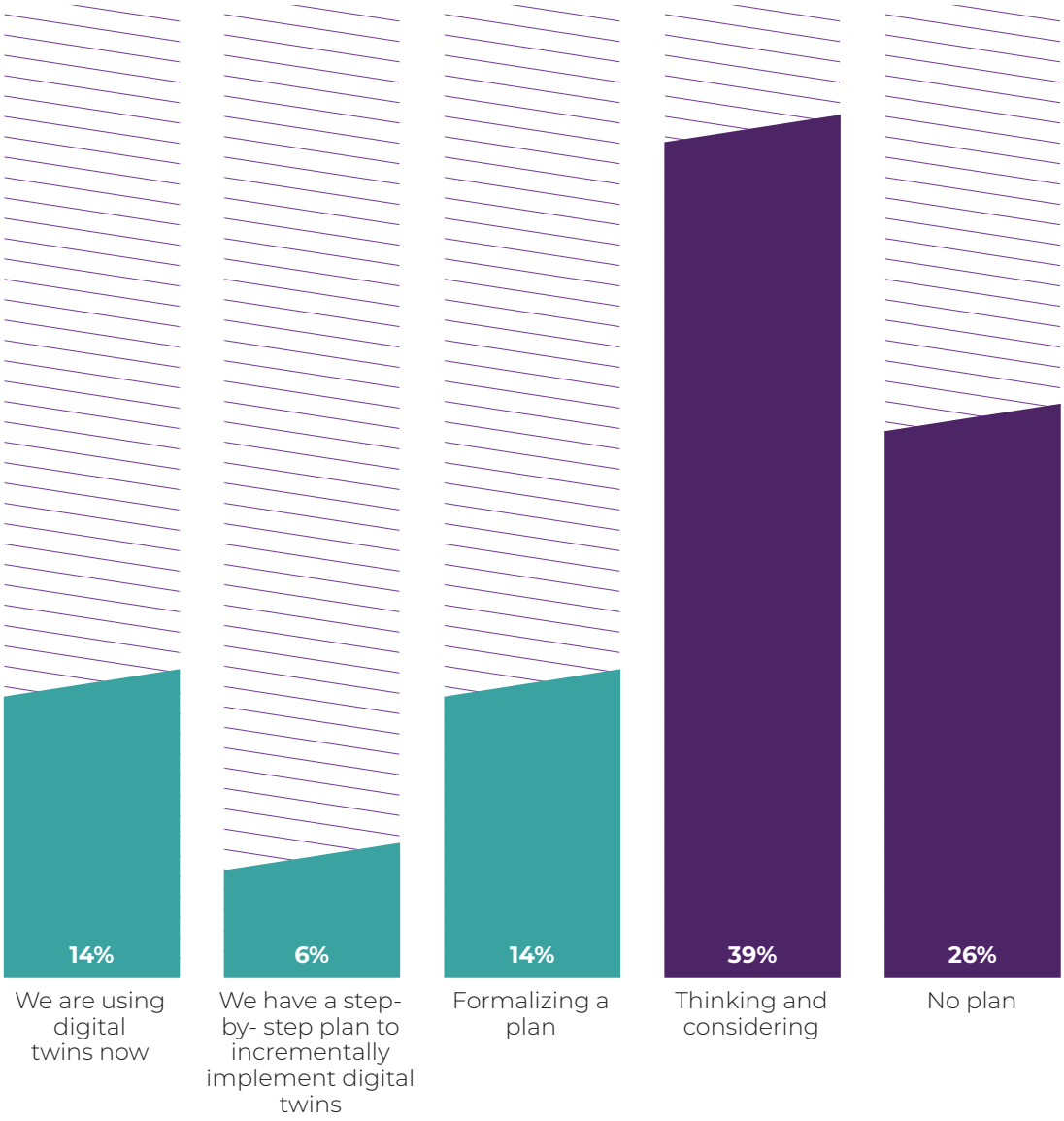

Q: Select the option that best represents how you use a digital twin for each of the following areas.

