Research Report:
The Status and Future of Engineering Design and CAE Technologies

EXECUTIVE SUMMARY

As consumers continue to demand more complex and reliable products, there is an added need for advanced engineering design and computer-aided engineering (CAE) tools. We surveyed over a hundred designers, engineers, managers, educators and specialists to help us understand how these tools support their work, how organizations are implementing them and what is keeping these tools from those that need them.

In this report, we uncover:
• If advanced design and CAE tools are accessible.
• How engineers incorporate these tools into their practice.
• Top design and CAE technologies for today and the future.
• Reasons why engineers and designers avoid these tools.
• Simulation practices.
• And much more.

Thanks to all our survey participants for sharing their experiences, and thanks to you for reading.

Sincerely,
Shawn Wasserman
Sr. Editor, engineering.com

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Engineering Design and CAE Technologies

HOW DO ORGANIZATIONS PLAN TO USE ADVANCED DESIGN AND CAE TOOLS?

Our respondents reported that organizations move to using advanced design and CAE tools to enable artificial intelligence (AI), machine learning (ML), generative design and digital transformations.

Overall, 57% plan to apply their tools to artificial intelligence and machine learning solutions, 49% want to use them for generative design and 46% are preparing to work on digital transformation.

Cloud computing (39%), digital twin work (32%) and democratization of simulation (32%) are still on the forecast, but not for most respondents.

Intelligence/Machine Learning **57%**

Generative Design **49%**

Digital Transformation **46%**

Cloud Computing **39%**

Digital Twin **32%**

Democratization of Simulation **32%**
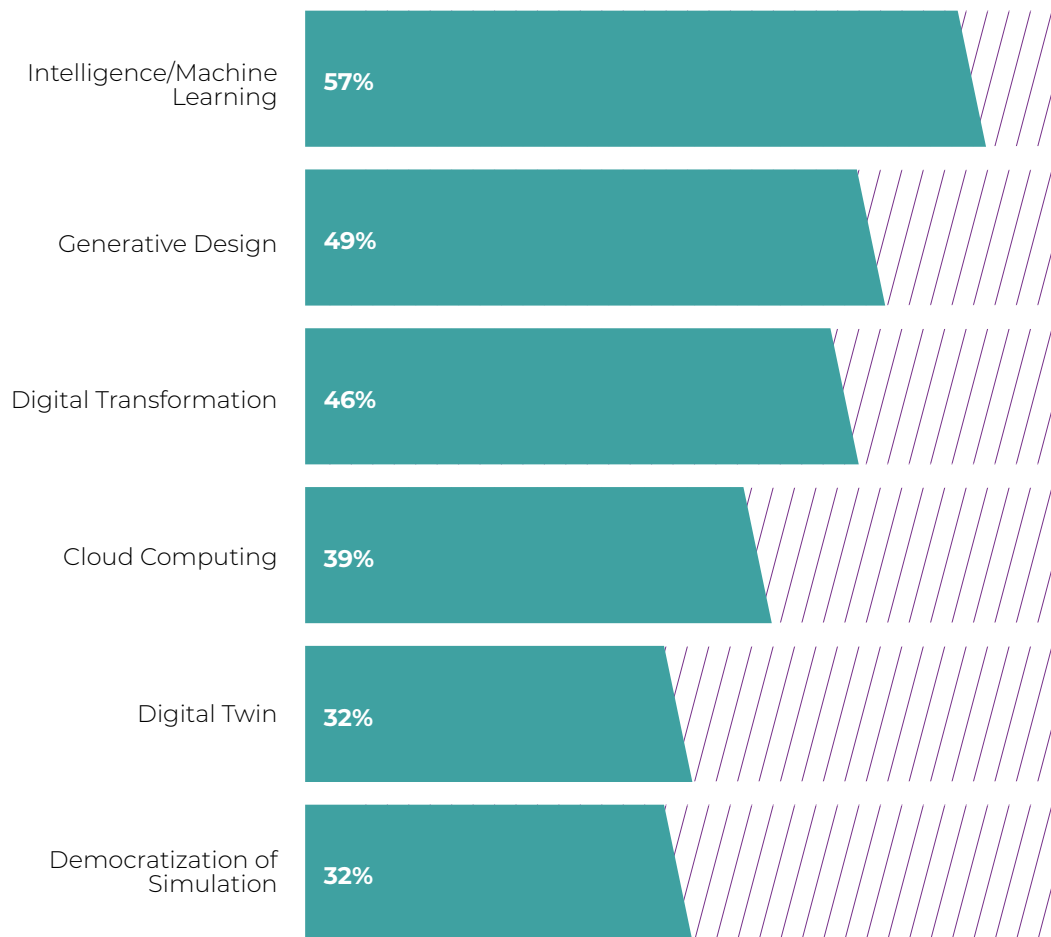
Q: Select your organization's top three goals with respect to advanced engineering tools? The chart displays the percentage of respondents who selected each option. Because respondents can select multiple options, the total can go above 100%.   N = 152

WHAT ARE THE TOP DESIGN AND CAE TOOLS AND TECHNOLOGIES USED TODAY?

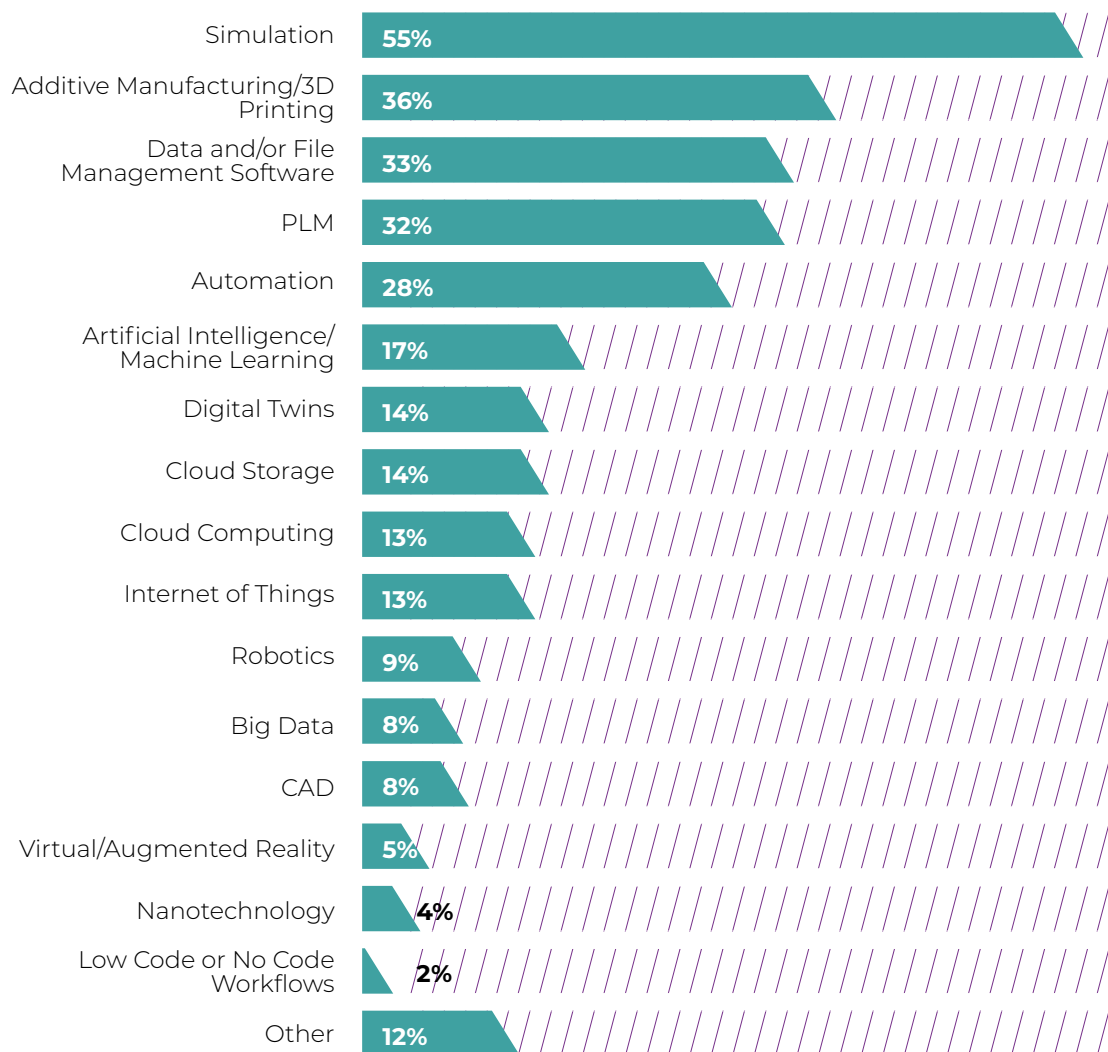Respondents considered simulation (55%), additive manufacturing/3D printing (36%), data/file management software (33%) and PLM (32%) to be the most important engineering design and CAE technologies used today.

