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The state of multiphysics simulation in 2025:
Challenges, trends and opportunities

Results and key findings from our market research survey of 250 engineers and decision makers in modern R&D

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Motivation for the report

The growing importance of simulation

Multiphysics simulation is increasingly vital for engineers and decision-makers in many industries. It helps model and predict how different physical effects interact, which is key for creating new products, improving existing ones, and solving problems. As technology becomes more complex, the demands on simulation methods are also rising, making it important to regularly assess and refine how we currently approach this work.

Why we conducted this study

To better understand the current state of multiphysics simulation, the difficulties users face, the potential of new technologies, and the main trends influencing its future, we surveyed 250 engineers and decision-makers in this field. This report shares the main findings from that survey, providing useful insights into the views, problems, and hopes of professionals who use multiphysics simulation regularly.

How the study was conducted

The survey was carried out in-house by Quanscient and distributed through multiple channels, including LinkedIn outreach, emails, our website, and existing mailing lists. While 78.5% of respondents were already familiar with Quanscient, and 21.5% were not, no statistically significant differences were observed in their responses indicating that prior awareness had no impact on the results presented in this report.

Key takeaways

Waiting for resources

84.8%

Percentage of respondents having to wait for simulation resources to free up in order to complete essential studies

Simplifying models

89.2%

Percentage of respondents having to simplify models to reduce runtimes due to operational constraints

Not satisfied with runtimes

54.4%

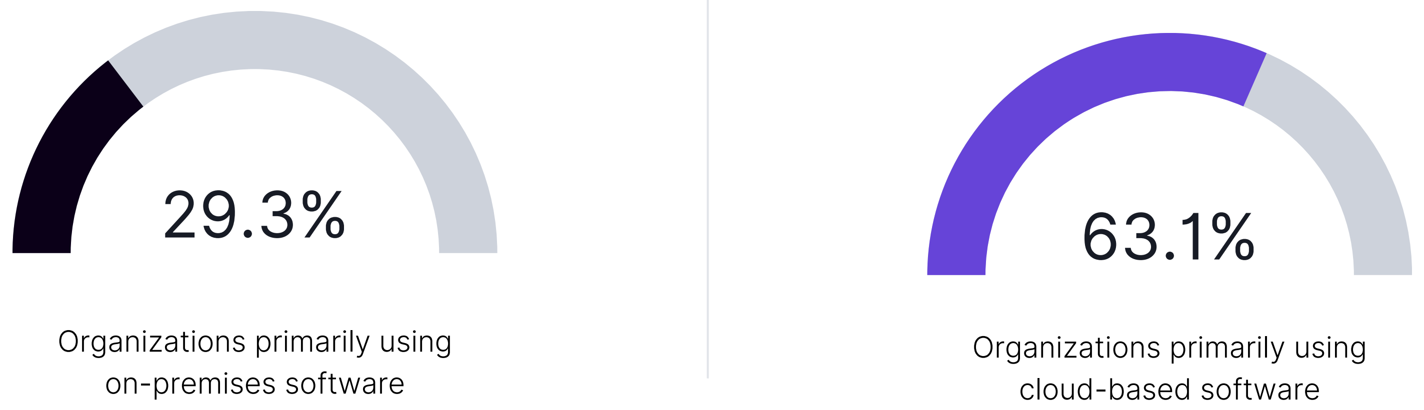
Percentage of respondents not being satisfied with their simulation runtimes

Not satisfied with scalability

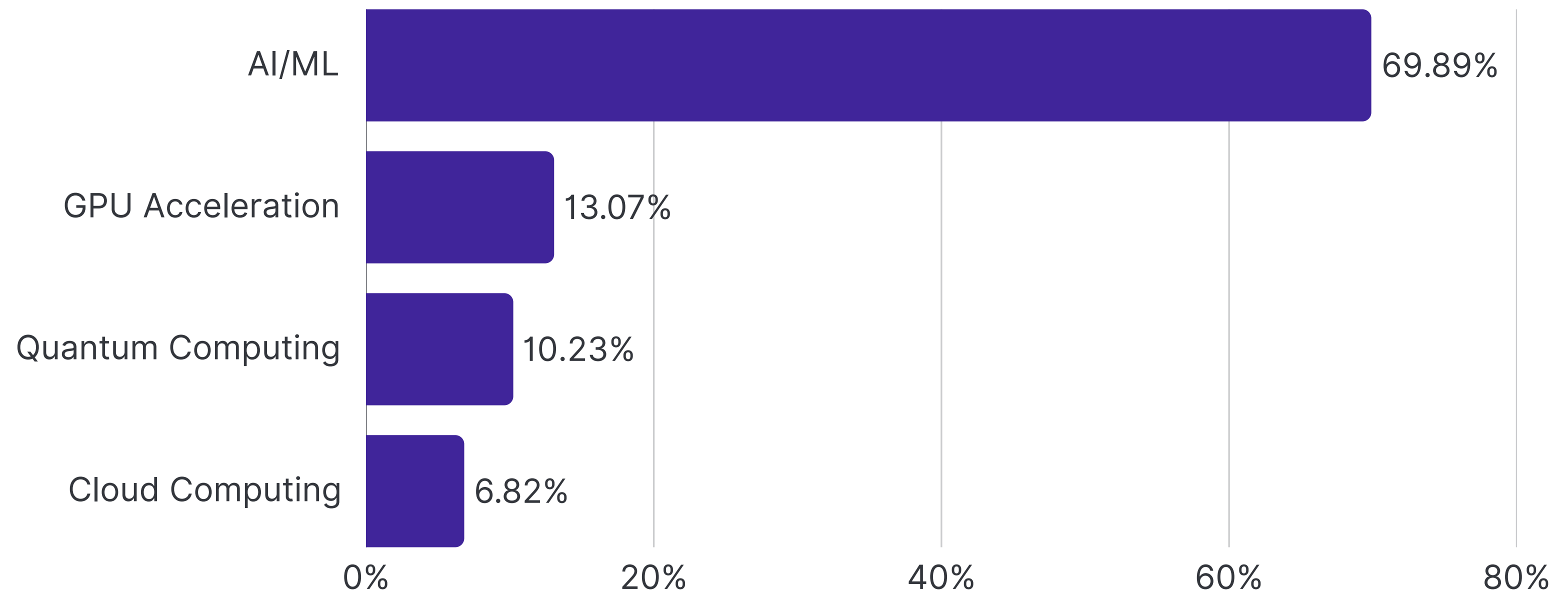
64.8%

Percentage of respondents not being satisfied with their scaling capabilities

Satisfaction with scaling capabilities



Expected advancements in the next 5 years



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Understanding our survey respondents

Who participated in the survey?

To ensure the insights and findings presented in this report accurately reflect the current state of multiphysics simulation, **we surveyed 250 engineers and decision-makers** actively involved in this field. This section provides an overview of the key demographics of our respondents, including their industries, company sizes, roles, and seniority levels.

Why respondent demographics matter

Understanding the composition of our survey participants is important for contextualizing the data presented throughout this report. By analyzing the demographics, we can identify trends and patterns within specific groups, allowing for a more nuanced interpretation of the results and ensuring the relevance of our findings to a broad range of stakeholders.

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Industry and organization size breakdown of respondents

Our survey gathered responses from **250 professionals,** offering a broad spectrum of perspectives on multiphysics simulation.

Notably, academia (22.4%) and electronics & semiconductors (21.6%) show strong representation. Organization sizes are varied, with the 11-50 employee range (23.9%) and the 5000+ employee range (21.6%) being the most prevalent.

Fig. 1 What industry do you work in?

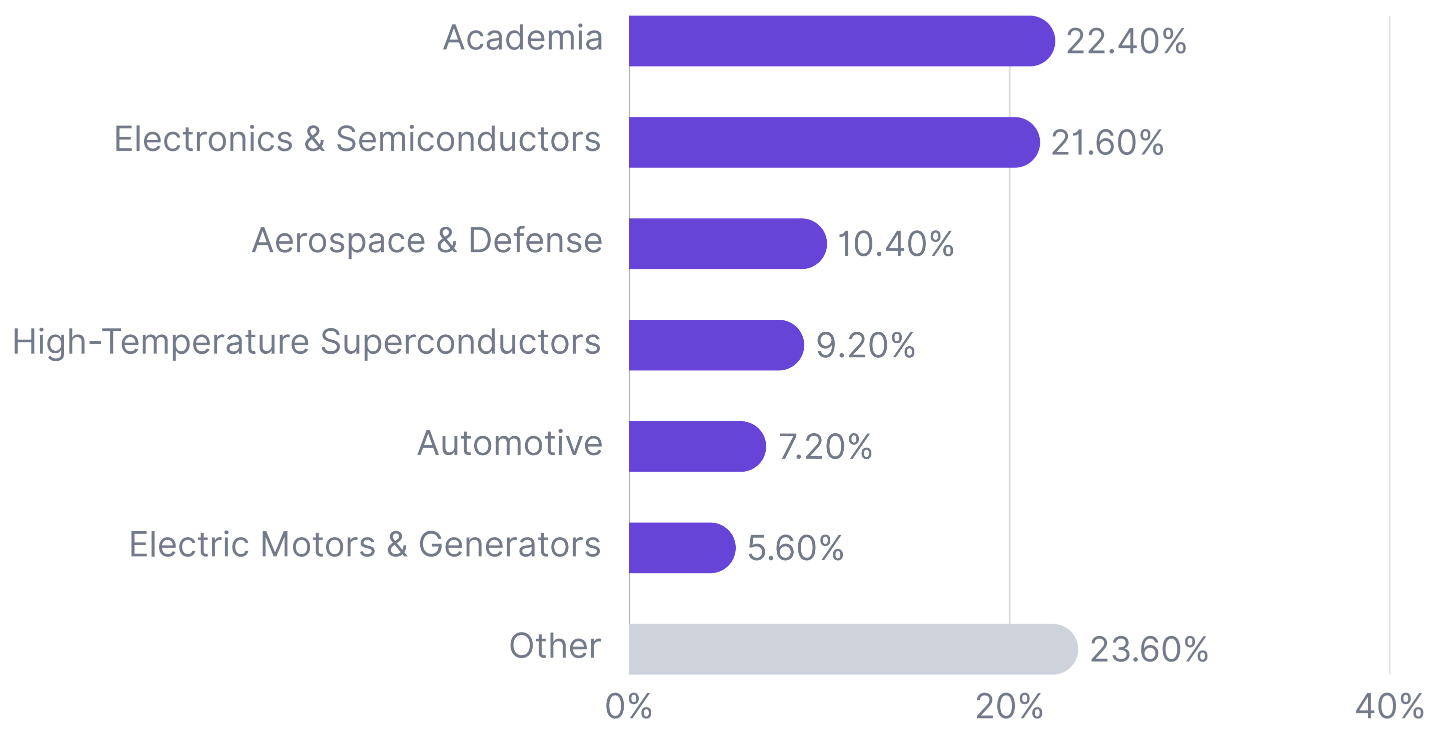
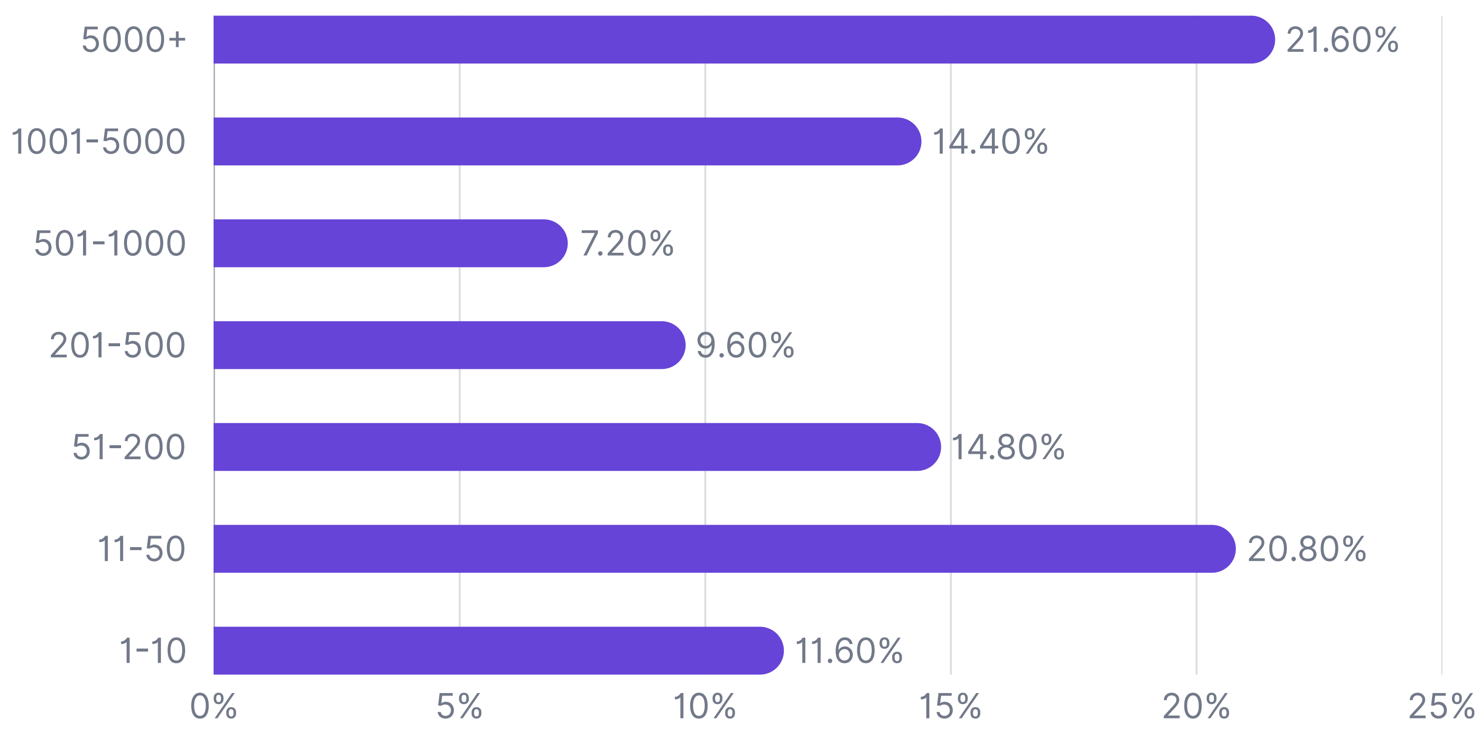


Fig. 2 What is the size of your organization? (Number of employees).