N = 218

# ARE COMPANIES READY AND PREPARED FOR IMPLEMENTATION?

We discovered that the majority of respondents (65%) are unprepared to launch digital twins, meaning that they have no plan in place or they are still in the consideration phase.

20% of respondents are formalizing their plans to implement digital twins, while 6% have a step-by-step plan in place. Only 14% of respondents are currently using digital twins.




Q: What is your plan to implement digital twins? N = 140

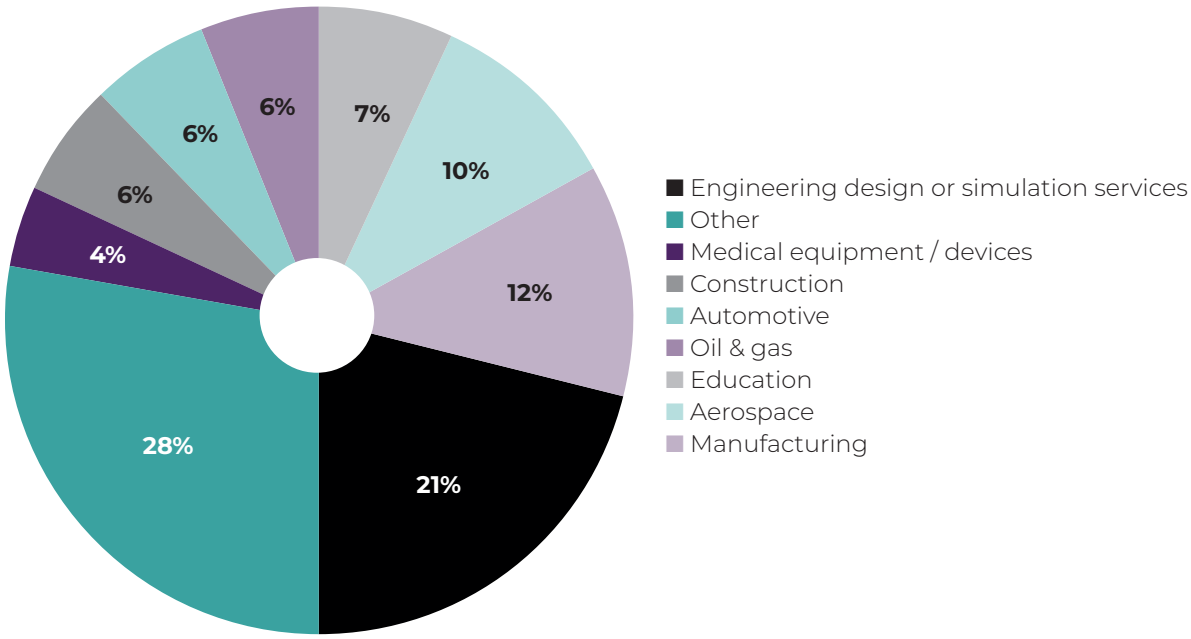
# Demographics

# INDUSTRIES REPRESENTED

Though respondents work in a diverse range of industries, the largest industries represented here are engineering design or simulation services (21%), manufacturing (12%) and aerospace (10%). There is some representation from those working in education (7%), oil and gas (6%), automotive (6%), construction (6%) and medical equipment/devices (4%).

28% of respondents were spread across various other industries. The other industries had less than 10 respondents each:

- Consumer products/electronics (3%).
- Each covering 2% of respondents: industrial machine tools, computer systems/peripherals, heavy equipment, chemicals/plastics/rubber, government and mining.
- Each covering 1% of respondents: food & beverage, communications.