Comparing the number of respondents who considered automation (28%) and robotics (9%) important, could point to a focus on digital automation.

Technology	Percentage
Simulation	55%
Additive Manufacturing/3D Printing	36%
Data and/or File Management Software	33%
PLM	32%
Automation	28%
Artificial Intelligence/Machine Learning	17%
Digital Twins	14%
Cloud Storage	14%
Cloud Computing	13%
Internet of Things	13%
Robotics	9%
Big Data	8%
CAD	8%
Virtual/Augmented Reality	5%
Nanotechnology	4%
Low Code or No Code Workflows	2%
Other	12%

Q: What are the 3 most important engineering and design tools/technologies for you and your team?
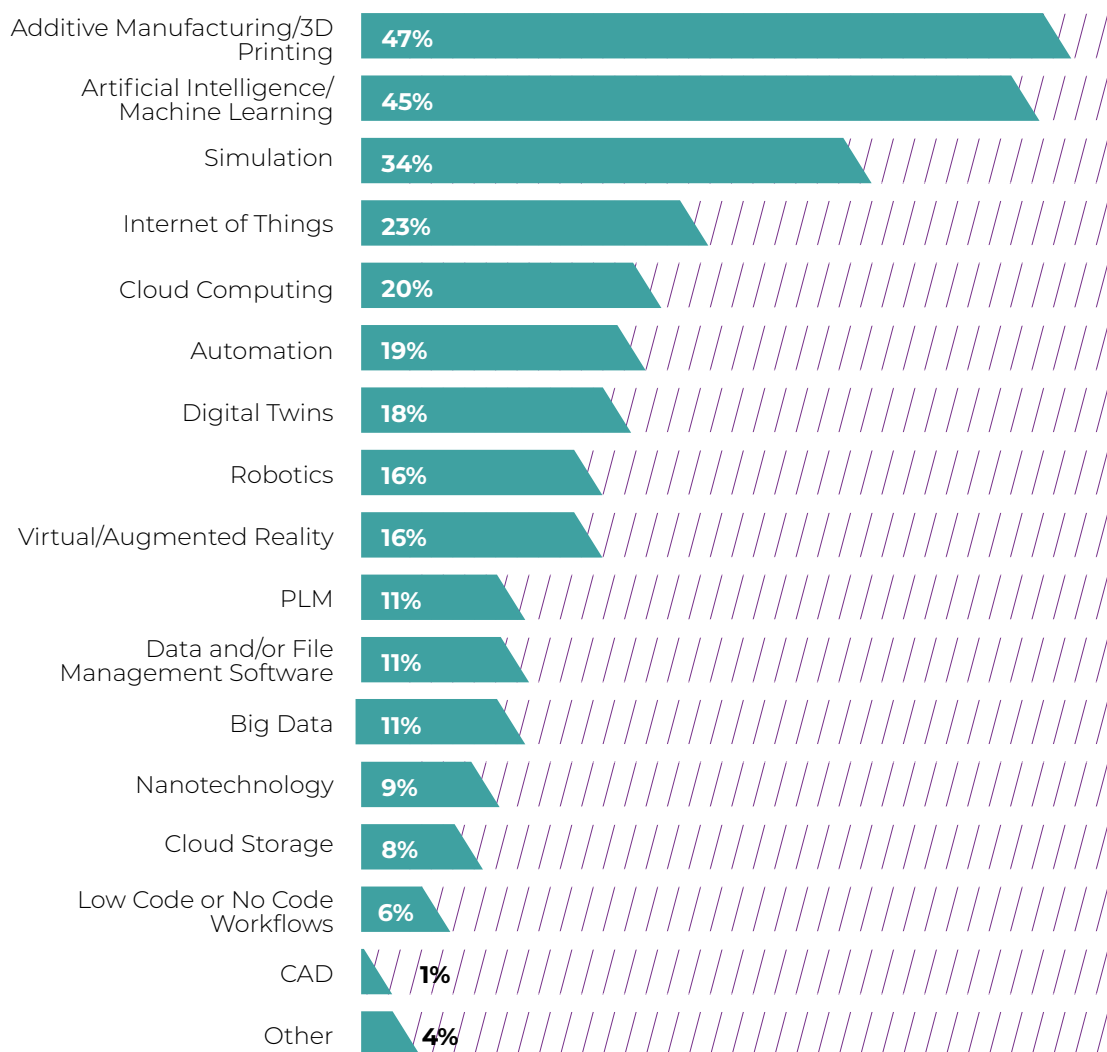The chart displays the percentage of respondents who selected each option.
Because respondents can select multiple options, the total can go above 100%

N = 160

WHICH ARE THE TOP DESIGN AND CAE TECHNOLOGIES OF THE FUTURE?

Respondents considered simulation (55%), additive manufacturing/3D printing (36%), data/file management software (33%) and PLM (32%) to be the most important engineering design and CAE technologies used today.

Comparing the number of respondents who considered automation (28%) and robotics (9%) important, could point to a focus on digital automation.

Technology	Percentage
Additive Manufacturing/3D Printing	47%
Artificial Intelligence/Machine Learning	45%
Simulation	34%
Internet of Things	23%
Cloud Computing	20%
Automation	19%
Digital Twins	18%
Robotics	16%
Virtual/Augmented Reality	16%
PLM	11%
Data and/or File Management Software	11%
Big Data	11%
Nanotechnology	9%
Cloud Storage	8%
Low Code or No Code Workflows	6%
CAD	1%
Other	4%

Q: What are the 3 most important engineering and design tools/technologies for the future of engineering?
The chart displays the percentage of respondents who selected each option.
Because respondents can select multiple options, the total can go above 100%

N = 160

BENEFITS OF DESIGN AND CAE TOOLS ACROSS INDUSTRIES

We asked our audience to consider what design engineers need across various industries. The majority (54%) considered AI/ML tools to be the most versatile.

On-Demand software licenses (50%) and data management and sharing tools (46%) also appeal to broad audiences. A high number of respondents for automated workflows (46%) further suggests a focus on digital automation.

Tools that may fit better within a specific niche include software license management (selected by 23%) and workload specific infrastructure architecture (20%).

Category	Percentage
Artificial Intelligence/ Machine Learning	54%
On-Demand Software Licenses	50%
Automated Workflows	46%
Data Management and Sharing	46%
Cloud Computing (or On-Demand Compute Resources)	40%
Global access to Simulation Data	39%
Standardized Workflows	33%
Software License Management	23%
Workload Specific Infrastructure Architecture	20%