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Breakdown of the ‘other’ industries

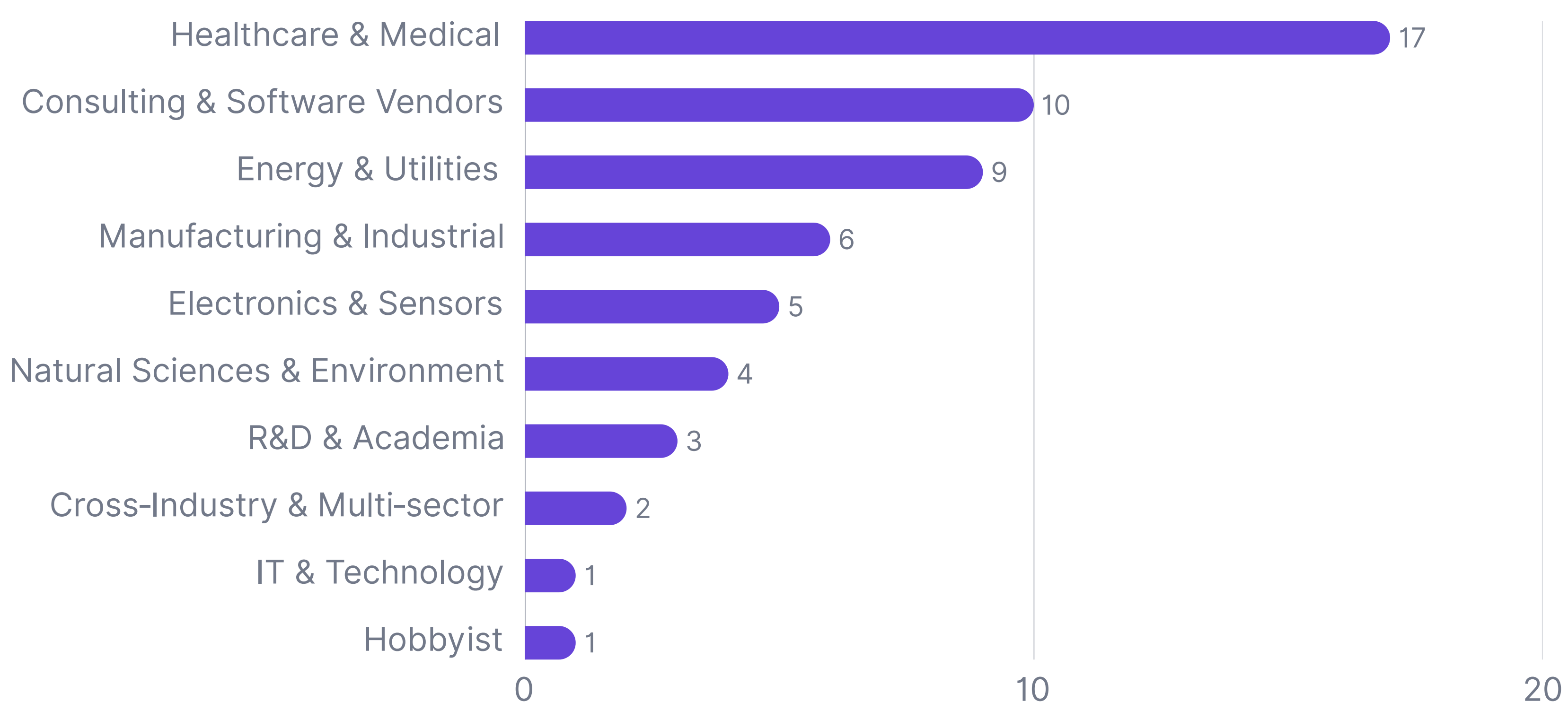
Notable number of ‘other’ industries

In addition to the predefined industry options in the survey, respondents could also select “Other, please specify” and enter their own description. A significant number chose this route, even in cases where their industry might appear to overlap with the listed categories. This suggests that those respondents did not feel the available options fully captured the nature of their work.

‘Other’ responses grouped manually

To better represent this segment, we manually reviewed and grouped the open-ended “Other” responses into broader categories. While some of these could conceptually align with predefined categories, we've presented them separately to respect how respondents chose to self-identify and to highlight the broader diversity in simulation use across sectors.

Fig. 3 Breakdown of the ‘other’ industries



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Respondent roles and seniority levels

Wide range of roles

The survey captured a diverse range of professional roles, with researchers/scientists (41.2%) and simulation engineers/analysts (26.0%) comprising a significant portion.

High degree of experience from senior responders

Notably, a substantial number of respondents occupy senior/lead (38.0%) and mid-level (27.6%) positions, reflecting a high degree of experience within the field. This distribution provides a comprehensive perspective on current multiphysics simulation practices.

Fig. 4 Distribution of roles

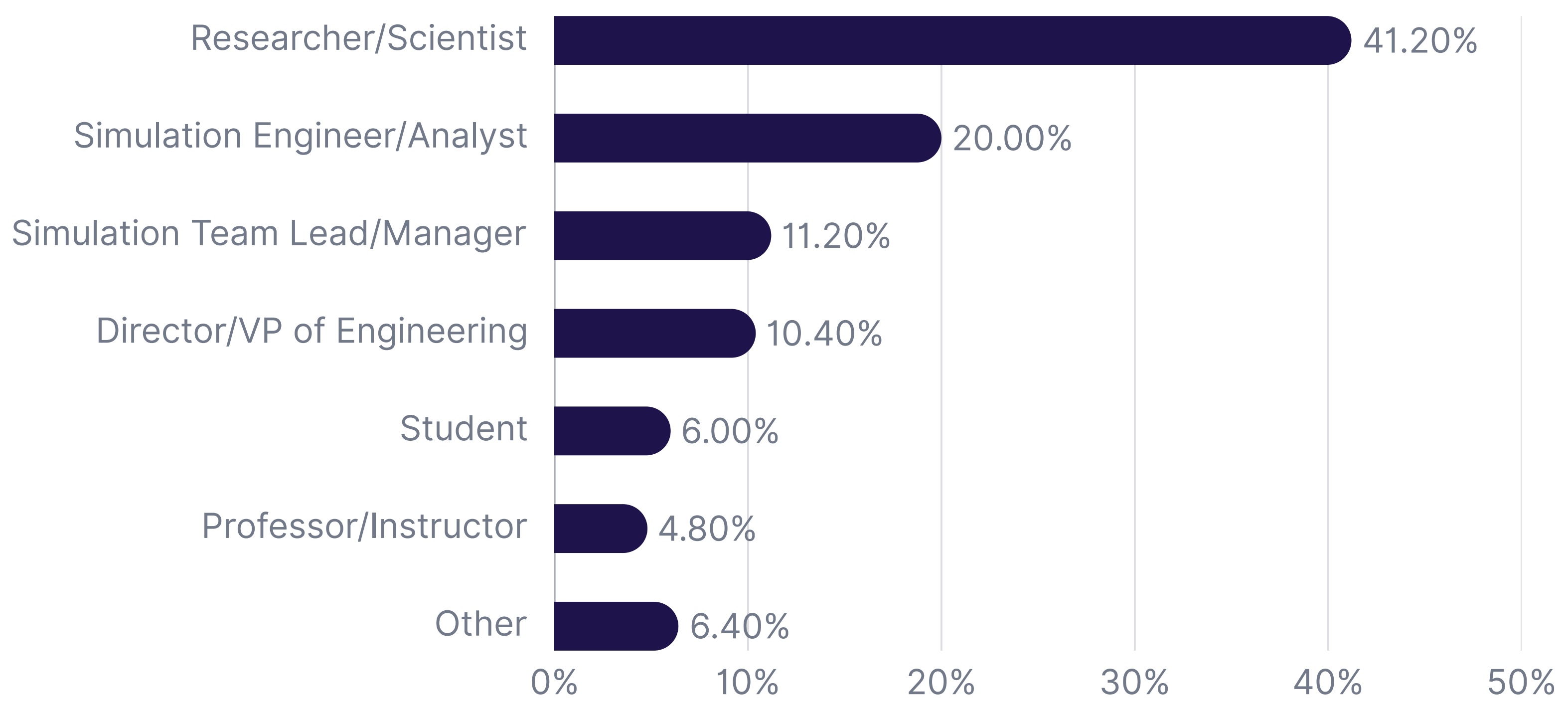
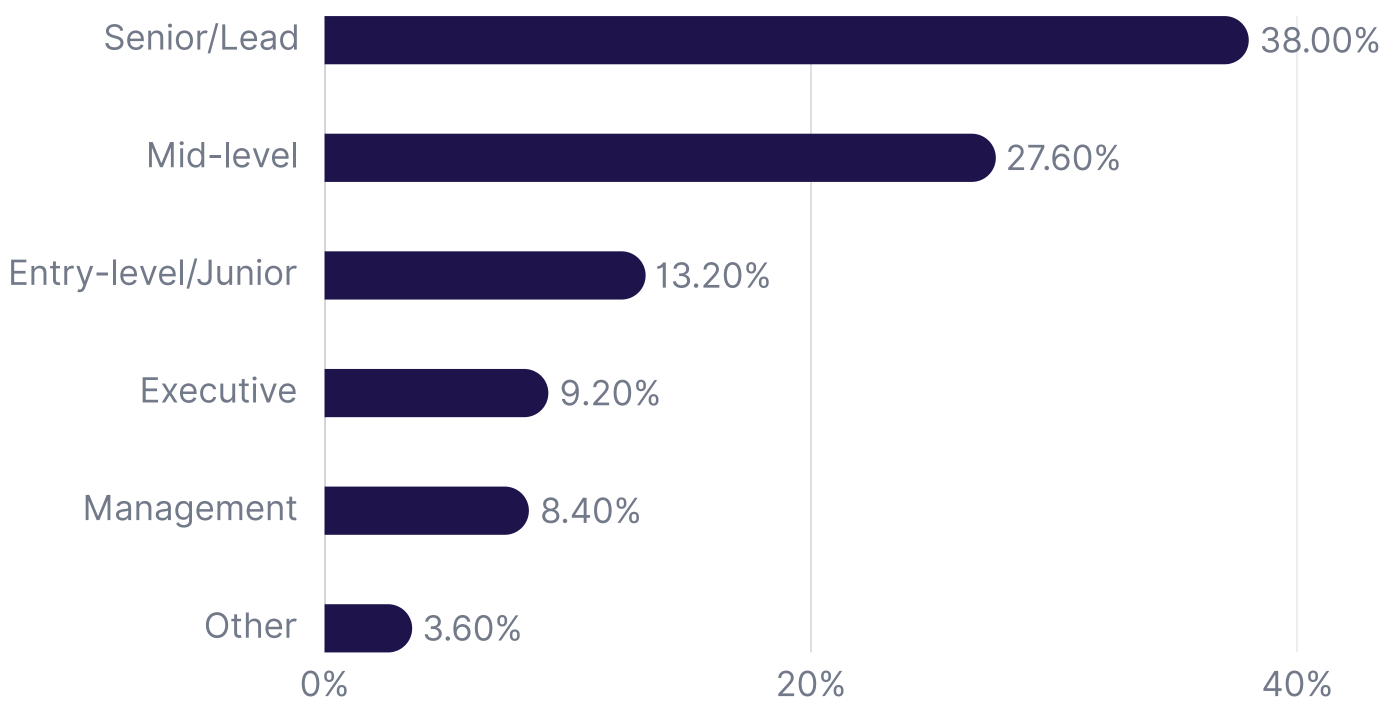


Fig. 5 Distribution of seniority



The current state of multiphysics simulation

Examining today's simulation practices

This section aims to provide a clear picture of the current state of multiphysics simulation. We will explore the primary simulation approaches employed by engineers and decision-makers, the software tools they rely on, and the extent to which they utilize multiple simulation platforms.

Setting the stage for analysis

Understanding the prevailing simulation methodologies and software choices is essential for contextualizing the challenges and opportunities discussed later in this report. By establishing a baseline of current practices, we can more effectively analyze the impact of emerging technologies and identify areas for improvement within the field.

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Predominant simulation approaches

On-premises dominance

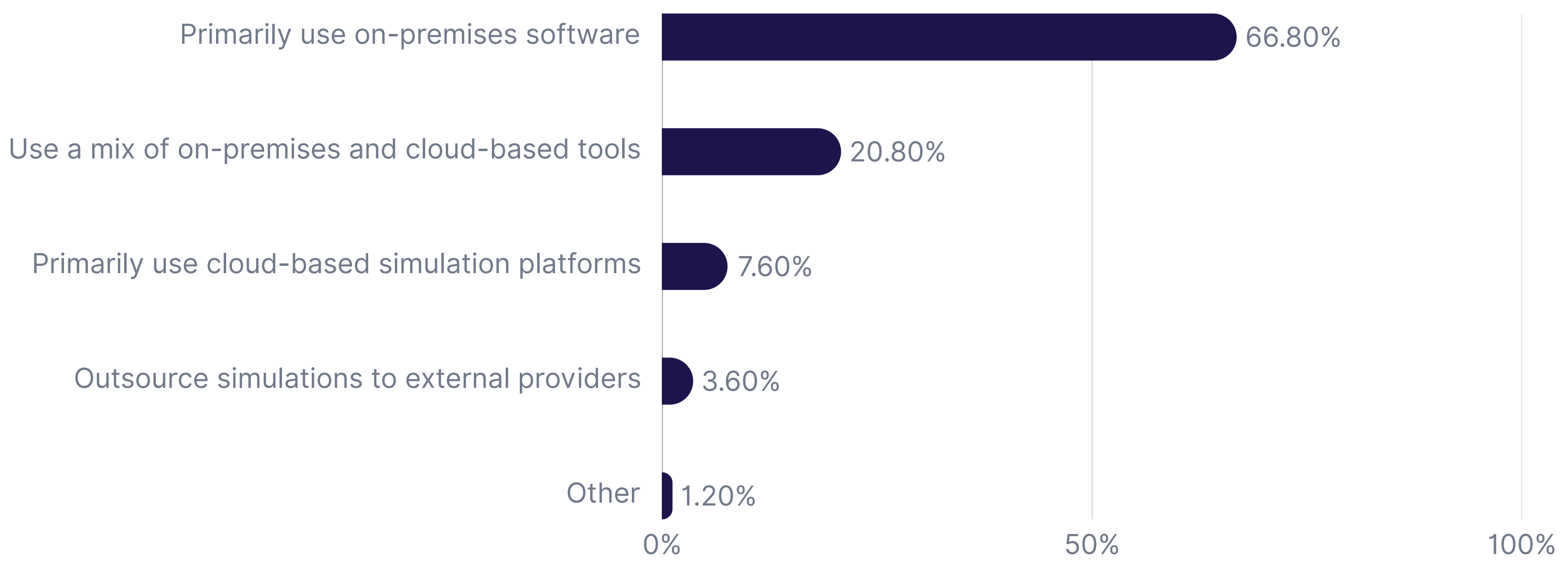
Our survey reveals a strong reliance on on-premises software for multiphysics simulations, with 66.8% of respondents primarily using this approach.

Emerging hybrid use

While 20.8% utilize a mix of on-premises and cloud-based tools, purely a cloud-based approach still remain less common, with just 7.60%.

28.4% report utilizing a cloud-based approach at least partly

Fig. 6 Which of the following best describes your primary approach to simulations?



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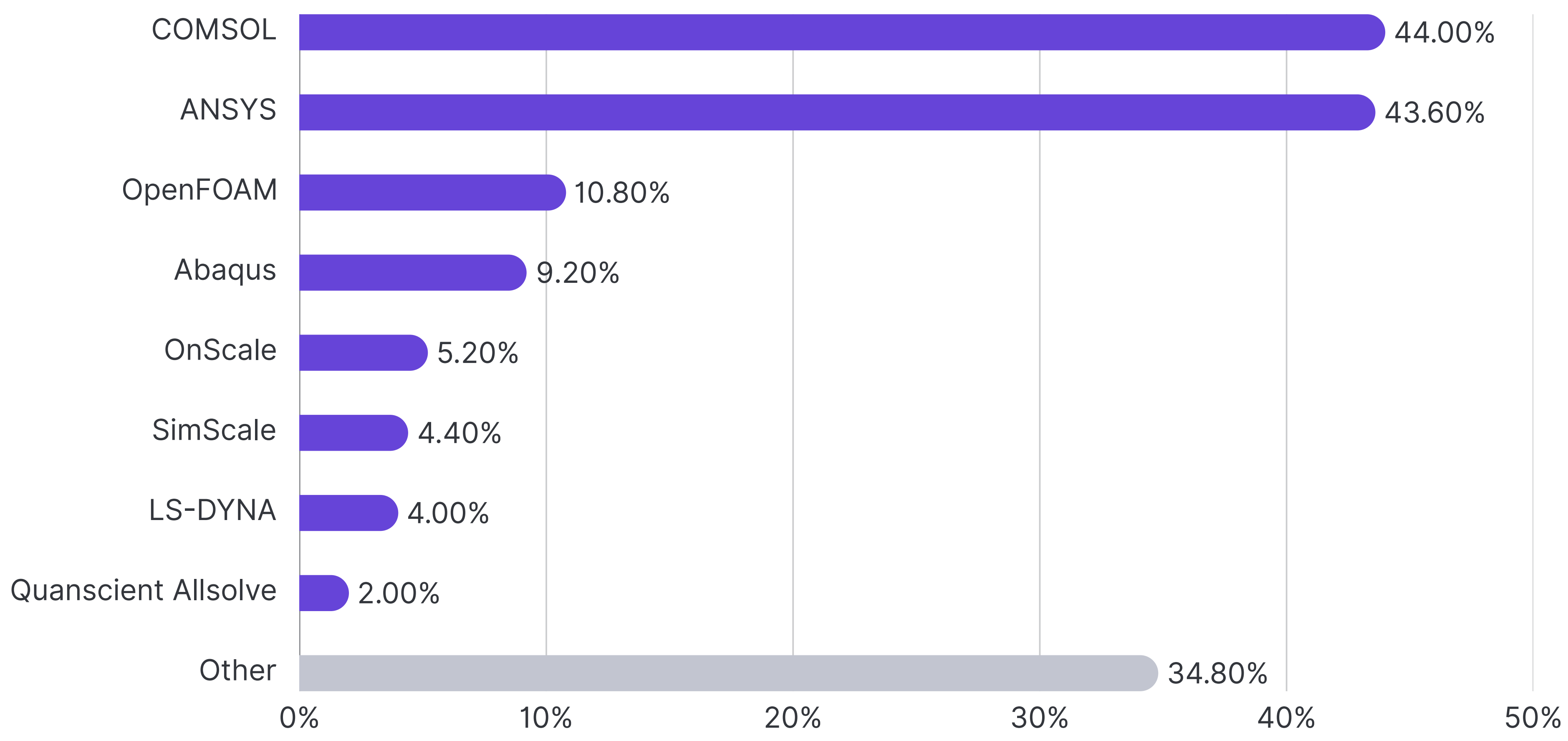
Primary choice for simulation software

Fig. 7 Primary choices for simulation software (select all that apply)



COMSOL and ANSYS tools the most common choice

Figure 7 highlights the popularity of specific simulation tools among respondents.