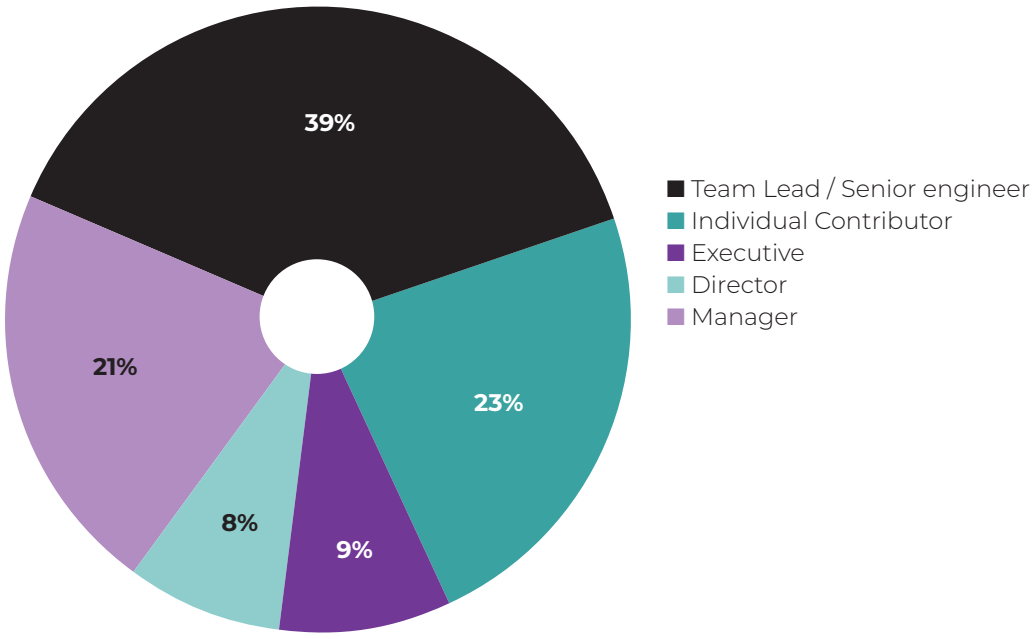



Q: What industry do you work in?

N = 261

# JOB ROLES REPRESENTED

The majority group included in this survey are team leads and senior engineers (39%). There is also good representation from management and above (38%). Almost a quarter (23%) of respondents serve as individual contributors within their organizations.