Q: What tools do you think would most benefit design engineers in various industries? Select all that apply.
The chart displays the percentage of respondents who selected each option.
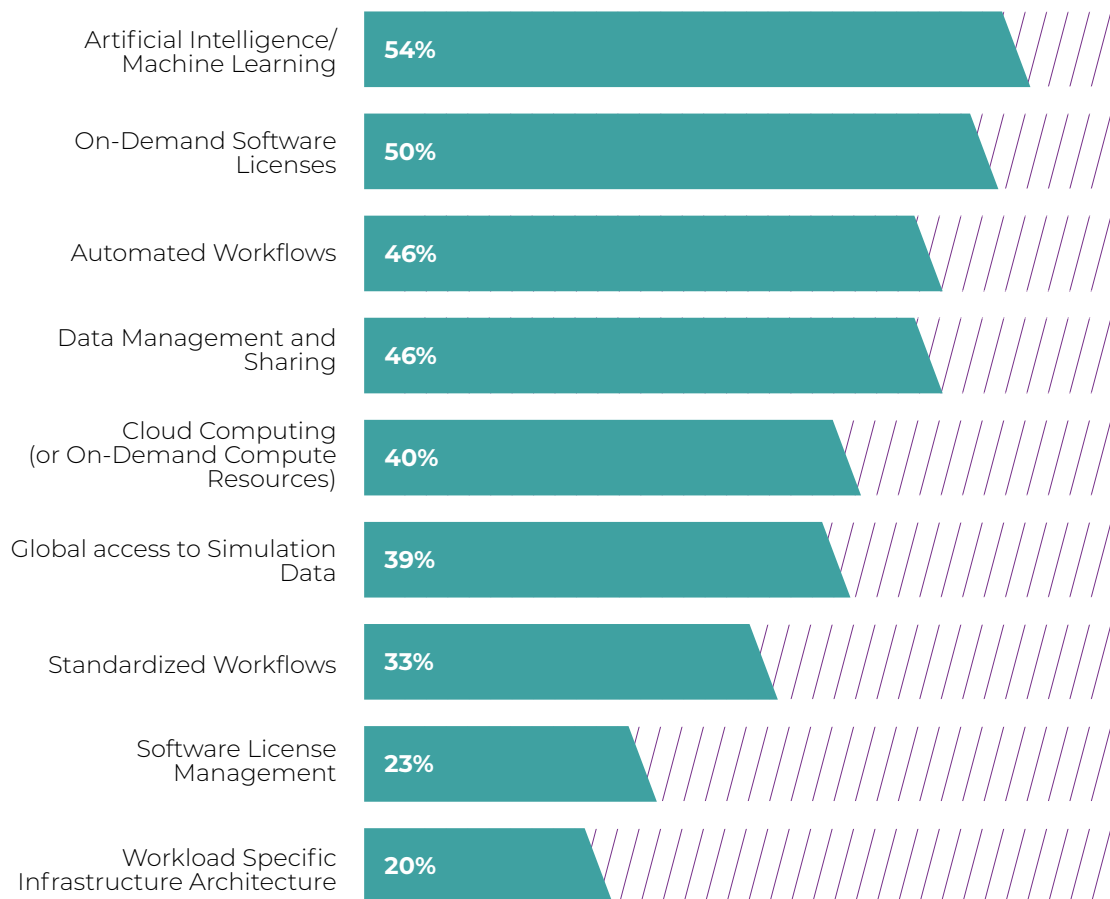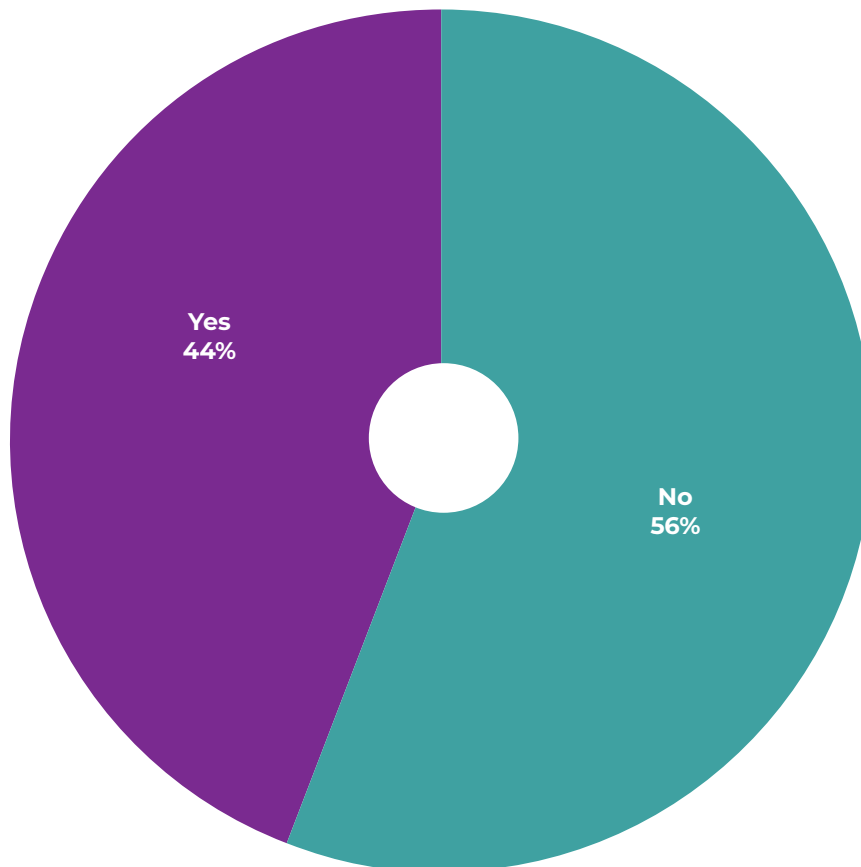Because respondents can select multiple options, the total can go above 100%.

N = 151

CAN ENGINEERS ACCESS THE BEST TOOLS WHEN NEEDED?

A surprising 56% of respondents believe that they do not have adequate access to the latest and greatest tools.

Less than half (44%) feel they have the best tools at their disposal to help them achieve their objectives.

Yes
44%

No
56%

Q: Do you feel you have access to the latest and greatest tools that allow you to produce better work and achieve your objectives?   N = 158

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DO DESIGN ENGINEERS FEEL DEPRIVED OF THE MORE ADVANCED TOOLS?

Like the previous question, nearly half (46%) of our respondents believed that design engineers are being held back from more advanced design and CAE technologies such as cloud computing, artificial intelligence and more.

Almost a fourth (22%) think that design engineers are comfortable with their tools and do not feel restricted. About a third of respondents were unsure.

46%	22%	33%
Yes	No	Unsure

Q: Are design engineers being held back from utilizing more advanced
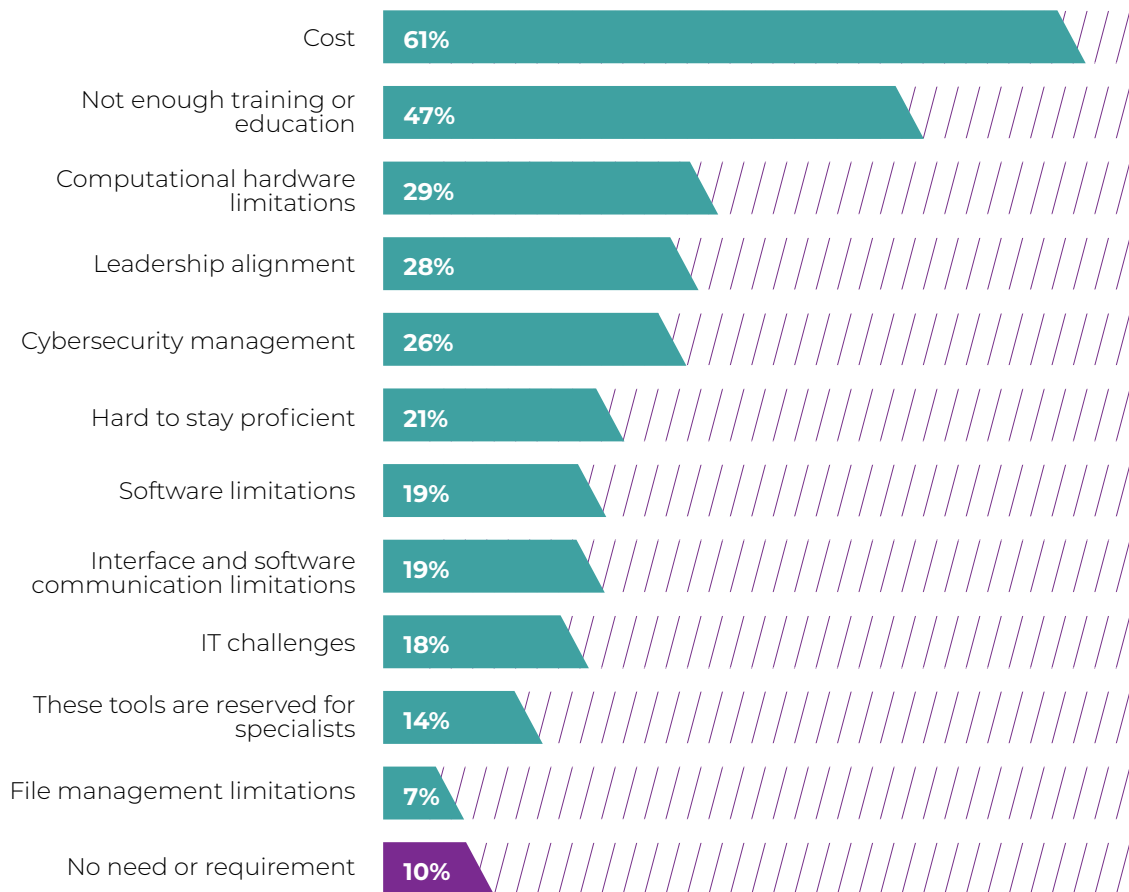   engineering tools (i.e., cloud computing, artificial intelligence, etc.)?   N = 158

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WHAT KEEPS ENGINEERS FROM USING ADVANCED DESIGN AND CAE TOOLS?

We found that cost (61%) was the top reason why design engineers don't utilize advanced design and CAE technologies. Knowledge gaps were another component, with 47% indicating that a lack of training and education is a contributing factor.

Twenty to thirty percent of respondents cited computational hardware limitations (29%), leadership alignment (28%), cybersecurity management (26%) and the challenge of staying proficient (21%) as key barriers.

For 10% of respondents there simply is no need, or they have yet to recognize a need, for advanced engineering tools.