COMSOL Multiphysics (44%) and ANSYS (44%) emerge as the most widely used software, confirming their leading positions in the multiphysics simulation market.

Other notable tools include OpenFOAM (11%), Abaqus (9%), and OnScale (5%), each catering to specific simulation needs and applications.

The "Other" category (35%) suggests a diverse range of specialized or less common tools used by respondents.

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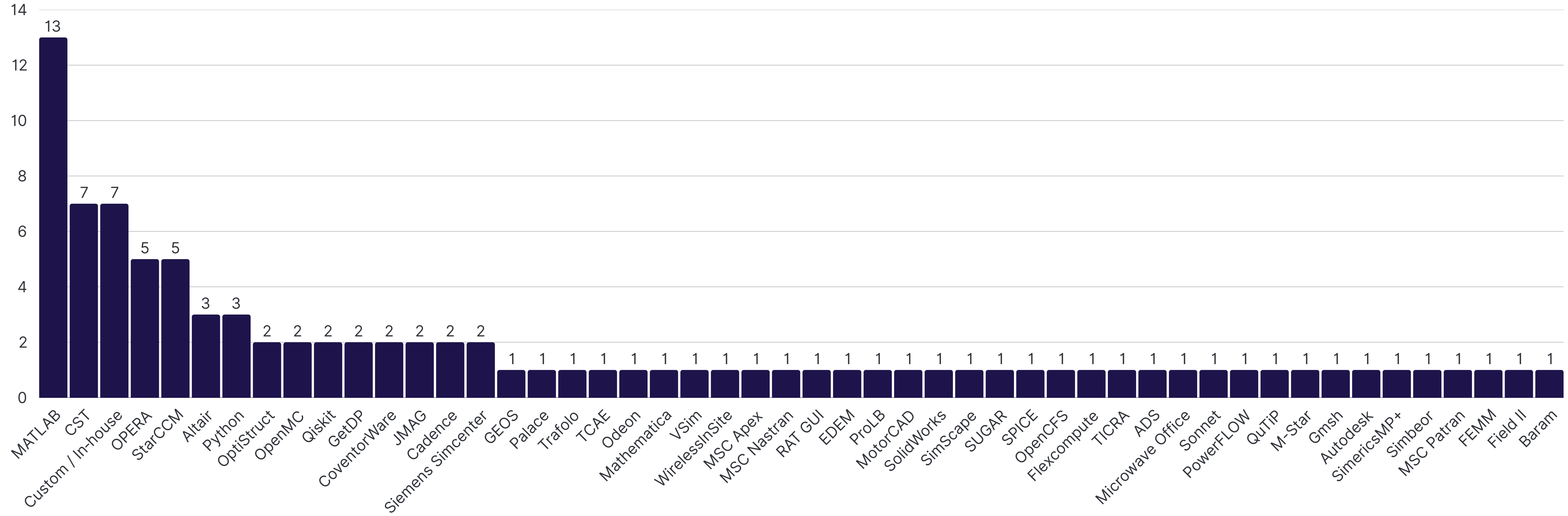
Breakdown of the 'other' software used

Fig. 8 Count of the other simulation tools mentioned



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Number of simulation tools primarily used

Indication of a single-tool dependence

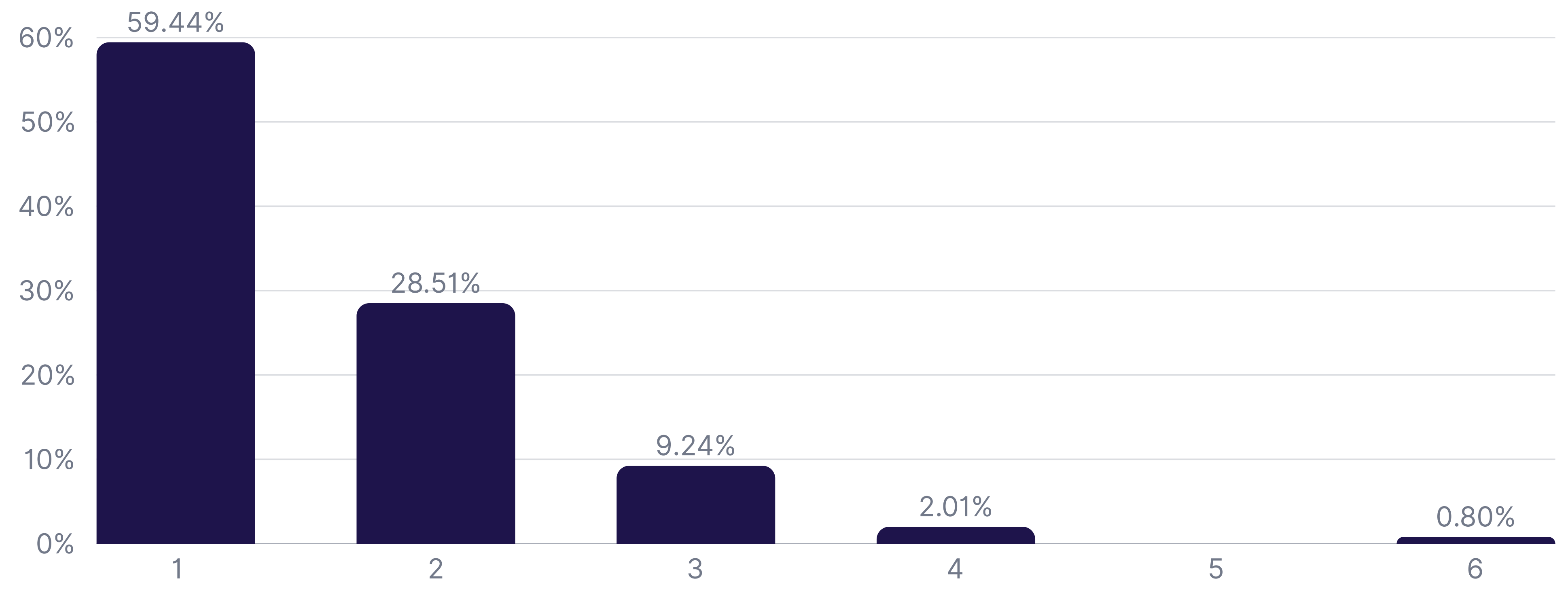
The survey reveals that a majority of respondents (60%) rely on a single simulation tool for their primary multiphysics needs.

A smaller segment (29%) utilizes two tools, while the use of three or more tools is considerably less frequent.

This indicates a tendency towards single-tool dependence in the field.

59.4% of the respondents utilize just one simulation software primarily

Fig. 9 How many simulations software a user primarily uses



The critical role of simulation in R&D

Understanding simulation's impact

This section explores the pivotal role multiphysics simulation plays in research and development across various industries. We will examine how simulations are utilized, at what stages of the development process they are employed, and the correlation between simulation usage and organization size.

Contextualizing organizational significance

By analyzing the diverse applications of simulation, we gain insights into its strategic importance in driving innovation and optimizing product development. This understanding provides a foundation for evaluating the challenges and opportunities associated with current simulation practices.

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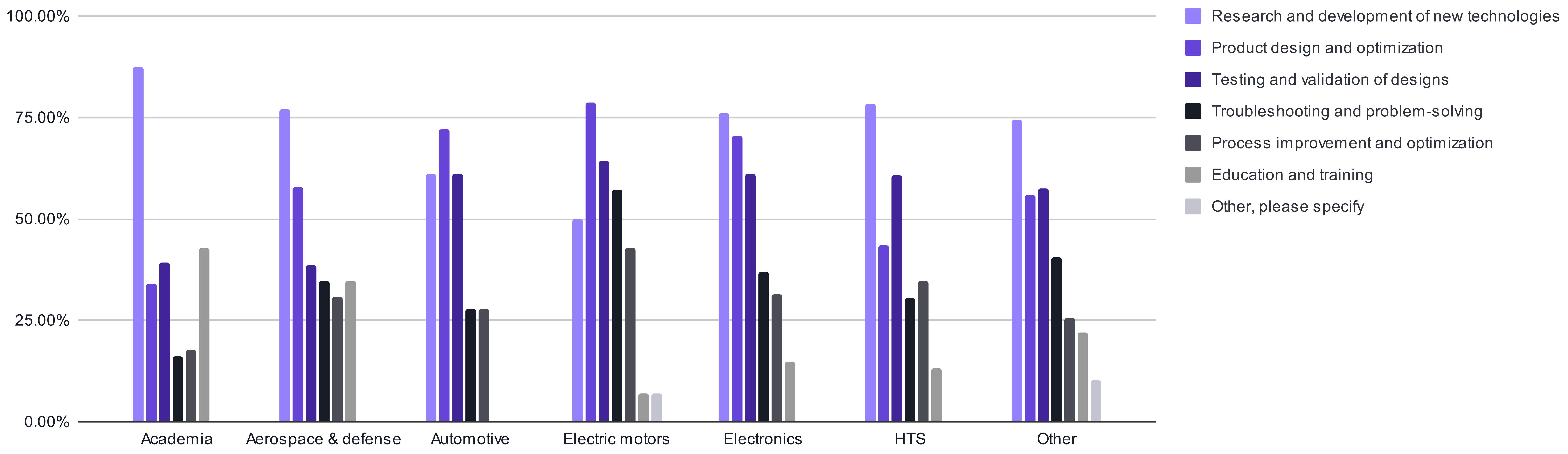
Key applications of simulation across industries

Simulation usage varies by industry

Product design, testing, and R&D are the leading simulation applications across industries. However, usage varies significantly by sector. The "other" category also reveals other applications, including sales enablement and consulting.

Fig. 10 How simulations are used by industry



Simulation usage across development stages

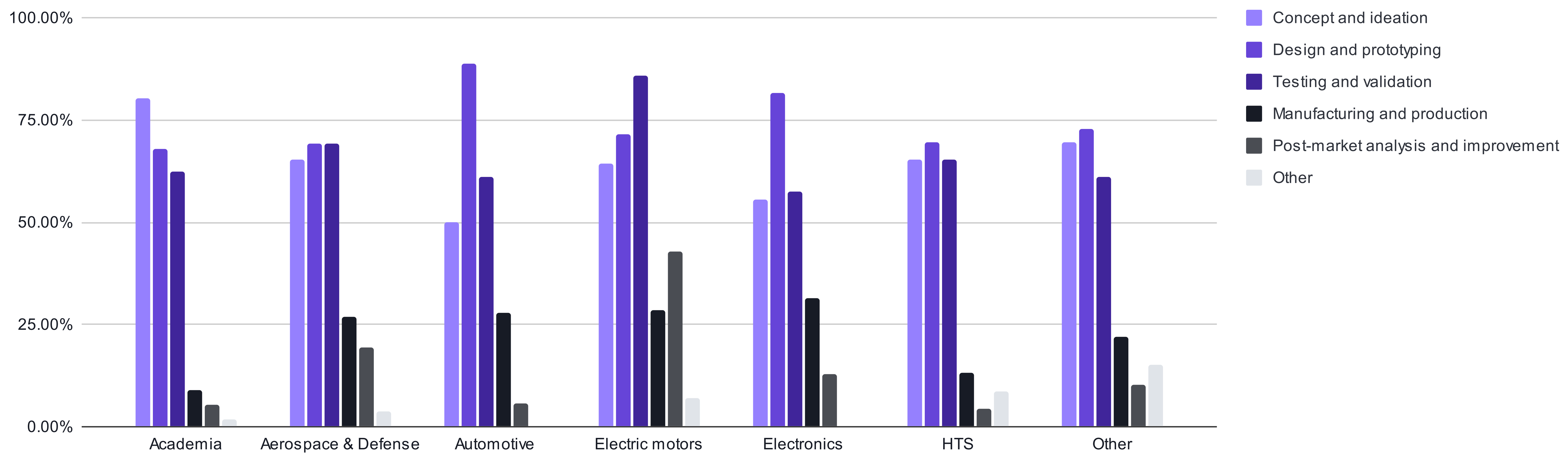
Early-stage emphasis

Figure 11 shows that simulations are predominantly employed in the early phases of product development, particularly during concept and ideation and design and prototyping. This pattern is consistent across most industries, highlighting the importance of simulation in shaping initial designs.

Decreasing usage in later phases

While testing and validation also sees substantial simulation usage, the application of these tools diminishes in later stages like manufacturing and post-market analysis. However, the specific usage at each stage varies across industries, indicating tailored approaches to simulation based on sector-specific needs.

Fig. 11 Stage simulations are used by industry



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Simulation usage perception by organization size

Smaller organization reporting limited usage

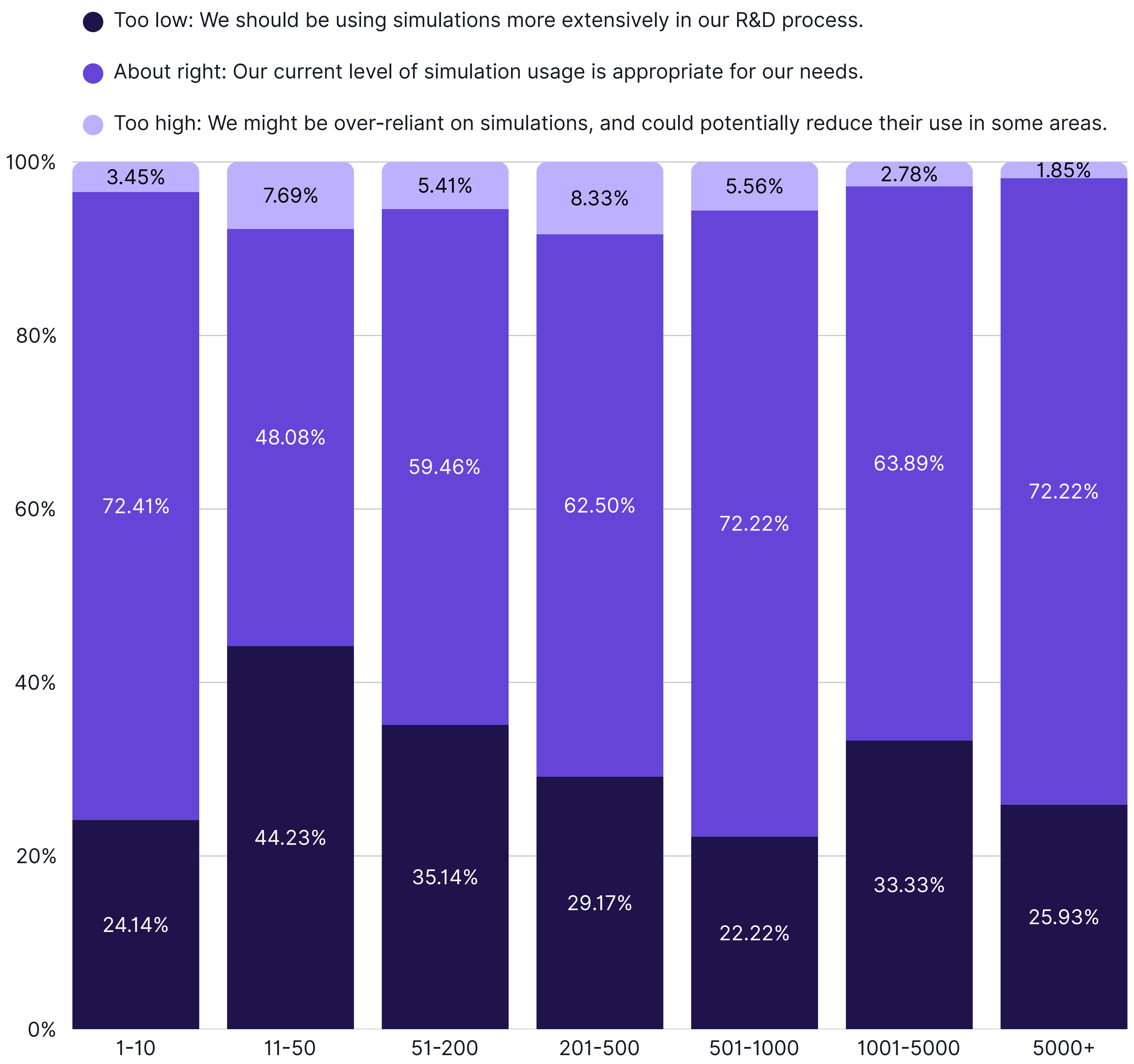
Figure 12 reveals that the majority of organizations, regardless of size, perceive their current simulation usage as "about right."