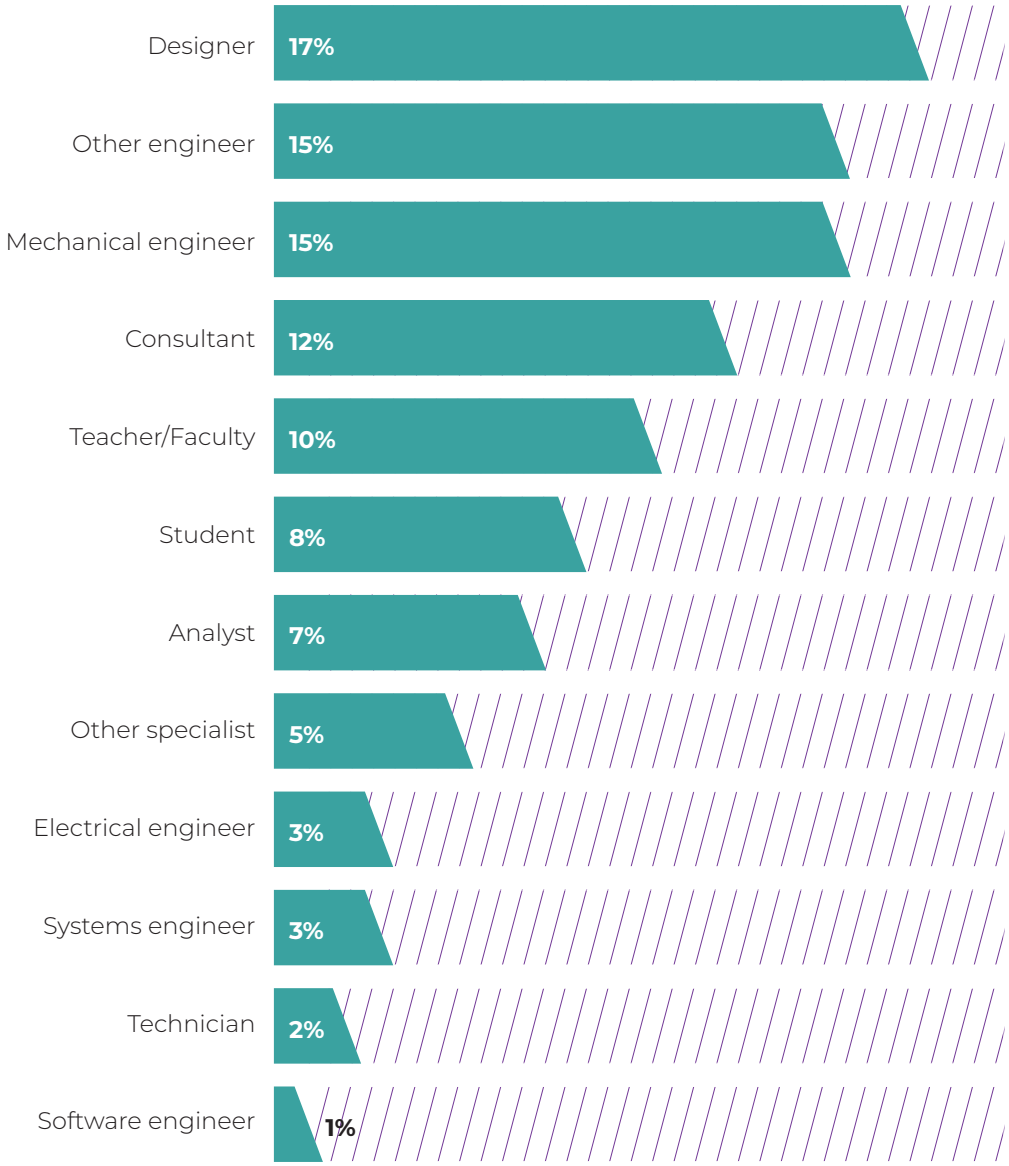

Q: Question: What is your current level of responsibility?

N = 259

# JOB ROLES REPRESENTED

The survey includes a diverse sampling of respondents who serve as engineers (37%) and specialists (43%) within their organizations.

The survey also incorporates feedback and impressions from students (8%) and teachers / faculty (10%).




Q: Which of the following is the closest match to your current role in relation to the field of engineering?

N = 261

# CLOSING COMMENTS

We conducted this survey to determine how companies today are thinking about digital twins. Are they familiar with the concept? Do they see the benefit? Do they have processes and documentation in place to support digital twin development?

We discovered that the majority of respondents (65%) have yet to devise a plan to implement digital twins. Only 14% of respondents are currently using digital twins. There is still plenty of opportunity to educate users about digital twins and their benefits.

In the next stage of this research, engineering.com will provide an expert analysis of how SMBs can devise a plan for digital twins, particularly by embracing the advantages of the cloud.

Other key takeaways from the survey include:

- 10% of respondents do not know what digital twins are. Only 30% understand digital twins as a complete virtual model of a real-world product or process.
- Most respondents hope to use digital twins to improve their products and processes. The main expected benefits are to enable more efficient engineering (32%), better understand products in the field (25%) and avoid potential problems (25%).
- Nearly half of respondents (42%) are held back from using digital twins because of a lack of knowledge, experienced personnel and tools.
- The construction industry is in a unique position with digital twins, with 50% of respondents in that industry (more than any other) understanding digital twins as a complete virtual model of a real-world product or process.
- Despite that, construction also reports the highest lack of support from management (40%) to implement digital twins. This industry is perhaps most poised to benefit from digital twins, as 56% of respondents report no formal process for linking specified requirements with product features.

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 engineering community.

Thanks for reading,

Roopinder Tara
Director of Content,
engineering.com


**This research was sponsored by Dassault Systèmes.**
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