Category	Percentage
Cost	61%
Not enough training or education	47%
Computational hardware limitations	29%
Leadership alignment	28%
Cybersecurity management	26%
Hard to stay proficient	21%
Software limitations	19%
Interface and software communication limitations	19%
IT challenges	18%
These tools are reserved for specialists	14%
File management limitations	7%
No need or requirement	10%

Q: What are the top three challenges holding design engineers back from utilizing more advanced engineering tools (including cloud computing and artificial intelligence)?
The chart displays the percentage of respondents who selected each option.
Because respondents can select multiple options, the total can go above 100%.

N = 72

Simulation Resources

WHERE ARE SIMULATIONS TYPICALLY PERFORMED?

Despite the simulation software industry's push to get users to compute simulations on the cloud, 56% of respondents still run simulations on a local workstation. This suggests that computational resources are still a limiting factor in the simulation process.

Other options include running simulations within a local cluster (13%), private cloud (6%) or public cloud (4%). Some respondents (5%) outsource simulation work to external vendors.

We discovered that 10% of respondents don't use simulations at all, and 5% have no idea where their organization perform simulations.

Local workstation	Local cluster	Private cloud	Public cloud	Outsourced to an external vendor	We don't use simulations	Don't know
56%	13%	6%	4%	5%	10%	5%
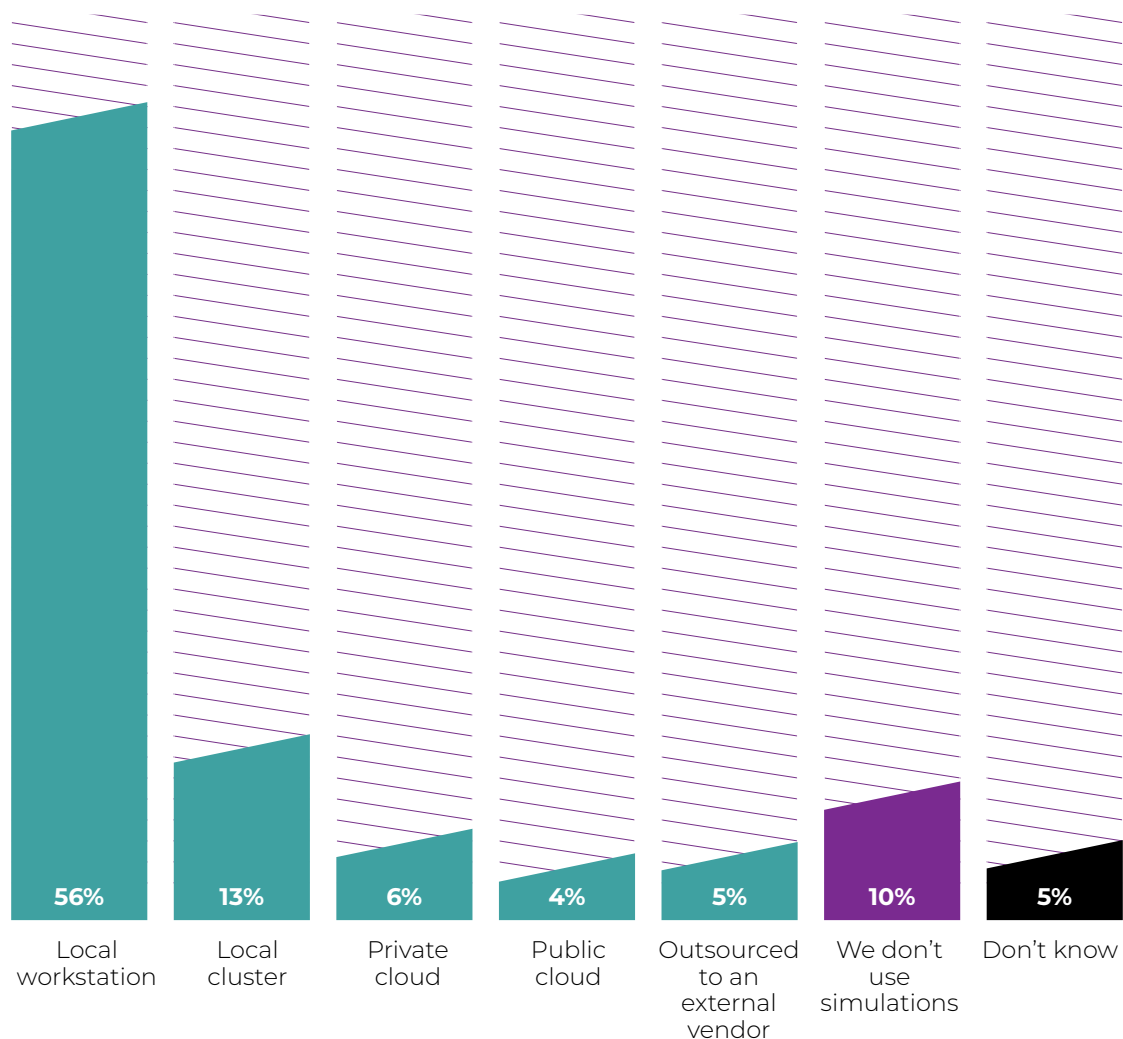
Q: Where are your simulations performed?   N = 156

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DOES THE DESIGN SPACE SUFFER FROM A LACK OF RESOURCES?

When computational resources become scarce, engineers need to limit the exploration of the design space. As seen in the previous question, the majority use local workstations to perform simulations, which severely limits resources.

Therefore, it isn't surprising that 18% of our respondents always limit the design space, 15% limit it 75% of the time, and 37% limit the design space half of the time. So, a total of 70% of respondents severely limit the design space.

A good portion (27%) only limit the design space 25% of the time. Only 4% have never limited the design space due to a lack of resources. This aligns with the number of people using the cloud in the previous question.