However, smaller organizations (11-50 and 51-200 employees) show a slightly higher inclination towards feeling their usage is "too low," suggesting potential for increased simulation integration in their R&D processes.

The perception of "too high" usage remains consistently low across all organization sizes.

! **44.23%** of respondents from organizations with 11-50 employees report underutilizing simulations in their R&D

Fig. 12 Thinking about your organization's R&D process, do you feel the current level of simulation usage is...?



Open ended: Describing role of simulation

Survey responses confirm that simulation is a vital and growing component of organizational R&D. It's seen as more than an add-on, serving as a key tool for validating ideas, optimizing designs, cutting costs, and accelerating innovation. While usage and expertise vary, its increasing importance in tackling complex development is clear.

Simulation is critical for R&D

Survey respondents overwhelmingly emphasized the critical and often fundamental role of simulation in their research and development processes.

It is frequently cited as essential for design, validation, and optimization, often serving as a **primary step before physical prototyping** to reduce costs, time, and the number of development cycles.

Many organizations are even striving towards a future of fully virtual product development, where simulation increasingly replaces physical testing.

Varying levels of integration across organizations

While the importance of simulation is widely acknowledged, the level of its integration varies significantly across organizations.

Some have fully embraced it as a core component of their R&D, while others still consider it a supplementary tool or **face challenges in fully leveraging its potential** due to factors such as lack of expertise, infrastructure limitations, or insufficient organizational support.

"Absolutely critical.”

"The first step for any new concept."

“Important but sometimes overlooked by the general organization.”

“Ever increasing. End goal is total product virtualization.”

"Simulation is an essential tool to better understand the phenomena we are interested in."

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Challenges with simulation in modern R&D:
4 key challenges identified

Our survey highlights four significant obstacles that emerged more often than others. In this section, we're going to examine each one by one in order of the perceived seveirty and negative impact. Further, we'll analyse how these challenges present themselves across organization sizes and industries.

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The 4 key challenges

1

Extended wait times for resources and simulation completion

2

Diminished result accuracy from model simplification

3

Limited capacity to efficiently explore design variations

4

Accurate meshing of complex models

Challenge 1: Waiting for resources and simulations to finish

This section focuses on the significant challenge of extended wait times for both computational resources and simulation completion (runtimes). We will explore the frequency of these delays, their duration, and the impact they have on engineering workflows.

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Frequency of resource wait times

! **84.8%** report experiencing wait times for simulation resources at least rarely

The majority have to wait for resources to free up in order to complete essential studies

Resource availability poses a notable challenge in simulation workflows.

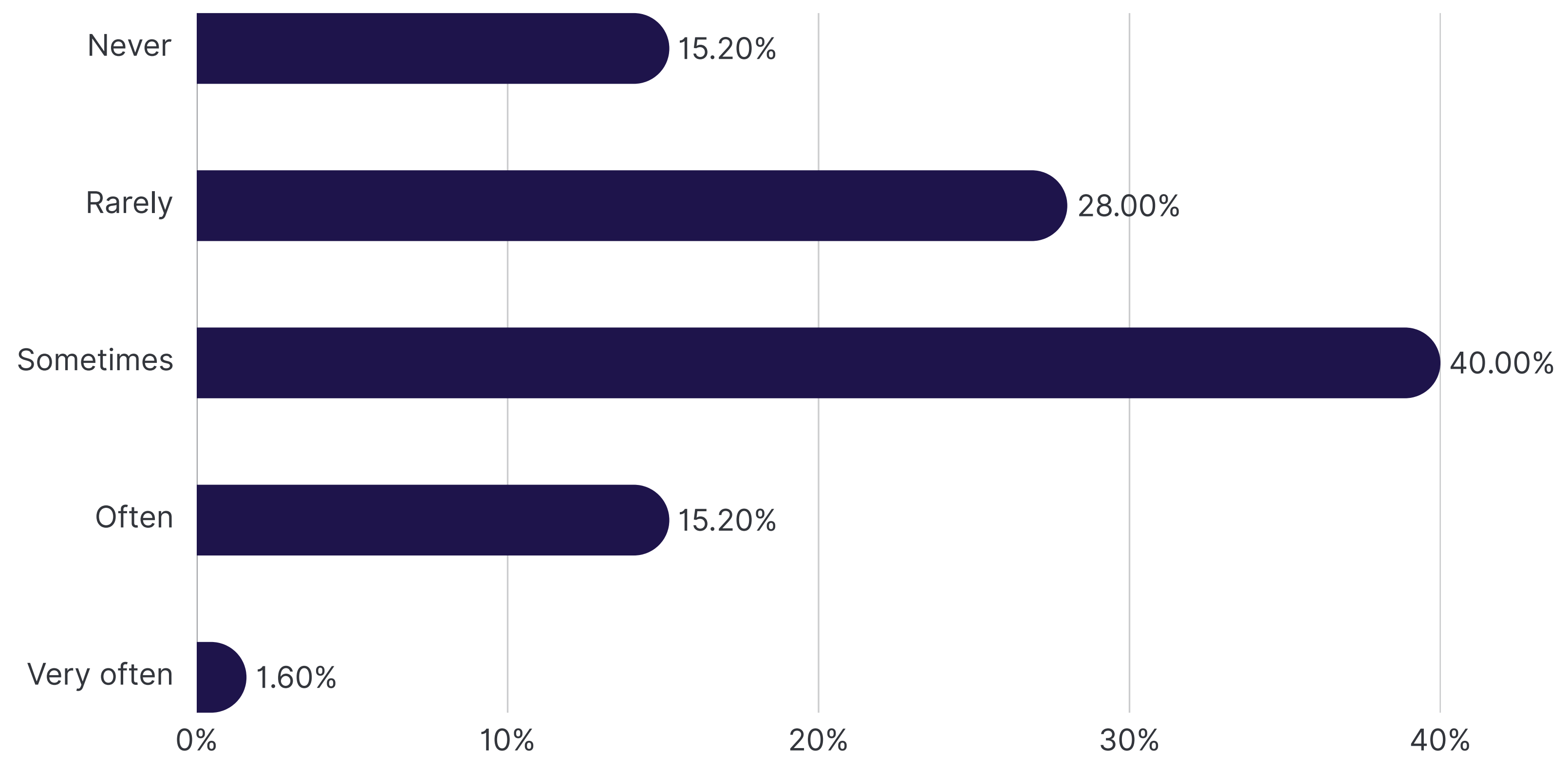
Figure 13 indicates that 84.8% of respondents experience wait times for simulation resources at least rarely.

Specifically, 40% report "sometimes" encountering delays, while 16.8% face them "often" or "very often."

Resource availability not the norm

Conversely, only 15.20% of respondents "Never" experience wait times, indicating that consistent resource availability is not the norm for most organizations.

Fig. 13 How often do you have to wait for simulation resources (licenses, hardware, cluster capacity) to become available in order to complete essential studies?



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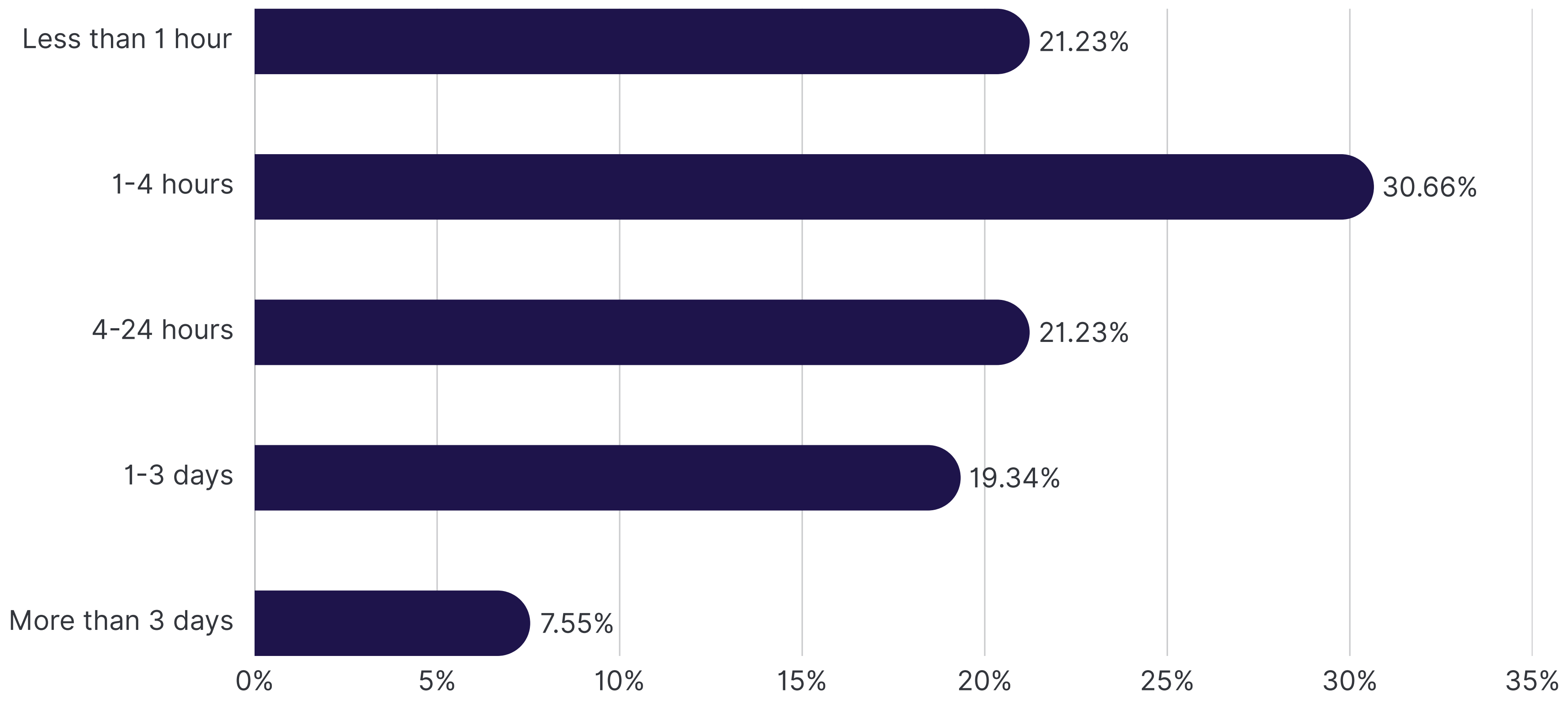
Duration of resource wait times

! **48.12%** experience waiting times ranging from 4 hours to more than 3 days

Fig. 14 When you do have to wait for simulation resources, how long is the typical waiting time?



Typical waiting time is in the hours

While a substantial portion of waits are relatively short, a considerable number extend to several hours or even days, further impacting productivity and project timelines.

Disrupting workflows and productivity

A combined 51.89% of respondents experience wait times of up to 4 hours). This indicates that many delays are manageable, potentially due to short queues for licenses or minor hardware limitations.

However, a significant 48.12% of respondents experience longer delays, ranging from 4 hours to more than 3 days. These extended wait times can significantly disrupt workflows, especially for time-sensitive projects.

The prevalence of delays lasting 1-4 hours suggests that resource contention is a frequent issue.

This could be attributed to limited license availability during peak usage times or temporary hardware bottlenecks.

The significant percentage of delays exceeding 4 hours highlights more severe resource constraints, potentially indicating insufficient hardware capacity or complex licensing challenges.

Model simplification and runtime satisfaction

Simplifying models the norm

Figure 15 reveals that a significant portion of respondents simplify their models to reduce simulation runtime. 44% report doing so "often," and 45.2% "sometimes."

Conversly, only 3.20% of respondents report never having to simplify their models.

Comparatively low satisfaction with simulation speed

Despite the majority of respondents simplifying their models to reduce the runtime, figure 16 indicates that satisfaction with the speed is relatively low.

Only 6% of respondents are "very satisfied," and 36.4% are "satisfied," while 26.8% are "dissatisfied."

! Despite **89.2%** having to simplify their models, only **42.4%** are satisfied with their runtimes

Fig. 15 Do you have to simplify your models to reduce your simulation runtime due to operational constraints?