Always	75% of the time	50% of the time	25% of the time	Never
18%	15%	37%	27%	4%
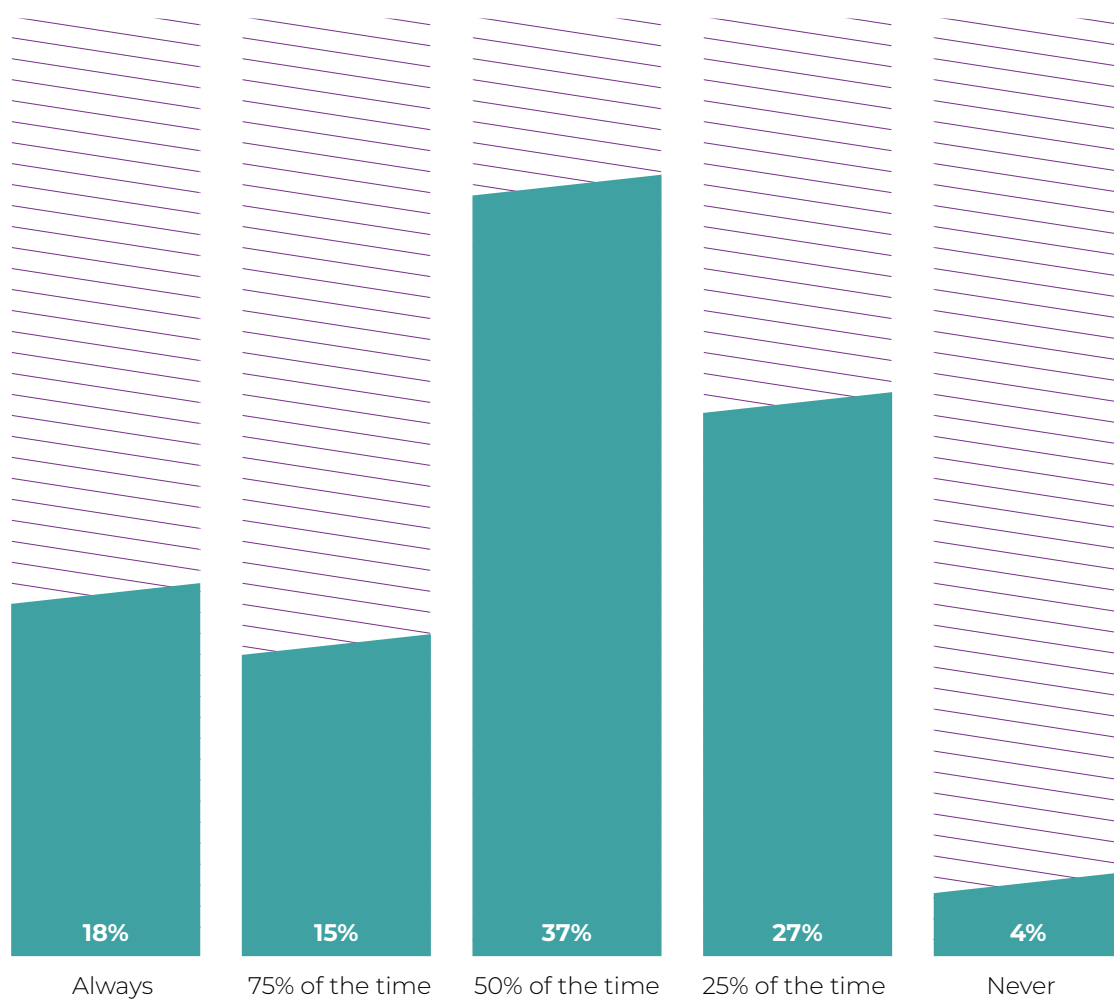
Q: Approximately, how often do you limit the design space due to lack of resources?   N = 79
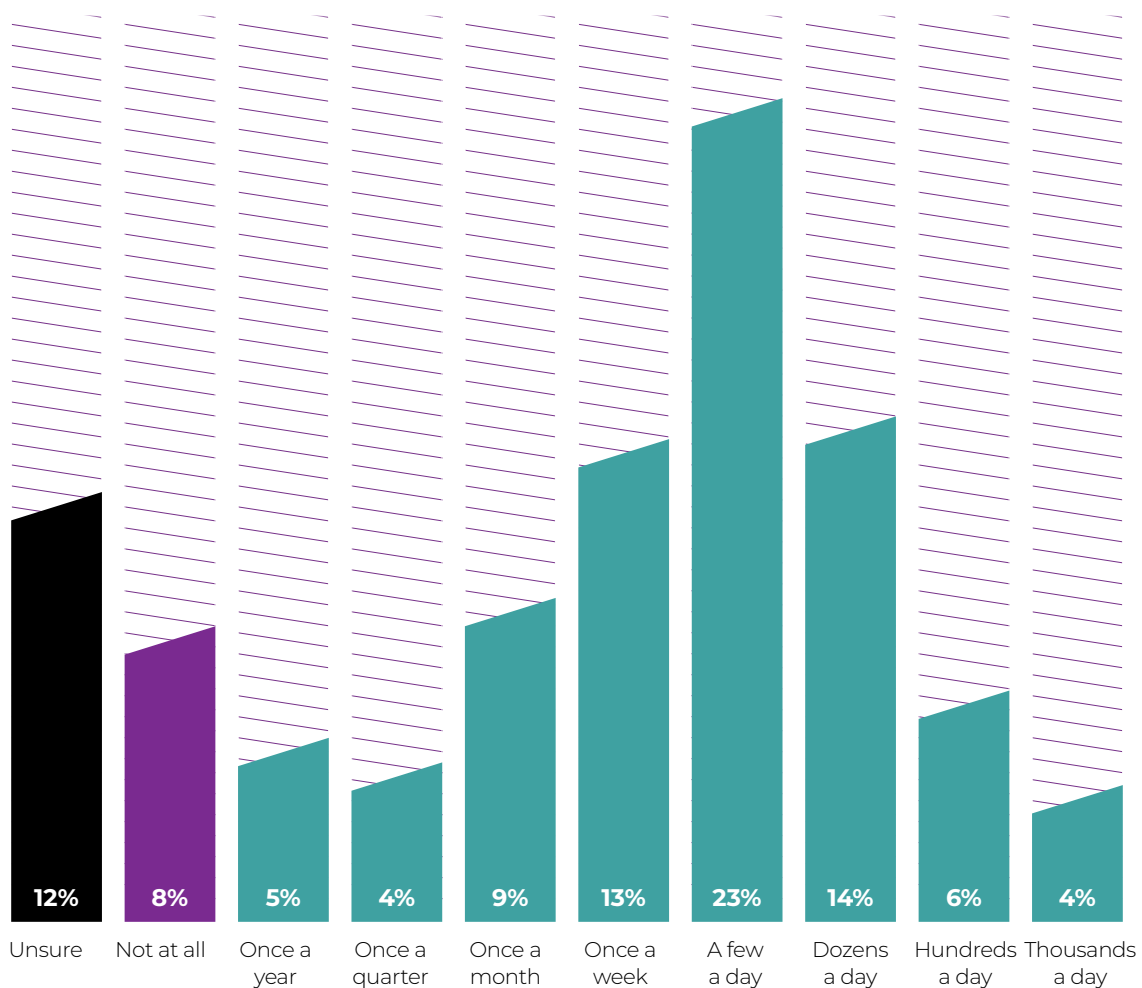
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HOW OFTEN ARE SIMULATIONS PERFORMED TODAY?

Organizations are performing simulations at different rates; however, the most common frequency is a few simulations a day (23%) followed by dozens of times a day (14%) and once a week (13%).

On the low end of usage, a few respondents perform simulations once a year (5%) or once a quarter (4%).

On the high end of usage, 4% of respondents perform simulations thousands of times a day and 6% do it a hundred times a day. This again aligns with the use of the cloud in previous questions.

We discovered that 8% of those surveyed avoid running simulations altogether.

12%	8%	5%	4%	9%	13%	23%	14%	6%	4%
Unsure	Not at all	Once a year	Once a quarter	Once a month	Once a week	A few a day	Dozens a day	Hundreds a day	Thousands a day

Q: How often does your company perform simulations? – Computing Frequency   N = 156
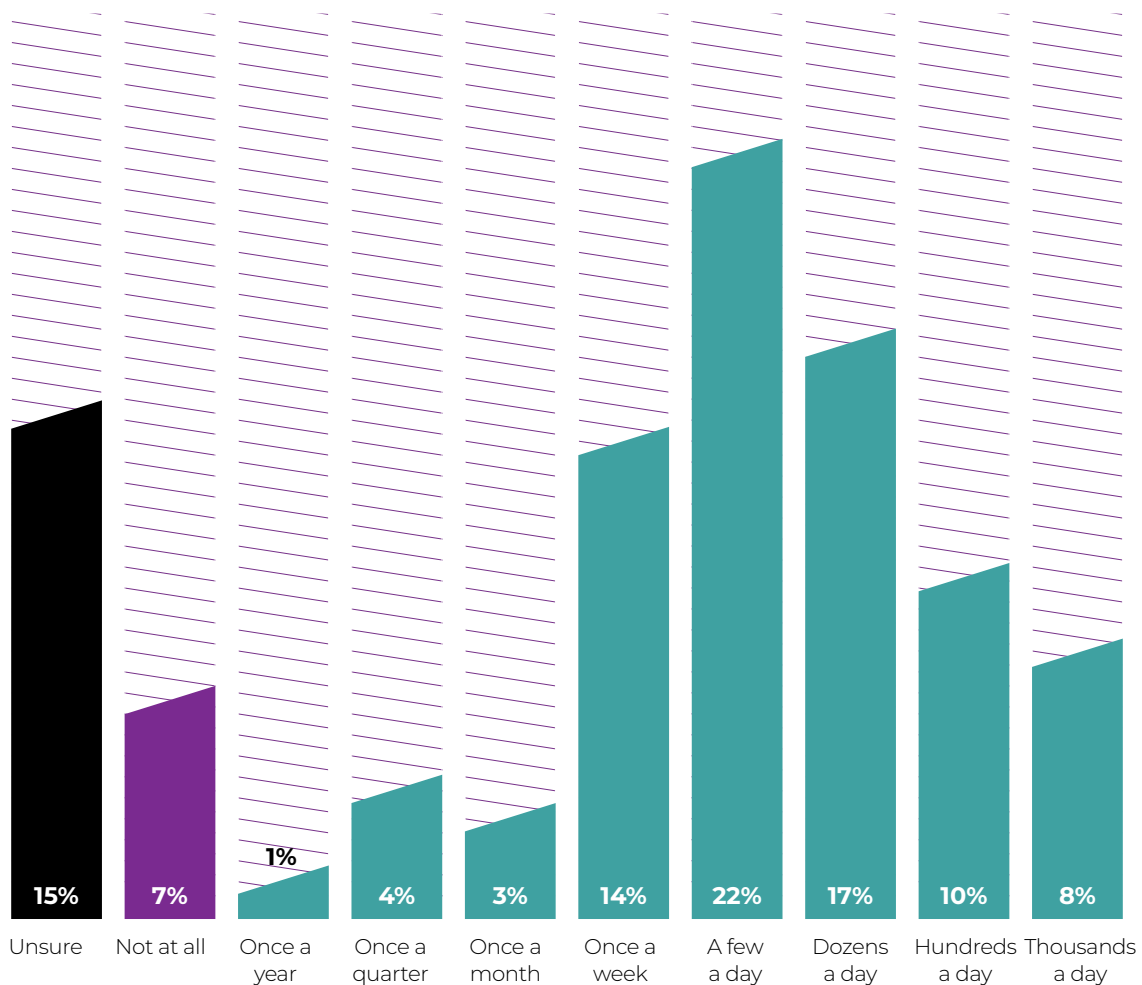
HOW OFTEN WOULD SIMULATIONS RUN WHEN UNRESTRICTED?

With no compute or software limits, the majority would still run a few simulations a day (22%), dozens a day (17%) and once a week (14%).