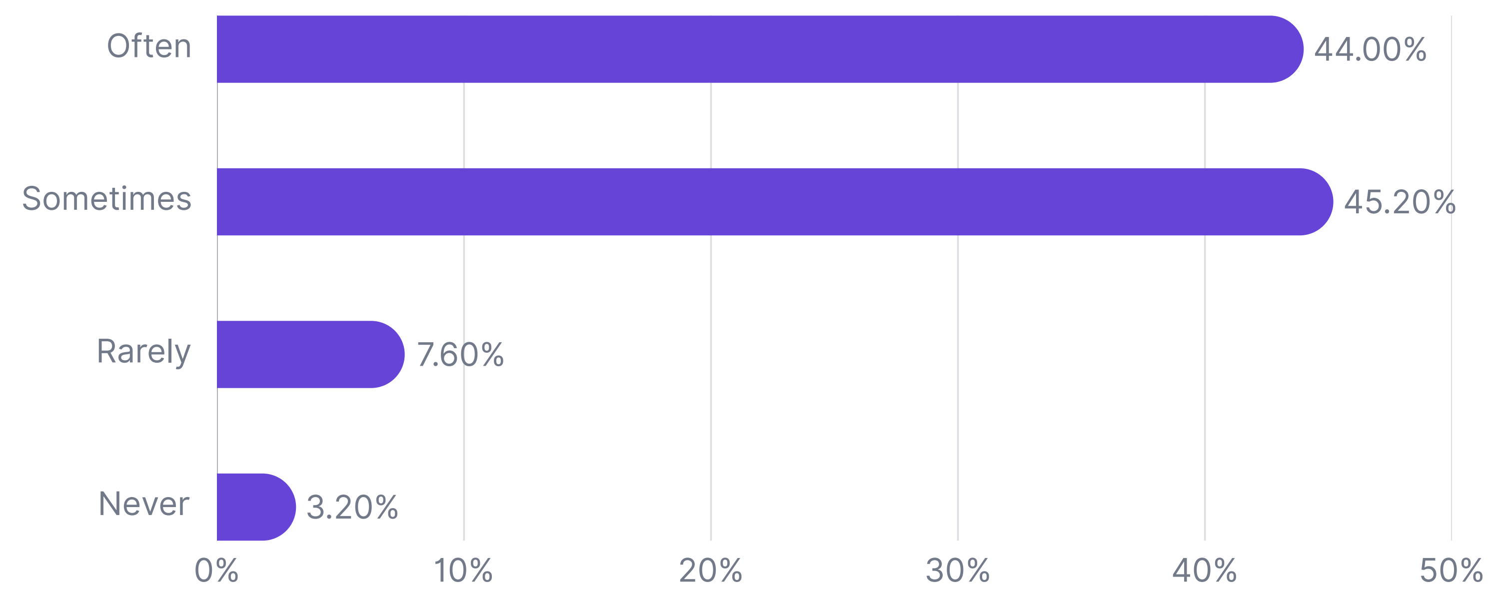
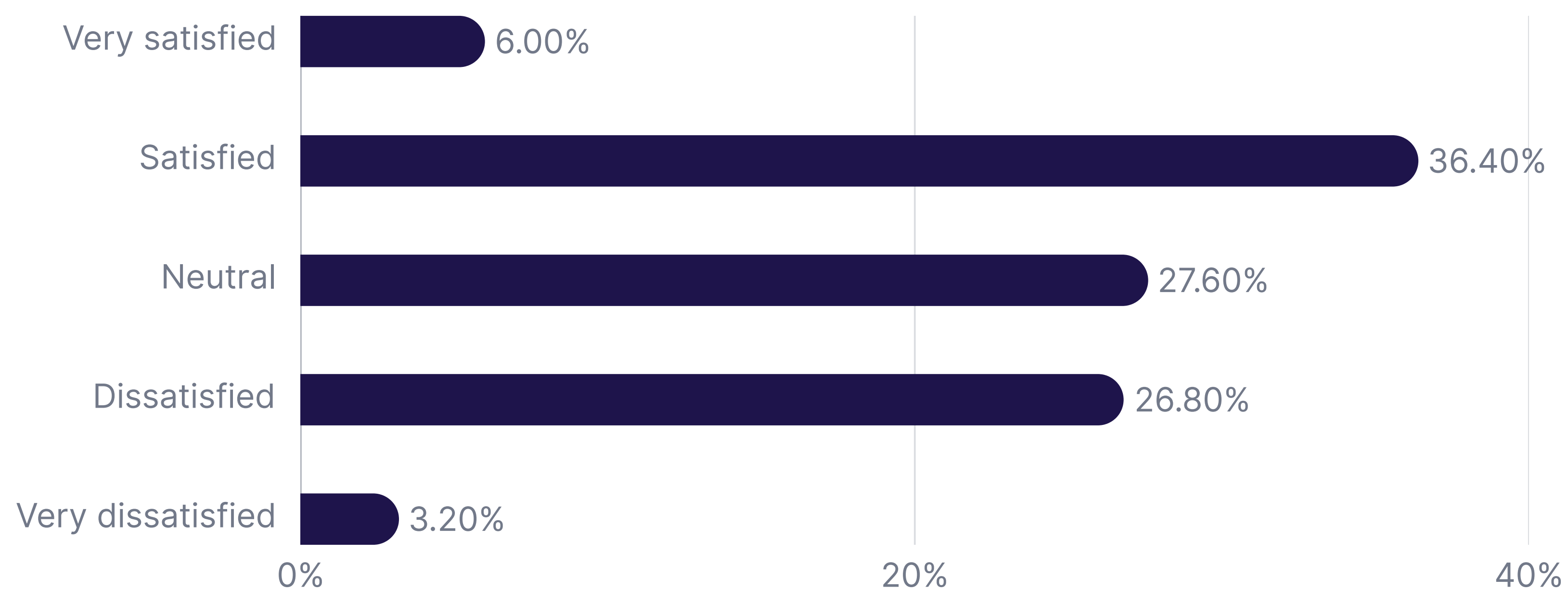


Fig. 16 How satisfied are you with the speed of your current simulation tools and processes?



Model simplification and speed satisfaction by simulation approach

Cloud user report a reduced need for simplification

Figure 17 indicates that **cloud-based platforms require the least model simplification**, suggesting better runtime efficiency compared to other approaches.

This implies that cloud-based solutions may offer more robust computational capabilities, allowing for more detailed simulations without sacrificing speed.

Cloud users report most satisfaction with runtimes

Figure 18 reveals a **higher user satisfaction with cloud-based platforms compared to other approaches**.

This reinforces the efficiency of cloud solutions and highlights potential limitations in on-premises setups.

Fig. 17 Having to simplify models by approach to simulation

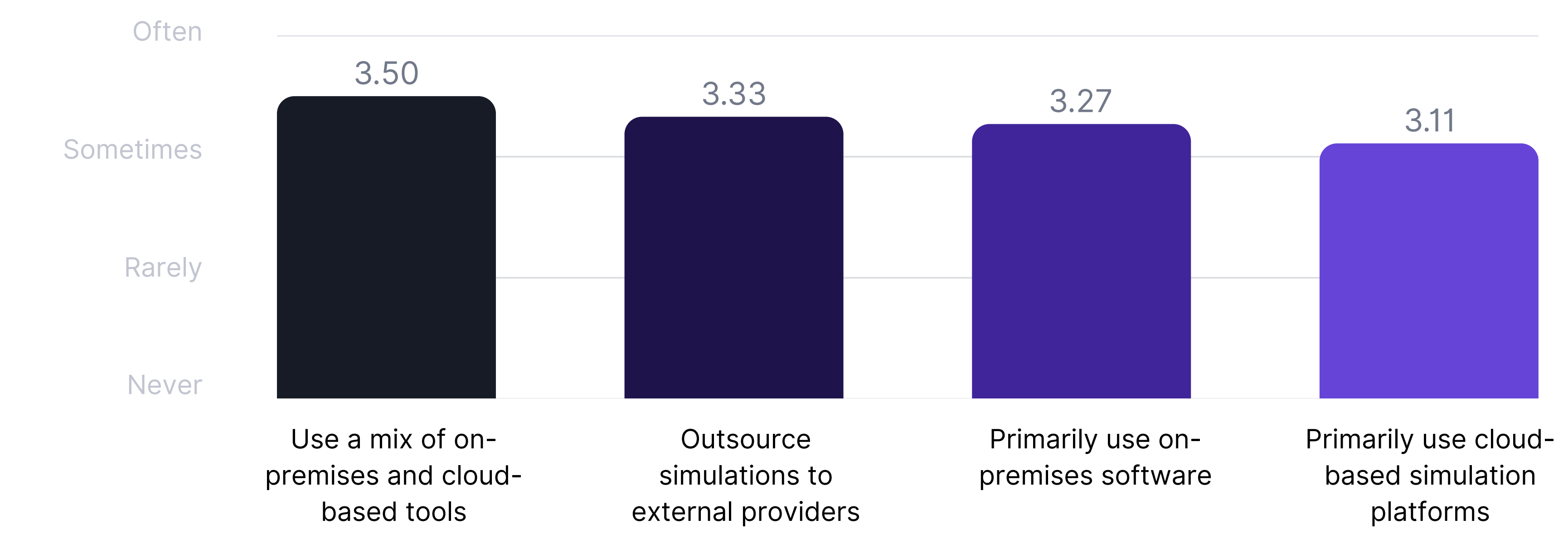
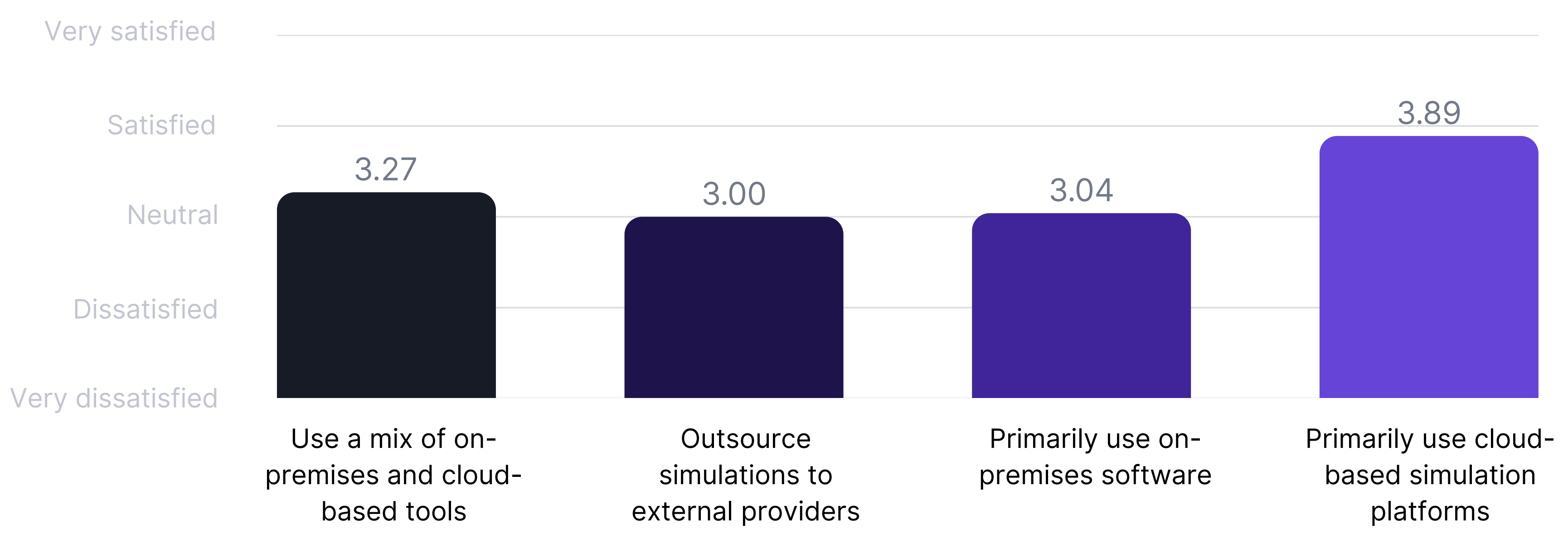


Fig. 18 Satisfaction with simulation speed by approach to simulation



Hopes for improvement: Resources and runtimes

Q: If you could wave a magic wand and instantly improve one thing about your simulation process, what would it be?

More resources, more power

A notable theme in the "magic wand" responses was the desire for better access to and management of computational resources.

Wishes for "massive parallel computing capabilities," "infinite resources," and "cloud-based solutions" clearly indicate that engineers frequently face limitations in the availability of the necessary hardware to run their simulations effectively.

This often translates to waiting in queues for resources to free up, hindering their workflow and delaying project timelines.

Faster runtimes

Perhaps the most prominent frustration expressed was the length of time required for simulations to run.

Numerous respondents wished for "faster run time," "reduce simulation time," and even "instant results."

This longing for speed highlights how long simulation durations act as a significant bottleneck, limiting the ability to quickly explore design variations, analyze complex scenarios, and obtain timely feedback.

The desire for near-instant results underscores the ideal of eliminating this waiting period altogether.

“Access to massive parallel computing capabilities”

"Infinite resources"

“No restrictions in computing resources”

“Supercomputer resources”

"Drastically reduce simulation time”

“Reduce the simulation time to almost zero”

"Reduce time required to run the simulations"

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Challenge 2: Reduced accuracy of results

This section examines the challenges associated with simplifying models to reduce simulation runtimes, and the subsequent impact on result accuracy. We will explore how this simplification varies across industries and organization sizes.

5.2 - Reduced accuracy of results

Model simplification across industries and organizations

! Simplifying models is a common practice across industries and organization sizes

Consistent model simplification across industries

Figure 19 reveals that, on a scale of 1 to 4 (where 1 is "Never" and 4 is "Often"), the average need for model simplification consistently exceeds 3 across all industries.

This highlights that model simplification is a prevalent challenge, irrespective of the specific industry.

Universal need across organization sizes

Figure 20 demonstrates that the need to simplify models is universal across all organization sizes, from small startups to large enterprises.

The absence of a discernible pattern indicates that this challenge is not confined to a particular size of organization, but rather a common issue across the simulation landscape.

Fig. 19 Having to simplify models by industry (Never=1, Often=4)

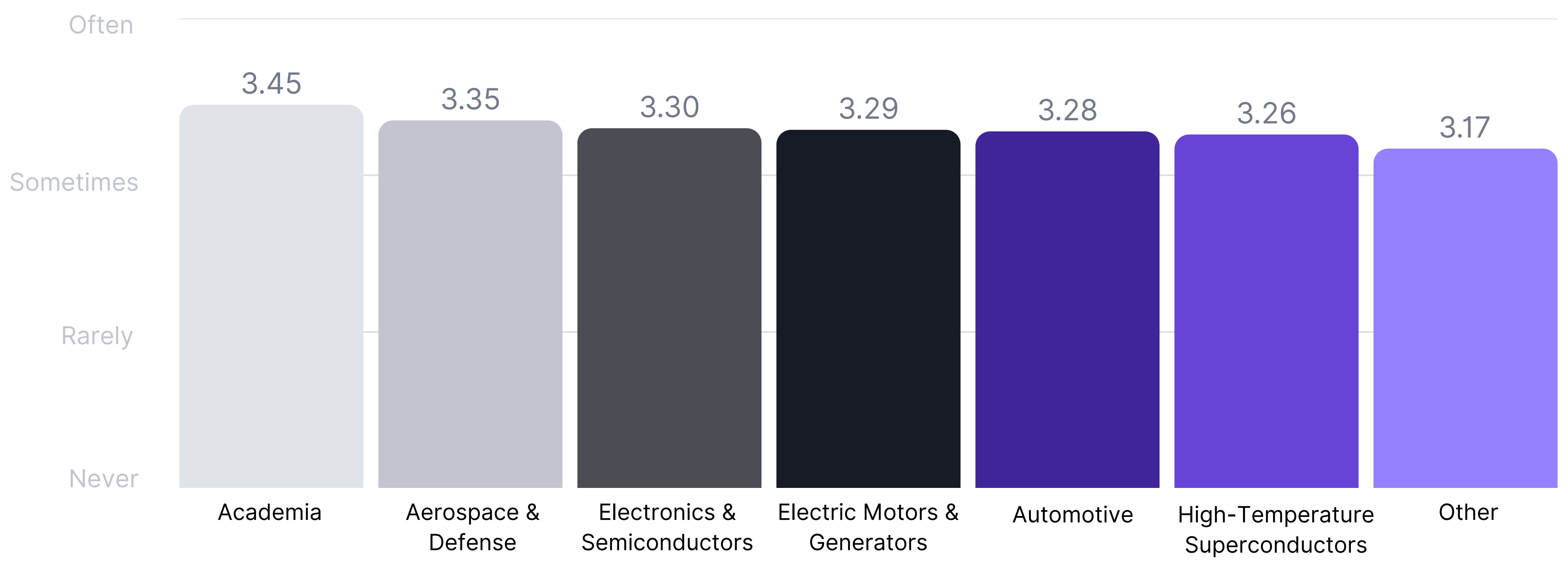
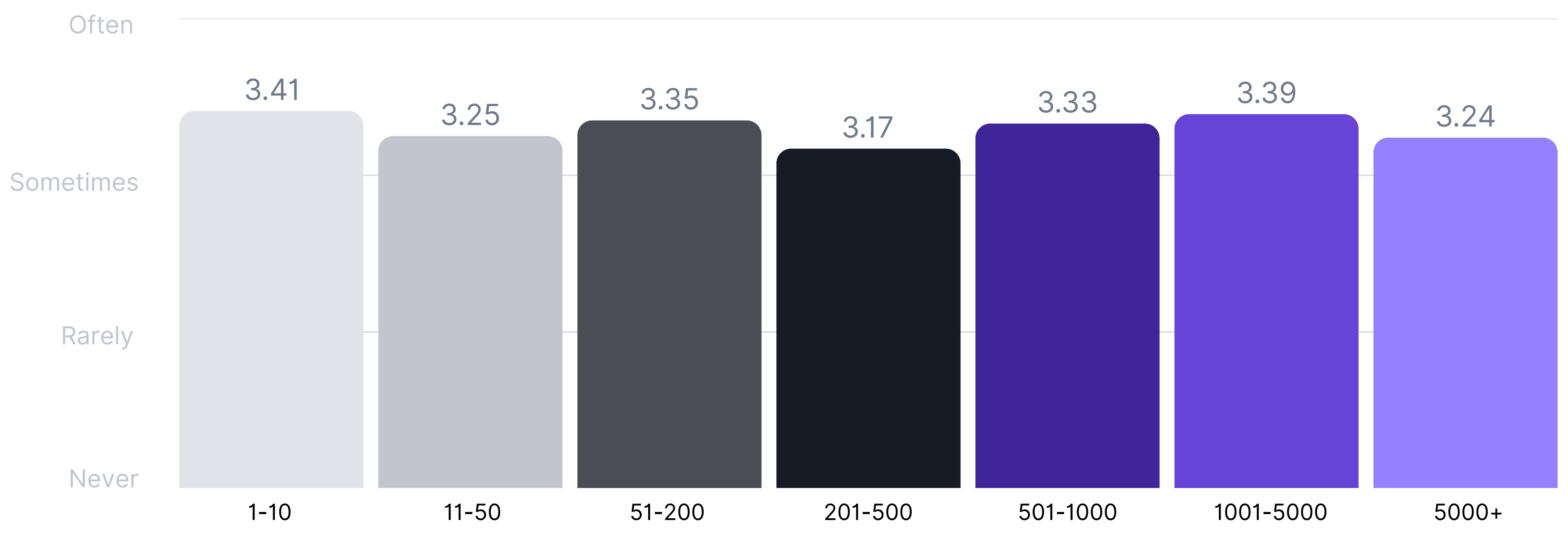


Fig. 20 Having to simplify models by organization size (Never=1, Often=4



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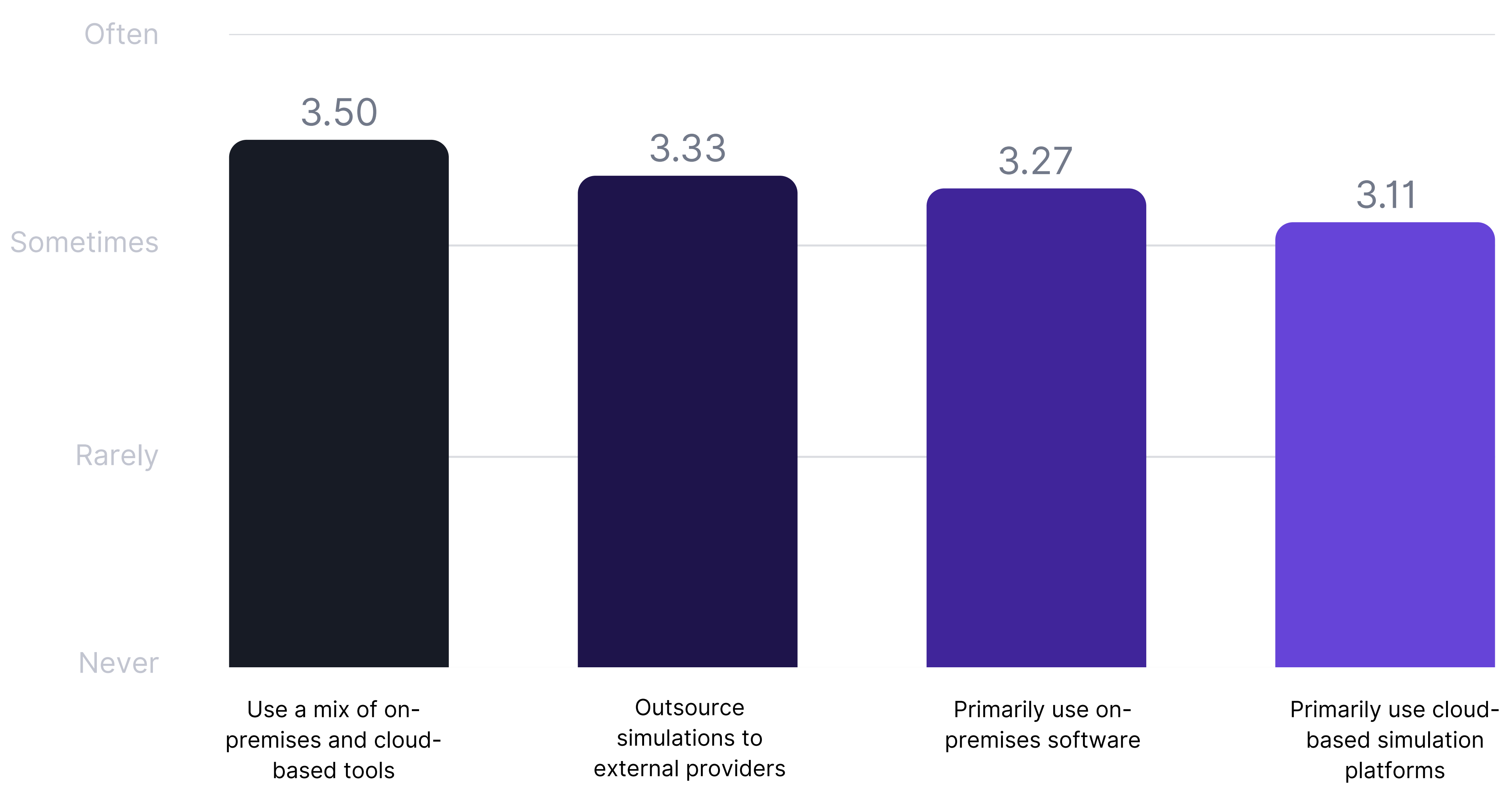
Model simplification by simulation approach

Fig. 21 Having to simplify models by primary approach to simulation



Cloud-based respondents report a slightly reduced need to simplify models

Varied simplification needs based on simulation approach

Figure 21 reveals that while all simulation approaches necessitate model simplification, as evidenced by average scores above 3 ("Sometimes"), cloud-based platforms exhibit a somewhat lower average need compared to others.

Notably, respondents using a hybrid approach, combining on-premises and cloud-based tools, report the highest average need for model simplification.

This suggests that the choice of simulation approach can influence the extent to which models must be simplified, potentially impacting result accuracy.

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Hopes for improvement: Accuracy of results

Q: If you could wave a magic wand and instantly improve one thing about your simulation process, what would it be?

The pursuit of real-world accuracy

A clear theme emerging from the open-ended responses is the desire for increased accuracy in simulation results.

Engineers are not only seeking faster solutions but also more reliable and representative outcomes.

The wish for "more accurate results by considering more physical phenomena" indicates a need for simulations that capture the complexity of real-world scenarios. T

his suggests that current simulations may sometimes be oversimplified, leading to a potential disconnect between predicted and actual behavior.

Balancing speed and accuracy

Several respondents highlighted the trade-off between speed and accuracy.

The desire for "getting accurate simulations nearly instantly" and to "make the simulation process faster without compromising accuracy" underscores the challenge of achieving both efficiency and reliability.

Furthermore, the comment about wanting "results without having to wait a long time or sacrificing accuracy" suggests that users are often forced to choose between timely results and precise predictions.

The desire to "remove the need to mesh the geometry and still have accurate results" points to a frustration with the complexities of model preparation, which can impact both speed and accuracy.

"Getting accurate simulations nearly instantly"

"Remove the need to mesh the geometry and still have accurate results and short simulation times with complex geometries and large assemblies"

"More accurate results by considering more physical phenomena"

"Make the simulation process faster without compromising accuracy"

"Results without having to wait a long time or sacrificing accuracy"

Challenge 3: Meshing of complex geometries

This section addresses the challenges respondents reported with meshing. We will examine how common the challenges with meshing are, what in specific is causing the challenges and what kind of aspirations do the respondents have for the future.

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Specific challenges with meshing

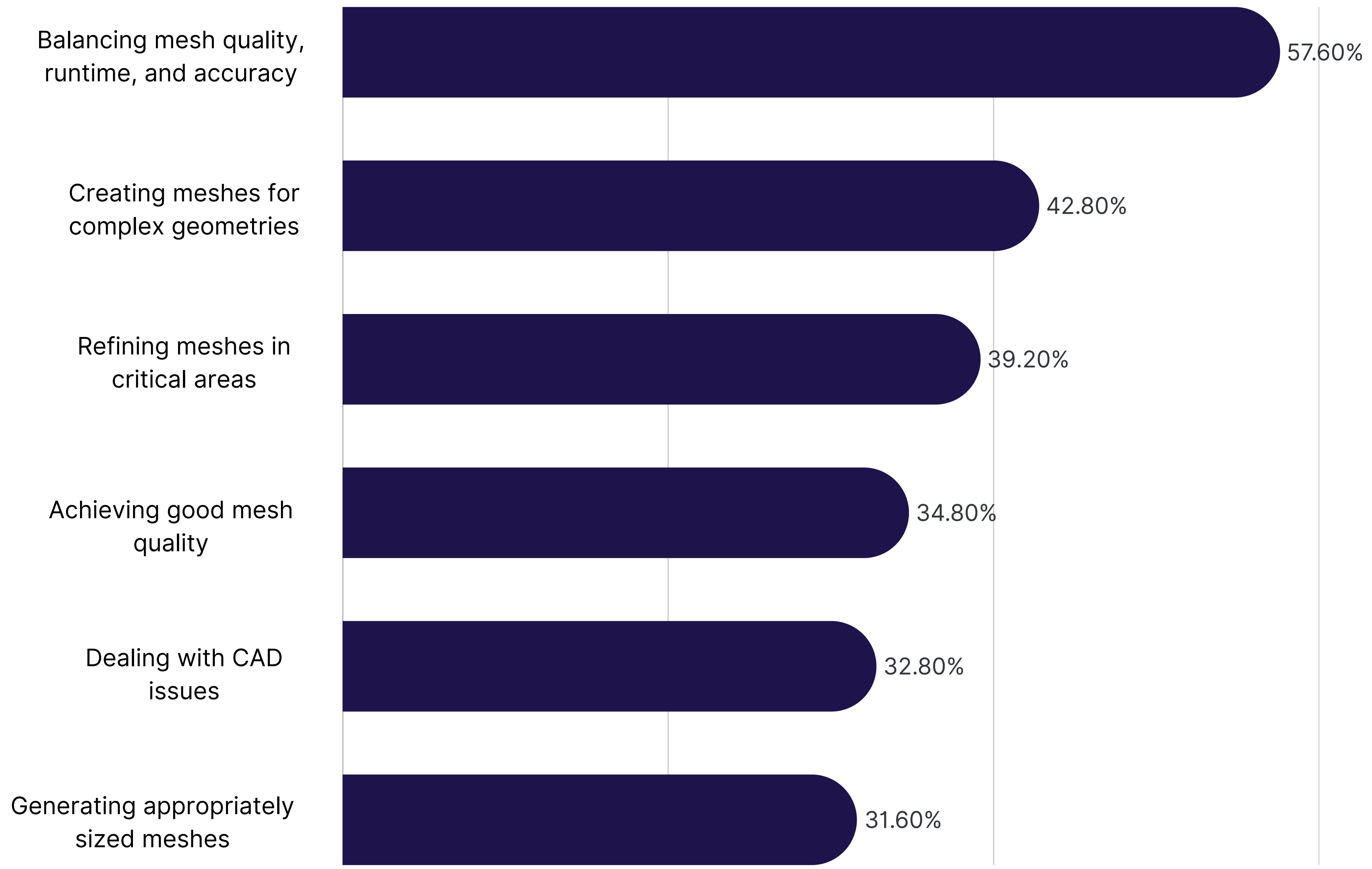
Balancing mesh quality, runtime, and accuracy deemed difficult

Figure 22 highlights the specific challenges encountered in meshing.

The most prevalent issue is "Balancing mesh quality, runtime, and accuracy" (57.60%), indicating the difficulty in optimizing these competing factors.

Additionally, "Creating meshes for complex geometries" (42.80%) and "Refining meshes in critical areas" (39.20%) pose significant hurdles in simulation workflows.

Fig. 22 Which of the following challenges do you face with meshing in your current simulation workflow? (Select all that apply)



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Open ended: Frustrations with meshing

Q: Is there something else that frustrates you in your simulation processes?

Mesh troubles seemingly irritating

When asked to rank the challenges, “Complex or time-consuming meshing process” was on the third place.

However, as a follow-up question, when asked about “other frustrations”, the mesh responses continued pouring in.

This serves as a clear indicator that a problem with meshing is real, and it’s annoying.

Mesh errors and CAD cleanup slow users down

Several respondents specifically highlighted the challenges associated with "CAD geometry preparation for large and complex models" and the difficulties annoyance with "CAD defeaturing”.

These comments point to the time-consuming and often cumbersome nature of preparing geometries for simulation, with meshing being a particularly problematic step.

More generally, "Mesh errors" were cited as a source of frustration, indicating that the meshing process itself can be unreliable and require significant troubleshooting.

“The meshing of complex geometries takes lot of time and gives lot of errors if the geometries are not captured properly with the limited options in the tool.”

"CAD defeaturing, meshing"

“Mostly set-up and meshing”

“CAD geometry preparation for large and complex models.”

“Meshing and simulation high loading“

“Lack of robust high-order mesh generators”

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Hopes for improvement: Meshing

Q: If you could wave a magic wand and instantly improve one thing about your simulation process, what would it be?

The persistent challenge of meshing

The responses clearly indicate that meshing remains a significant bottleneck and source of frustration for many simulation users.

The frequent mention of "meshing," "mesh generation convergence," and "meshing complex geometries" underscores the challenges associated with creating high-quality meshes, particularly for intricate models.

Users are looking for improvements in both the speed and reliability of meshing processes.

The need for efficient meshing solutions

Several quotes highlight the desire for more efficient and automated meshing solutions.

The wish for "easier mesh generation," "less time-consuming meshing," and even "instant wonderful meshes from an ugly CAD file" suggests a strong need for tools that can simplify and accelerate mesh creation.

Furthermore, the mention of "meshing AI" points to a growing interest in leveraging artificial intelligence to automate and optimize meshing workflows.