However, access to added resources saw more interest from the higher end of simulation usage. The number performing a hundred simulations a day jumped to 10% (from 6%) and the number performing thousands a day doubled to 8%.

This suggests that there is an interest from industry leaders to utilize the high compute power of the cloud to better optimize designs.

| Unsure	Not at all	Once a year	Once a quarter	Once a month	Once a week	A few a day	Dozens a day	Hundreds a day	Thousands a day
15%	7%	1%	4%	3%	14%	22%	17%	10%	8%

Q: With no compute and software limits, how often would your company perform simulations? - Computing Frequency

N = 151

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DOES SOFTWARE LIMIT SIMULATION CYCLES AND DESIGN FIDELITY?

We sought to learn more about the link between simulation cycles and design fidelity with the software and computing resources available. With recent advances in computing technology and simulation tools, we expected to find that technology is becoming less of a barrier.

Instead, we learned that 50% of our respondents experienced limitations to the number of simulation cycles, and to the fidelity of designs, because of their software or computing resources. This tracks with the high use of local workstations and the low usage of cloud computing. However, it also suggests that there is an appetite to boost computational resources.

Yes
50%

No
50%
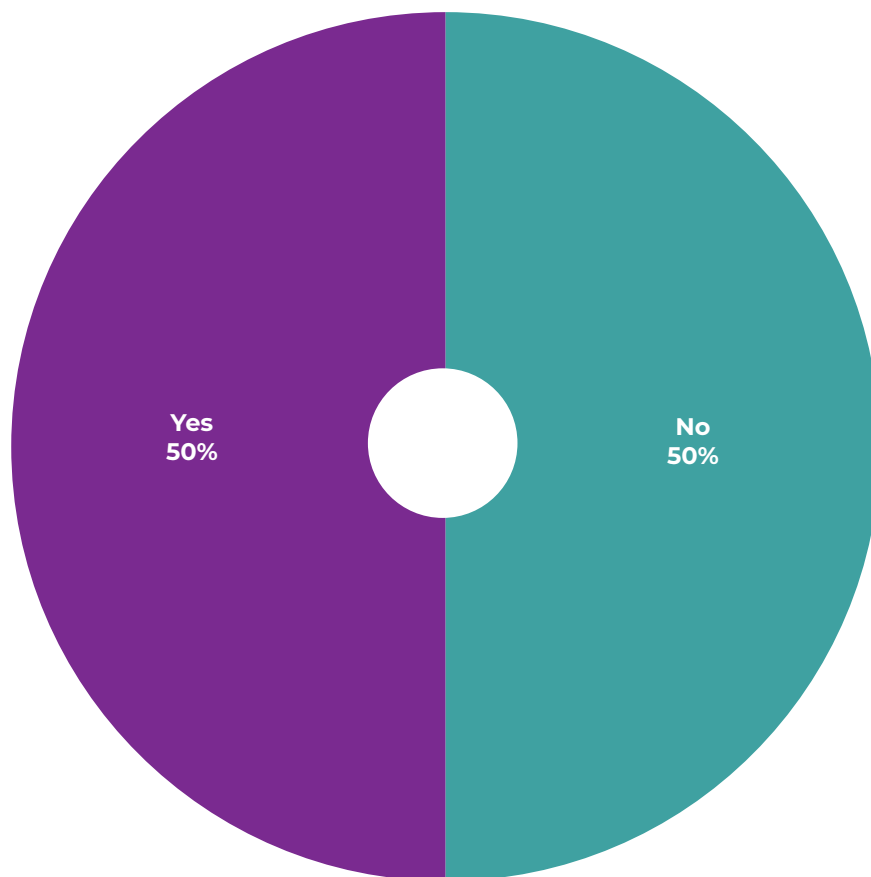
Q: Are the number of simulation cycles and fidelity of designs limited by the software or compute resources you have access to?

N = 158

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Digital Transformation

IS DIGITAL TRANSFORMATION IN THE PLAN?

Are organizations approaching digital transformation with intentionality? We found that only 25% have a digital transformation roadmap.

The majority operate without a roadmap (38%) or do not share that information with their employees. This leaves 37% of respondents unsure of the existence of their organization's roadmap.
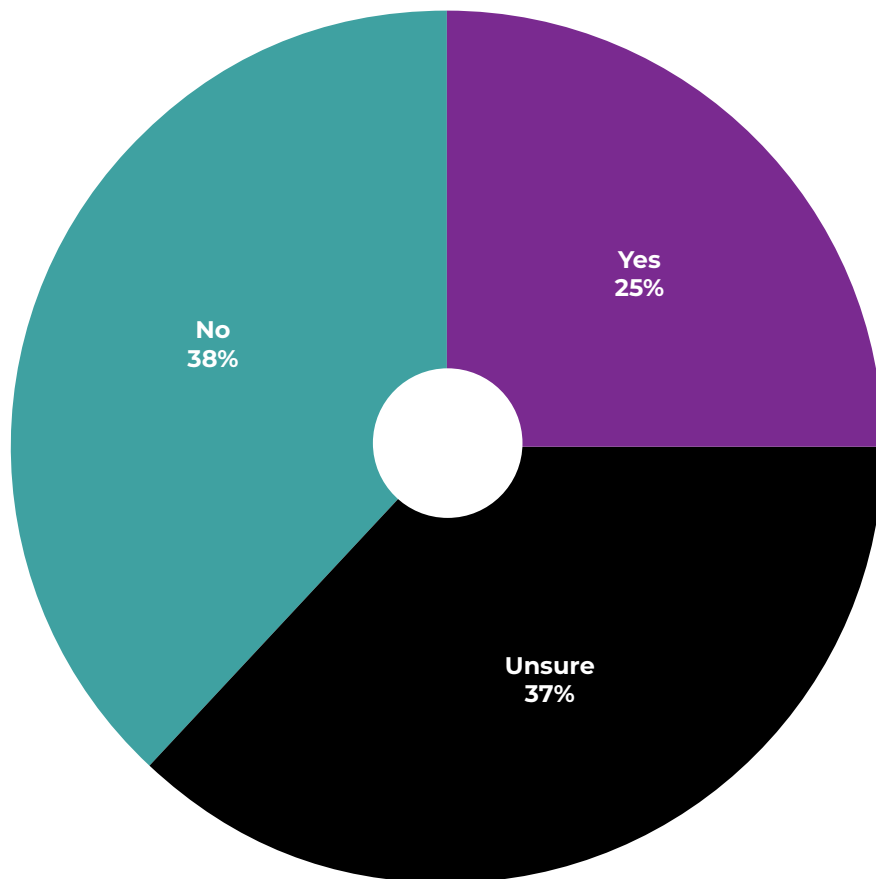
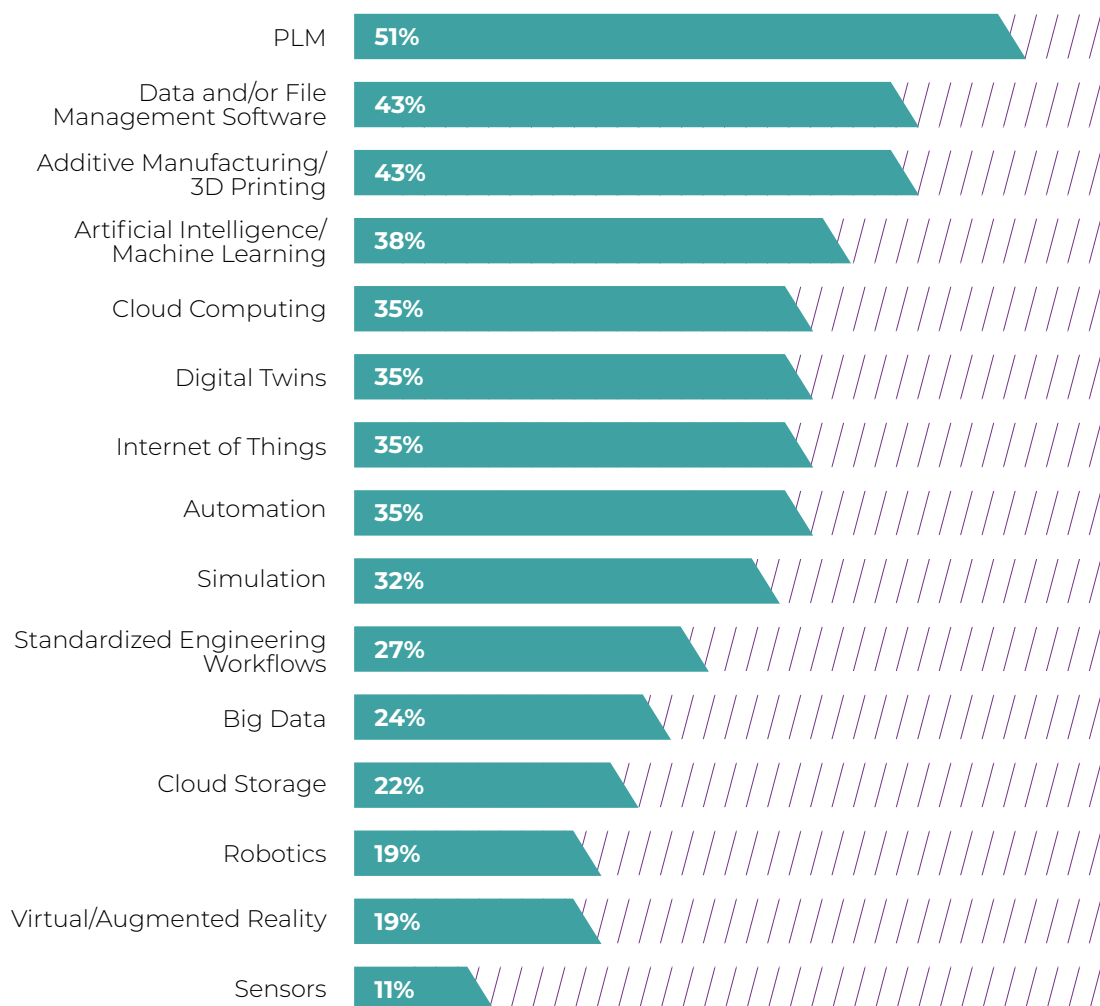Q: Does your organization have a digital transformation roadmap?   N = 151