“Meshing”

“Mesh generation convergence”

“Meshing complex geometries”

“Easier mesh generation”

"Meshing ability"

“Less time consuming meshing”

“Easy meshing, accelerate simulation”

“Meshing”

“Instant wonderful meshes from an ugly CAD file”

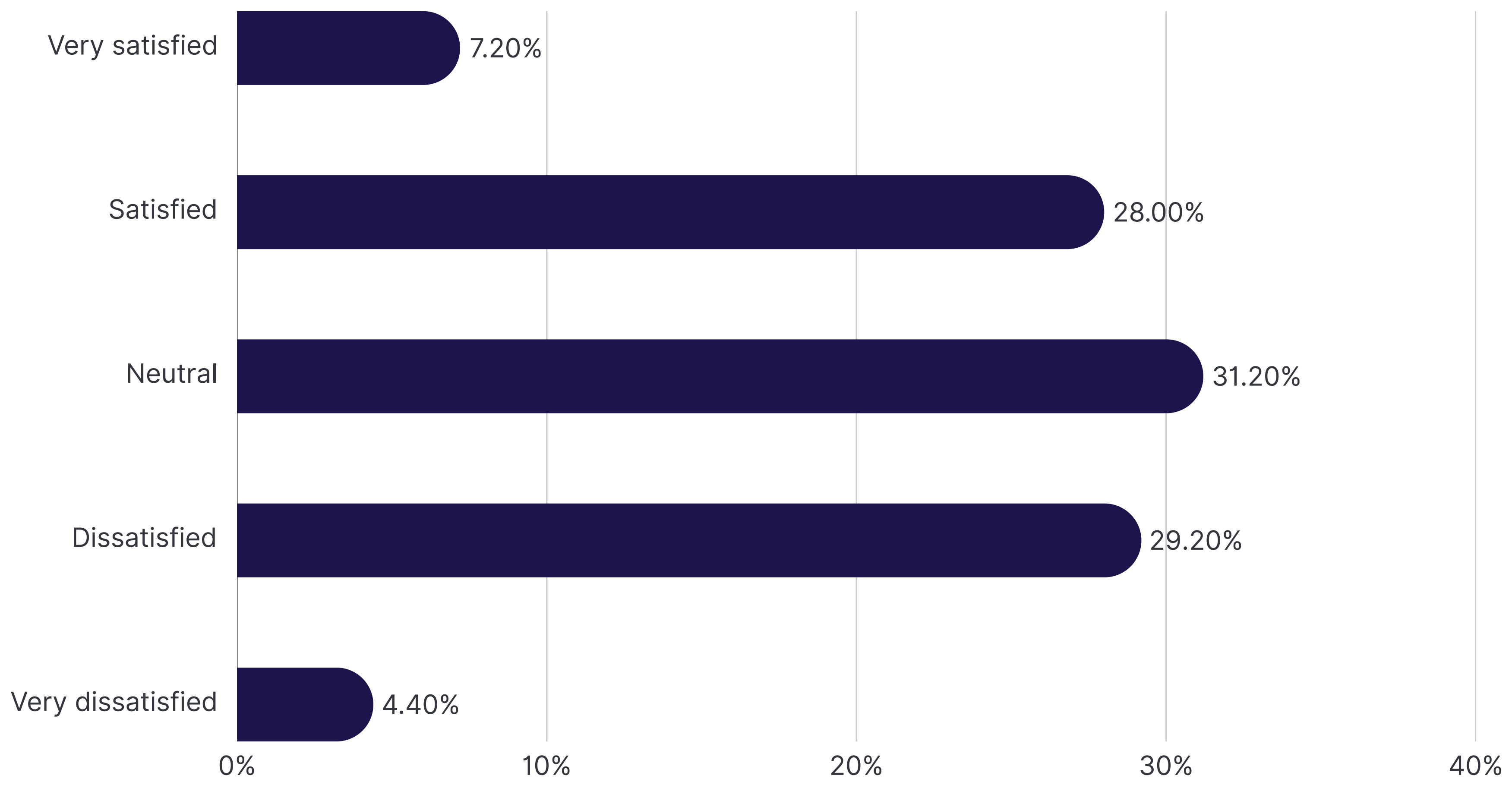
"Mesh and supercomputer resources"

Challenge 4: Limited ability to explore design options

This section addresses the challenge of limited ability to explore a wide range of design options when using current simulation tools and processes. We will examine respondent satisfaction with the ability to scale simulations and investuigate how this limitation impacts innovation.

Satisfaction with simulation scalability

Fig. 23 How satisfied are you with your current ability to scale your simulations (e.g., run many simulations in parallel, explore a wide range of design parameters)?



Majority of respondents other than satisfied

Figure 23 indicates a moderate level of dissatisfaction with the ability to scale simulations.

While a combined 46.2% of respondents express some level of satisfaction (39% "Satisfied" and 7.2% "Very satisfied"), a significant 64.8% remain "Neutral", “Dissatisfied” or “Very dissatisfied”.

This suggests that a substantial portion of users face limitations in their ability to run parallel simulations and explore a wide range of design parameters, hindering comprehensive design optimization.

> **!** **64.8%** of respondents are not “*Satisfied*” or “*Very satisfied*” with their ability to scale simulations

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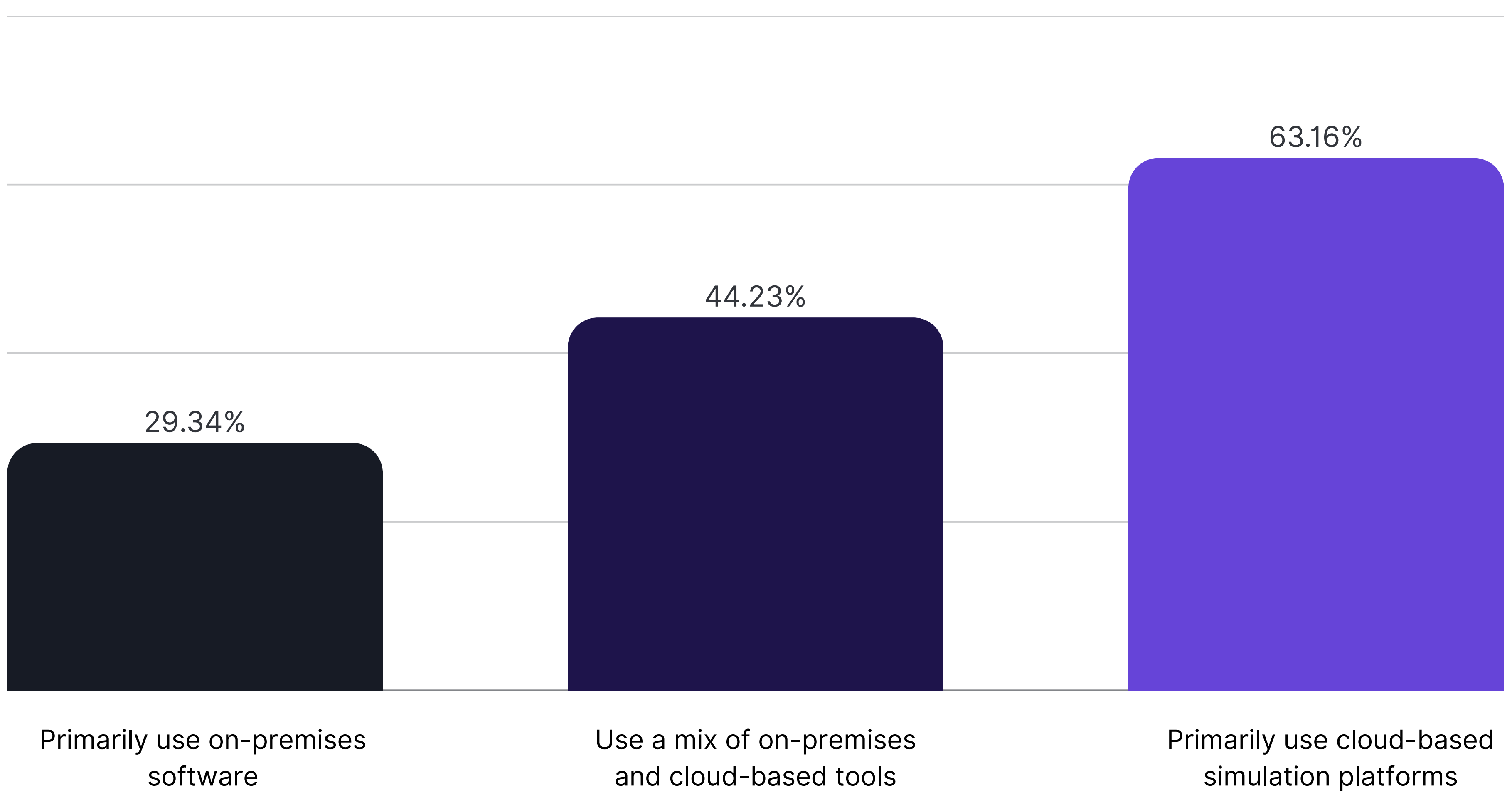
Scalability satisfaction by simulation approach

63.16% of cloud-based respondents report being “Satisfied” or “Very satisfied” with their scaling abilities

Fig. 24 Percentage of respondents *Satisfied* or *Very satisfied* with scaling capabilities by primary approach to simulation



Cloud-based users report highest satisfaction

Figure 24 illustrates a clear correlation between simulation approach and satisfaction with scaling capabilities.

Cloud-based platforms demonstrate the highest satisfaction (63.16%), indicating their effectiveness in enabling users to run parallel simulations and explore a wide range of design parameters.

In contrast, on-premises software shows the lowest satisfaction (29.34%), suggesting limitations in scalability.

A hybrid approach falls in between (44.23%).

This highlights the significant impact of the chosen simulation approach on the ability to conduct comprehensive design exploration.

Hopes for improvement: Scalability and design exploration

Q: If you could wave a magic wand and instantly improve one thing about your simulation process, what would it be?

Faster iterations for efficient design

Respondents expressed a strong desire for tools that enable rapid and efficient exploration of design spaces.

The ability to "instantly make several iterations over any variable" and to "make large parameter sweeps run in parallel" highlights the need for faster ways to assess design variations.

This suggests that current workflows often hinder the ability to quickly iterate and optimize designs, leading to potential delays in the development process.

Intelligent and automated design exploration

The emphasis on "better optimization tools" and "automatic scaling options" indicates a need for more intelligent and automated approaches to design exploration.

Users are looking for systems that can efficiently manage computational resources and provide intuitive ways to navigate complex design spaces.

The desire for an "intuitive parametric model builder, automated meshing, integrated fast solver" underscores the demand for integrated tools that streamline the entire design exploration process, from model creation to result analysis.

“The ability to instantly make several iterations over any variable in our design scripts and plot the results.”

“Optimization of structures”

“Make large parameter sweeps run in parallel to speed them up”

“Better optimization tool, simple parameter sweeps”

“Intuitive parametric model builder, automated meshing, integrated fast solver”

“Automatic scaling options considering the computing and memory resources and the goal of the simulation”

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Other challenges faced

While the previous sections highlighted the primary challenges of resource constraints, accuracy trade-offs, and limited design exploration, our survey also revealed other obstacles encountered by simulation users.

Ranking of simulation frustrations

Runtimes and computing power emerge as top annoyances

Figure 25 ranks the frustrations of simulation users from most to least annoying, where lower numbers indicate higher annoyance.

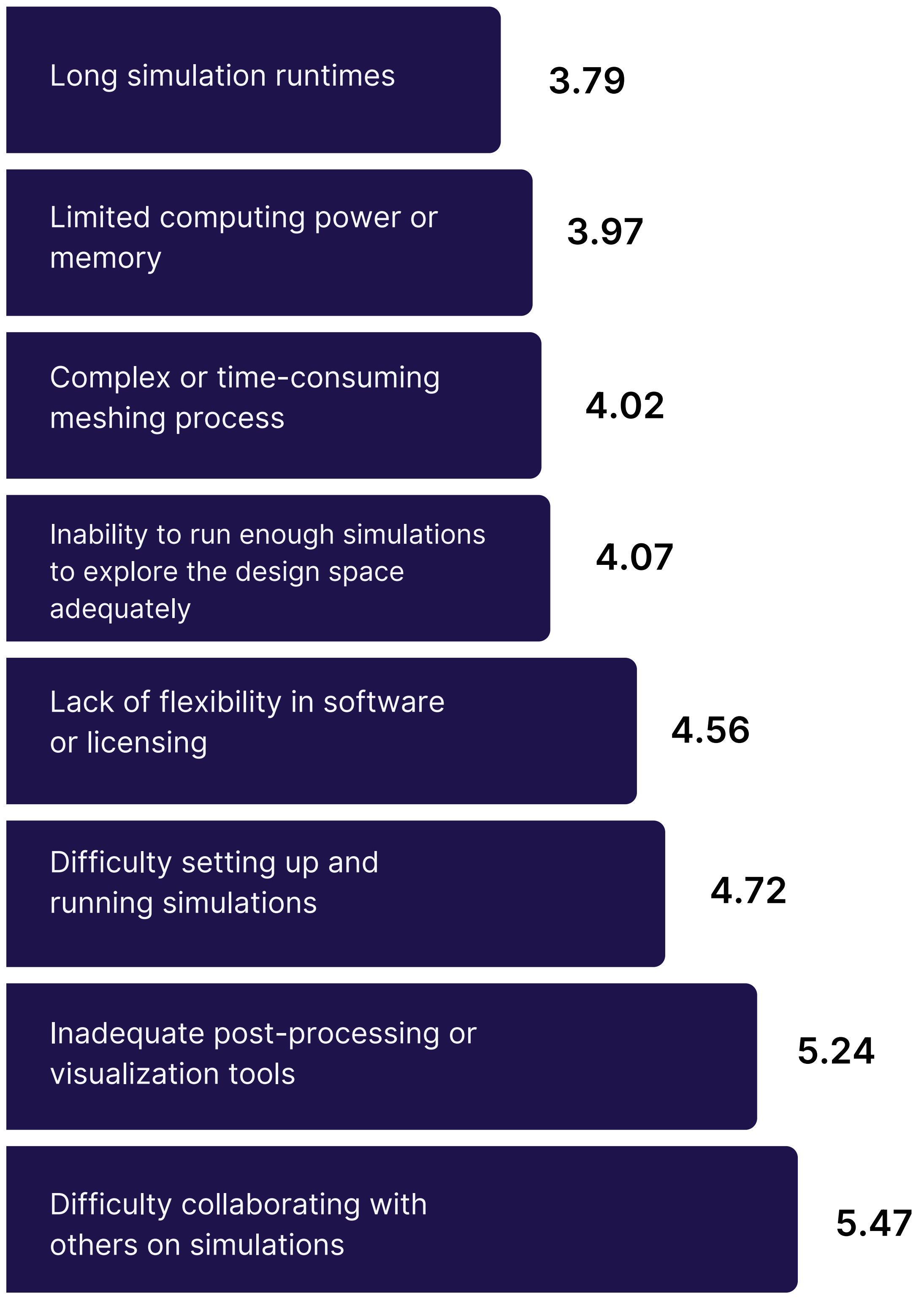
"Long simulation runtimes" (3.79) emerges as the top frustration, highlighting the critical need for improved computational efficiency.

"Limited computing power or memory" (3.97) and "Complex or time-consuming meshing process" (4.02) also represent significant concerns.

Conversely, "Difficulty collaborating with others on simulations" (5.47) is perceived as the least annoying challenge.

Simulation speed was ranked as the biggest frustration

Fig. 25 Biggest frustrations in order from most annoying to least annoying (average ranking from 1-8)



Magic wand: Areas of improvement

Q: If you could wave a magic wand and instantly improve one thing about your simulation process, what would it be?

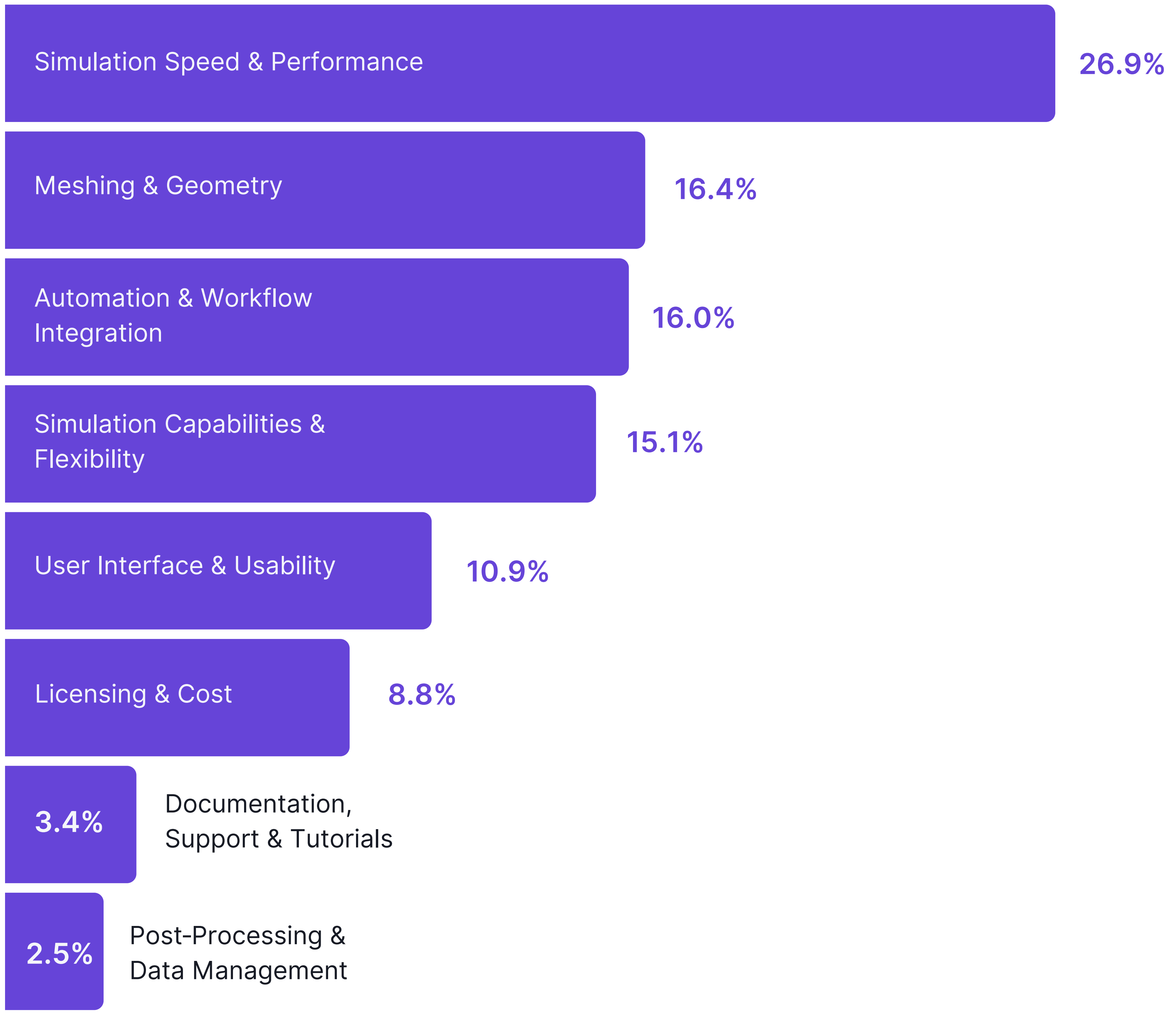
Most users want faster simulations, easier meshing, and more automation in their workflow

The most common theme was Simulation Speed & Performance, with users emphasizing the need for faster runtimes and better hardware utilization. One respondent captured this sentiment well: “Reduce the simulation time to almost zero,” while another simply wished for “instant results.”