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WHICH DIGITAL TRANSFORMATION SOFTWARE IS BEING IMPLEMENTED?

Not many respondents answered this question, which tracks with the low number of organizations that have, or share, their digital transformation plan.

However, the technologies that appear to be regularly implemented include PLM software (51%), data management software (43%) and additive manufacturing/3D printing (43%).

Other tools that are implemented include AI/ML (38%), cloud computing (35%), digital twins (35%), Internet of things (35%) and automation (35%).

Technology	Percentage
PLM	51%
Data and/or File Management Software	43%
Additive Manufacturing/ 3D Printing	43%
Artificial Intelligence/ Machine Learning	38%
Cloud Computing	35%
Digital Twins	35%
Internet of Things	35%
Automation	35%
Simulation	32%
Standardized Engineering Workflows	27%
Big Data	24%
Cloud Storage	22%
Robotics	19%
Virtual/Augmented Reality	19%
Sensors	11%

Q: Which software or technology is your organization implementing for a digital transformation? Select all that apply. The chart displays the percentage of respondents who selected each option. Because respondents can select multiple options, the total can go above 100%. [Chart showing responses with 11% or more]

N = 37

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Demographics

INDUSTRIES REPRESENTED

Though respondents work in a diverse range of industries, the largest industries represented here are Engineering Design or Simulation Services (14%), Aerospace (12%), Manufacturing (11%), Medical Equipment/Devices (7%), Education (7%), Automotive (6%), Oil & Gas (4%), Consumer Products/ Electronics (4%), Construction (4%), Electronic Design Automation (3%) and Computer Systems/Peripherals (3%).

23% of respondents were spread across various other industries. Industries that had fewer than 4 respondents each, included:
- Government (3%).
- Each representing 2% of respondents: Industrial Machine Tools; Communications.
- Each representing 1% of respondents: Heavy Equipment; Food & Beverage; Mining; Chemicals/Plastics/Rubber; Biotechnology.

Industry	Percentage
Engineering Design or Simulation Services	14%
Aerospace	12%
Manufacturing	11%
Medical Equipment/Devices	7%
Education	7%
Automotive	6%
Oil & Gas	4%
Consumer Products/Electronics	4%
Construction	4%
Electronic Design Automation (EDA)	3%
Computer Systems/Peripherals	3%
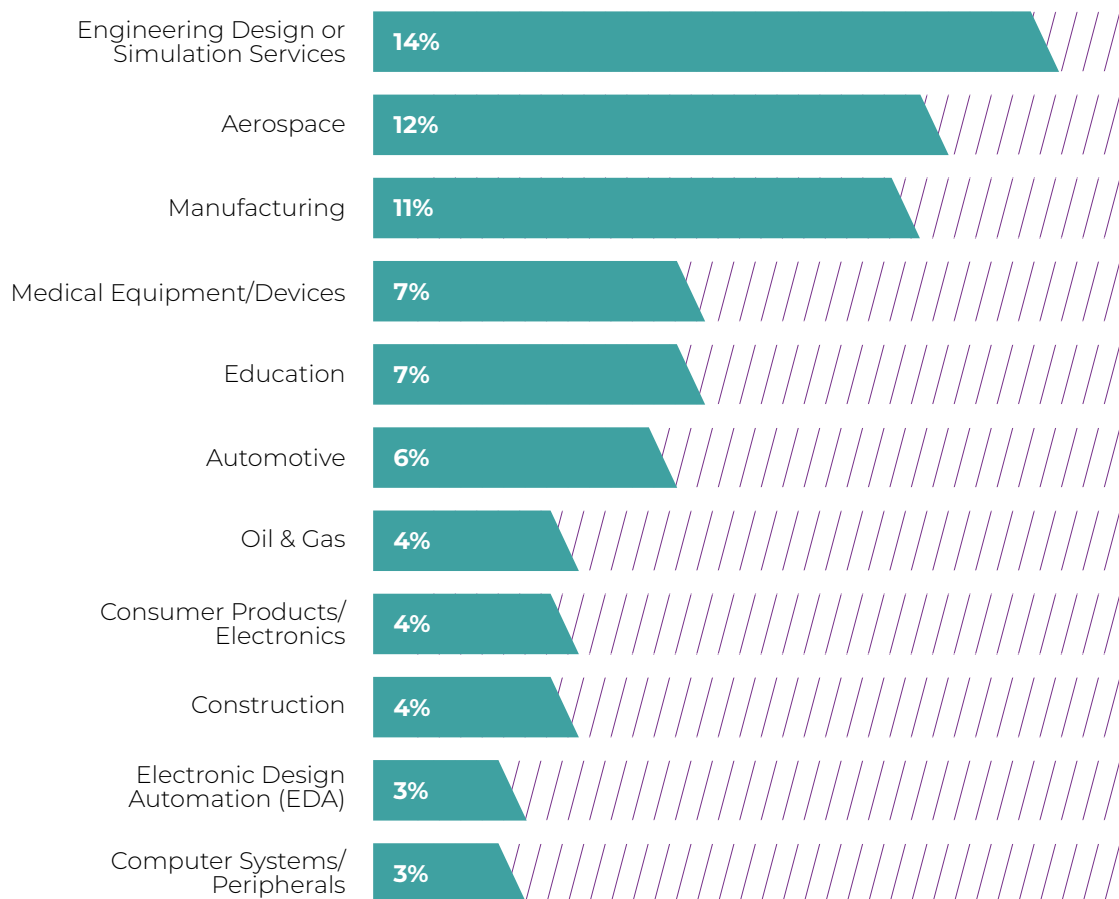
Q: What industry do you work in?
   [Chart showing industries with 3% or more]

N = 159

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ORGANIZATION SIZE

The survey sample represented large and small organizations alike.

Our respondents worked primarily for very larger organizations (38%) with 501+ employees or very small firms with fifty or fewer employees (32%).

A smaller percentage represented companies with 101 – 500 employees (18%) and 50 – 100 employees (13%).

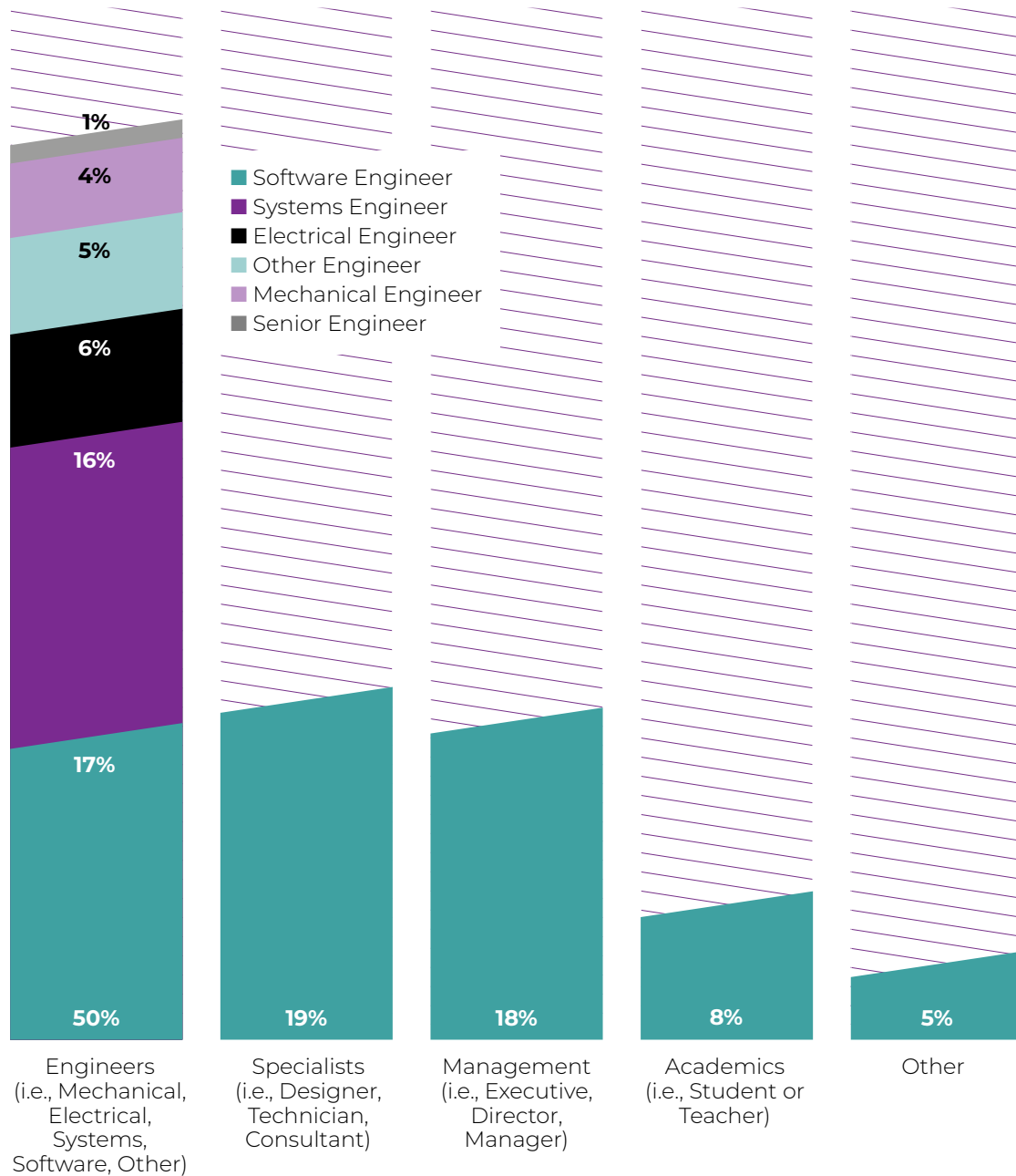| <50 employees	50-100 employees	101-500 employees	501-1000 employees	1001-5000 employees	>5000 employees
32%	13%	18%	7%	13%	18%
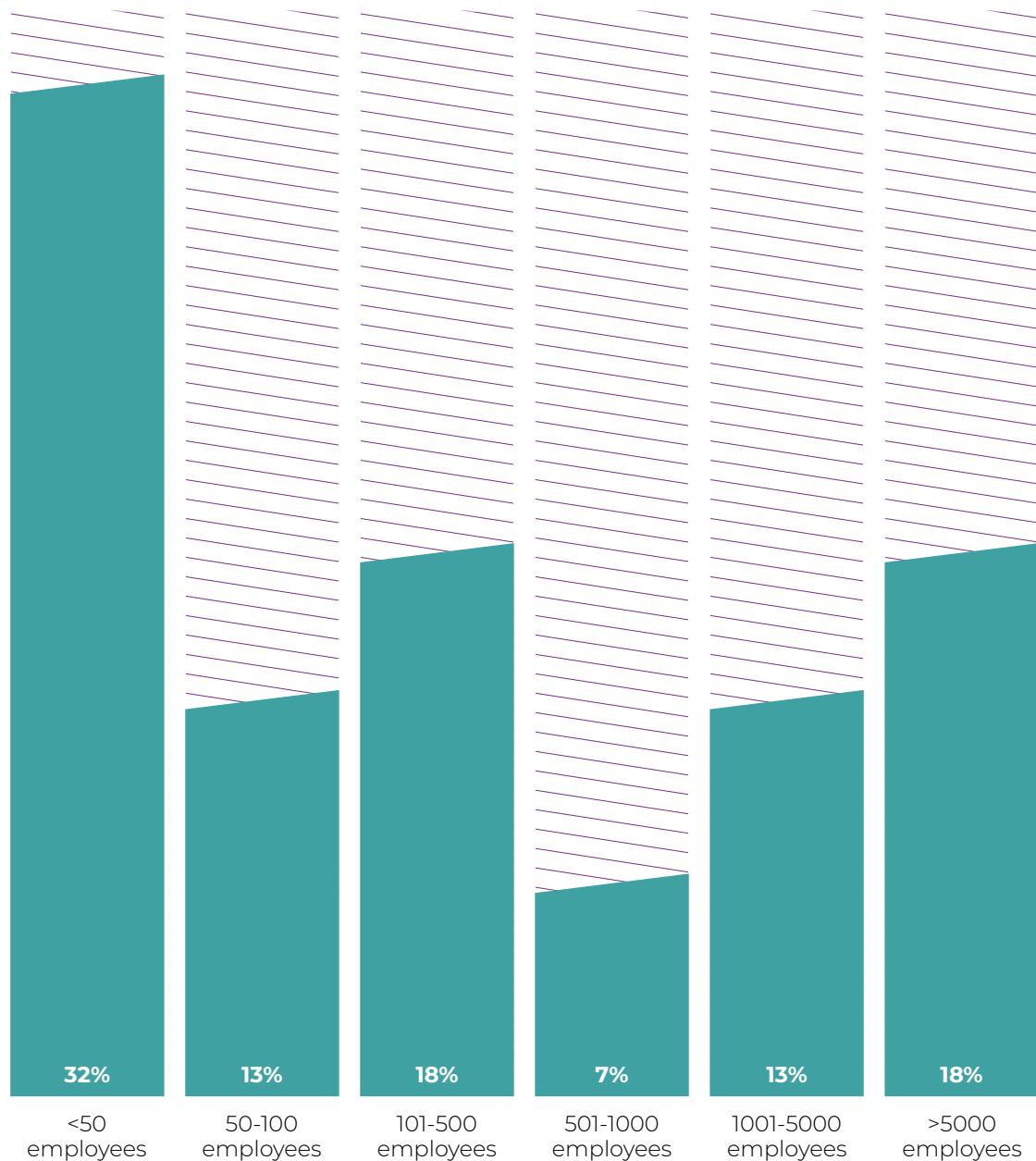
Q: What is the approximate size of your organization?   N = 159

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JOB ROLES REPRESENTED

Half of those included in this survey are Engineers (50%).

However, there is good representation from those who consult, design or serve as technicians for their companies (19%), managers (18%), academics (8%) and 5% working in other roles.

Legend:
- Software Engineer
- Systems Engineer
- Electrical Engineer
- Other Engineer
- Mechanical Engineer
- Senior Engineer

Engineers column (stacked):
- 1%
- 4%
- 5%
- 6%
- 16%
- 17%
- 50%

Engineers (i.e., Mechanical, Electrical, Systems, Software, Other): 50%
Specialists (i.e., Designer, Technician, Consultant): 19%
Management (i.e., Executive, Director, Manager): 18%
Academics (i.e., Student or Teacher): 8%
Other: 5%

Q: What is your job role?

N = 126

CLOSING COMMENTS

We conducted this survey to see how organizations utilize and implement advanced design, CAE and digital transformation tools. We discovered a large gap between those who have access to these tools and those who don't. Despite engineers' appetite to use these tools, organizations do not access them to their full potential.

A few additional takeaways from the survey include:
- Nearly half (46%) of respondents believed engineers are being held back from advanced design and CAE technologies such as cloud computing and artificial intelligence. Cost (61%) was the top reason design engineers don't utilize these tools. Knowledge gaps were another component with 47% indicating that a lack of training and education is a contributing factor.
- We asked our audience to consider what design engineers need across various industries. The majority (54%) considered artificial intelligence and machine learning tools to be versatile across industries. On-Demand software licenses (50%), automated workflows (46%) and data management and sharing tools (46%) are also applicable to a broad audience.
- Respondents provided insight into their organizations' top goals for advanced design and CAE tools. Overall, 57% plan to apply their tools to artificial intelligence and machine learning solutions, 49% want to use them for generative design and 46% a want to work on digital transformation.
- Half of respondents need to limit the number of simulation cycles, and fidelity of designs, because of their software or computing resources. However, only 10% of simulations are run on the cloud (6% on private and 4% on public clouds). With unlimited resources, the number of engineers performing hundreds or thousands of simulations a day nearly doubled.

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,

Shawn Wasserman
Sr. Editor, engineering.com

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