Meshing & Geometry was the second most cited area, reflecting ongoing challenges with mesh generation and geometry prep. Users expressed a desire for “instant wonderful meshes from an ugly CAD file” and “automatic mesh of very complex geometry.”

Simulation speed is the number one issue respondents would fix if they had a magic wand

Fig. 26 Areas of improvement in the open-ended magic wand question



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Expectations for the next 5 years:
Emerging technologies

4 key technologies established

We identified four key technologies that our respondents see as having the biggest impact in the next 5 years.

Analysis of each

In this section of the report, we'll cover each of the technologies, examine their current level of usage and undesrtand the desire for them and the challenges they can address.

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The 4 key technologies

1

Artificial intelligence / Machine learning

2

GPU Acceleration

3

Quantum Computing

4

Cloud Computing

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Advancements in simulation technology in the next 5 years

Q: What key advancements in simulation technology do you expect to have the biggest impact in the next 5 years?

Artificial intelligence and machine learning seen as the biggest game-changers

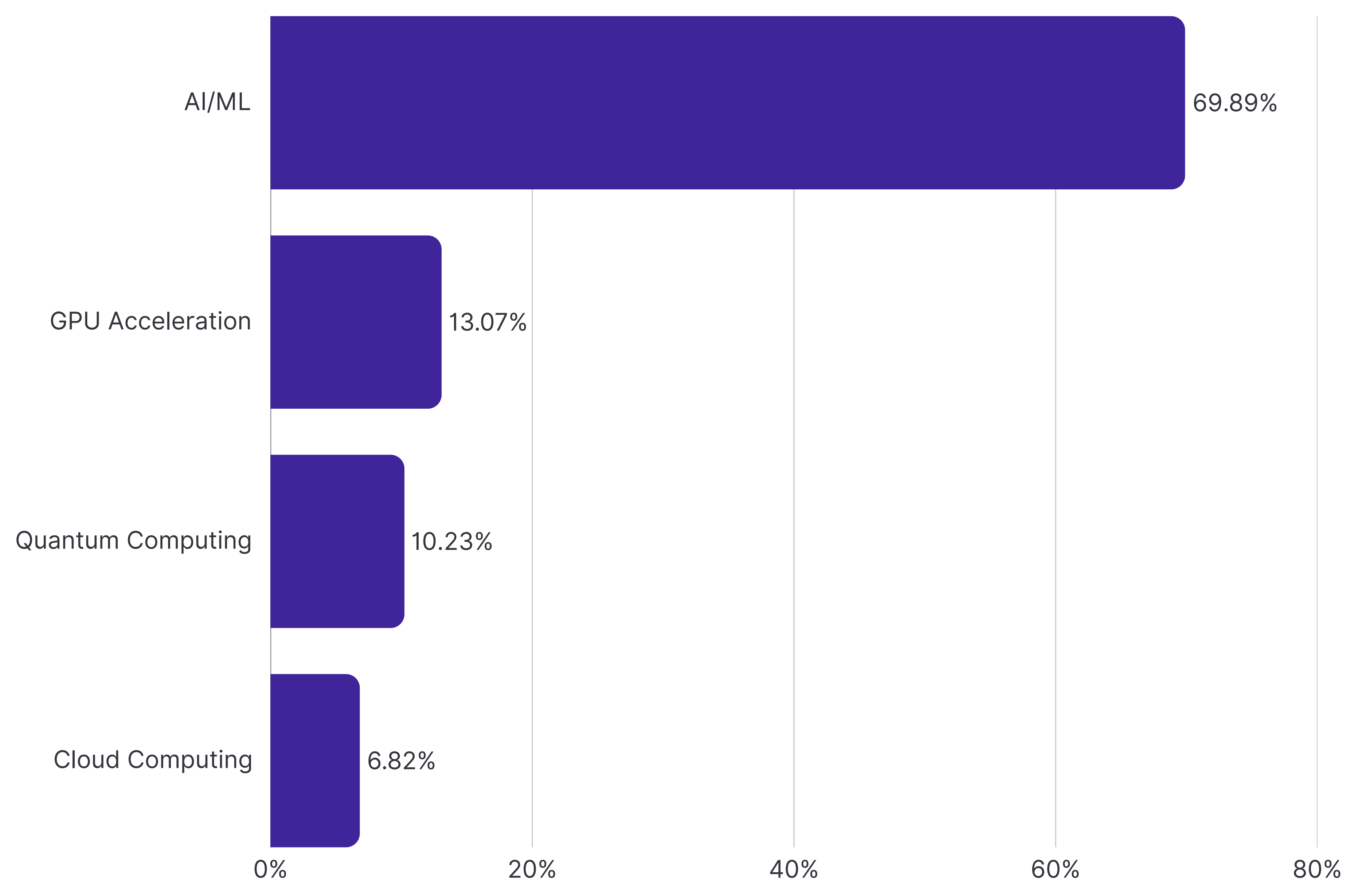
Figure 27 illustrates the anticipated impact of emerging technologies on the field of simulation within the next 5 years.

AI/ML stands out as the most frequently mentioned technology (69.89%), indicating a strong belief in its transformative potential.

GPU Acceleration (13.07%), Quantum Computing (10.23%), and Cloud Computing (6.82%) also garner attention.

Let's go through the technologies one by one to investigate the current status and find out more details.

Fig. 27 Mentions of technologies by percentage expected to have the biggest impact in the next 5 years



Technology 1: Artificial Intelligence (AI) / Machine Learning (ML)

AI is reshaping how simulations are built and used

Artificial Intelligence and Machine Learning (AI/ML) are rapidly transforming many technical domains, and multiphysics simulation is no exception. AI/ML methods—including emerging approaches like Physics-Informed Neural Networks (PINNs)—offer the potential to automate complex tasks, enhance model predictions, and extract meaningful insights from large simulation datasets. The ability to integrate data-driven methods with classical physics-based models is opening up new ways to design, optimize, and troubleshoot simulation processes.

ML can address speed and usability challenges in simulation

While AI/ML solutions have begun to make inroads into simulation workflows, their adoption remains early-stage in many industries. Challenges include the integration of AI tools into established simulation software ecosystems, ensuring reliability of AI predictions, and bridging the gap between expert knowledge and automated processes. Nonetheless, early experiments have shown promise—particularly in areas like advanced geometry processing, mesh optimization, and design optimization.

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What respondents expect: AI / ML

Respondents want AI to simplify and speed up simulation tasks

Open-ended responses related to AI/ML accounted for the largest share of technology mentions (123 counts).

Respondents highlighted that “advanced AI tools to speed complex model development” and “AI integration in simulation to support DOE and design optimization” are key areas of interest.

Several noted that AI could fundamentally reduce time for tasks such as meshing and parameter tuning, with one participant remarking, “AI will streamline many simulation tasks and may replace first-order simulation in some cases.”

AI is seen as a path to automation and better user guidance

The survey indicates strong expectations that AI/ML advancements will lead to significantly faster simulation workflows, improved accuracy in complex problem-solving, and more intuitive user experiences.

Respondents believe that further integration of AI will not only optimize simulation runtimes but also democratize access to high-end simulation by reducing the need for deep domain expertise.

AI is expected to make simulation tools significantly smarter, helping automate tasks, deliver intelligent insights, and reduce the reliance on deep expertise

“AI-driven simulations will reduce the flaws in design as legacy data with AI suggestions will help to produce high quality products”

“AI application in simulation so that the optimization process becomes more intelligent and automatic”

“Having an AI copilot that automatically suggests simulation settings and can tune them and help with setup”

“AI might take the simulation technology to the next leap”

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Technology 2: GPU Acceleration

GPUs are transforming simulation runtimes and scale

GPU acceleration leverages the parallel processing power of graphics processing units to handle computation-intensive tasks typical in multiphysics simulation. This technology is enabling simulations to run faster by distributing computations across many cores, which is critical when dealing with highly detailed models and complex physics. As simulation software increasingly supports GPU acceleration, there is a growing opportunity to drastically reduce run times.

Adoption is growing but not yet universal in simulation tools

Adoption of GPU acceleration is gaining momentum, particularly in fields that require rapid iteration or deal with large models. However, challenges remain: many simulation codes are still predominantly CPU-based, and rewrites or optimizations to leverage GPUs can be resource-intensive. Additionally, ensuring that simulation accuracy is maintained while boosting performance is a critical concern.

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What respondents expect:
GPU acceleration

Respondents expect faster cheaper simulation from GPUs

Although mentioned less frequently (23 counts), respondents see GPU acceleration as a game changer.

Comments like “True GPU assisted speeding up of simulation” reflect expectations that the technology will make traditionally CPU-intensive tasks far more efficient.

Respondents are generally optimistic that enhancing computational capability through GPUs will facilitate the simulation of larger and more complex models.

GPU acceleration is tied to enabling larger more complex models

Survey feedback suggests that GPU advancements are expected to improve simulation speed, empower real-time modeling, and support larger-scale parallel computations.

By shifting computational loads to GPUs, users foresee an era of enhanced performance, where waiting times shrink and simulation complexity is no longer a barrier.

GPU acceleration is expected to deliver major performance gains, enabling faster runtimes and the ability to handle increasingly complex simulations more efficiently

“GPU acceleration for traditionally CPU based FEM”

“Cheaper GPU compute. CFD simulations moving to GPU”

“New solvers that can natively run on GPU”

“Speedup through use of GPUs”

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Technology 3: Quantum computing

Quantum simulation is promising but not yet ready

Quantum computing represents a paradigm shift in computation, promising to solve problems that are intractable for classical computers. In simulation, quantum computing could revolutionize the way we approach highly complex, multi-variable problems by harnessing quantum superposition and entanglement. Although still in its infancy, quantum computing is generating significant excitement as it offers fundamentally new avenues for simulation and modeling.

Potential is high for solving problems classical methods cannot

At present, quantum computing is largely confined to research and experimental stages within the simulation space. Key challenges include high error rates, limited qubit counts, and the need to develop entirely new algorithms tailored for quantum architectures. Despite these hurdles, steady advancements in quantum hardware and simulation-specific quantum algorithms are paving the way for increased adoption over the next five years.

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What respondents expect: Quantum Computing

While seen as potentially transformative, most users remain skeptical about the near-term impact of quantum computing, expecting meaningful benefits to remain several years away

Respondents are hopeful but cautious about quantum's timeline

Quantum computing was referenced in 18 responses, with remarks such as "Quantum computing advancements will allow us to make headway into the future much more quickly" underscoring its perceived transformative potential.

Respondents see quantum computing not only as a tool for boosting simulation speed and accuracy but also as a way to tackle simulation problems that are currently out of reach.

Quantum is seen as a future breakthrough for tough simulations

There is a shared sense among respondents that quantum computing will eventually enable fundamentally new simulation methodologies.

It is expected to address limitations in current computational approaches by opening pathways to simulate complex systems more accurately and quickly.

The integration of quantum computing, while still on the horizon, is anticipated to pave the way for breakthroughs that could redefine the simulation landscape.

"Quantum-assisted simulations"

"Quantum-based simulation"

"Quantum simulations to speed up the parallel processing"

"Quantum Computing advancements will allow us to make headway into the future much more quickly"

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Technology 4: Cloud computing

Cloud simulation offers scalability and collaboration

Cloud computing offers a flexible and scalable alternative to traditional on-premises hardware. By moving simulation workloads to the cloud, organizations can access virtually unlimited computational resources and benefit from cost-effective, on-demand infrastructure. Cloud-based simulation environments also enable real-time collaboration and the integration of diverse data sources, enhancing overall productivity.

Cloud reduces hardware barriers but comes with perceived risks

Currently, cloud computing is emerging as an option in the simulation arena. Early adopters are experimenting with hybrid models where cloud resources supplement local hardware. Key challenges include data security, integration with legacy systems, and the adaptation of simulation software to distributed architectures. Nonetheless, its potential to drive significant cost and time savings is being recognized in the industry.

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What respondents expect: Cloud Computing

Users anticipate greater scalability, collaboration, and access to powerful resources via the cloud, but also express concerns around cost, security, and integration

Respondents see cloud as key to accessibility and flexibility

Cloud computing was mentioned in 12 responses, with respondents noting its promise for offering “cloud-based simulation” and “spreading and adoption of cloud-based simulation with virtually unlimited resources.”

There is a clear expectation that cloud platforms will reduce reliance on costly local hardware and streamline access to advanced computational capabilities through on-demand services.

Cloud adoption is expected to grow as tools mature

The feedback shows that users believe cloud computing will lower barriers to simulation by enabling resource sharing and flexible licensing.

In the next five years, cloud platforms are poised to make simulation tools more accessible, facilitate complex multiphysics collaborations, and ultimately cut down simulation cycle times through on-demand parallel processing.

“Cloud, ability to compromise CPU-hours according to development deadline and day-to-day workload”

“Spreading and adoption of cloud based simulation, with virtually unlimited resources”

“Software running in the cloud”

“Cloud-based and distributed simulations.”

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Areas of improvement overall

Q: How will these technological advancements shape the field?

Hopes of speed, power, and seamless workflows

Across the open-ended responses, respondents consistently identified four broad areas where they hope to see the most impact from simulation technologies: faster simulations, greater automation, easier usability, and more intelligent or insightful tools (Fig. 28)

Speed was mentioned most frequently, with users seeking faster runtimes and real-time simulation capabilities to streamline design workflows and reduce bottlenecks: "*Speed and AI assistance*", "*Extremely high speed simulation*", and "*Simulation time is shortened and the efficiency can be greatly improved*" were just a few examples.

Automation also emerged as a major theme, especially in areas like setup, meshing, and workflow orchestration, with users expressing a desire for "*Automation of setting up simulation parameters*" and "*Auto workflows to minimise having to 'learn' the tool, rather than doing engineering with a tool.*"

! **26.9%** of the foreseen advancements in the next 5 years are directly related to runtimes

Demand also for smarter, more intuitive, and more accessible simulation tools

Ease of use, accessibility, and lower barriers to entry were highlighted in responses that envisioned simulations being more user-friendly and democratized: "*Hopefully AI will replace the lack of expertise*" and "*Simulation on the go in every aspect of life.*"

Finally, respondents emphasized the value of intelligent support, predictive capabilities, and context-aware tools: "*Smart enough to help me finish my work quickly,*" "*AI can enhance the accuracy and efficiency of simulations by automating complex tasks*", and "*Design suggestions as part of the results.*"

Together, these themes paint a clear picture: users are hoping for technologies that not only run faster but also work smarter and more intuitively, removing tedious overhead and making simulation a more accessible tool in everyday engineering.

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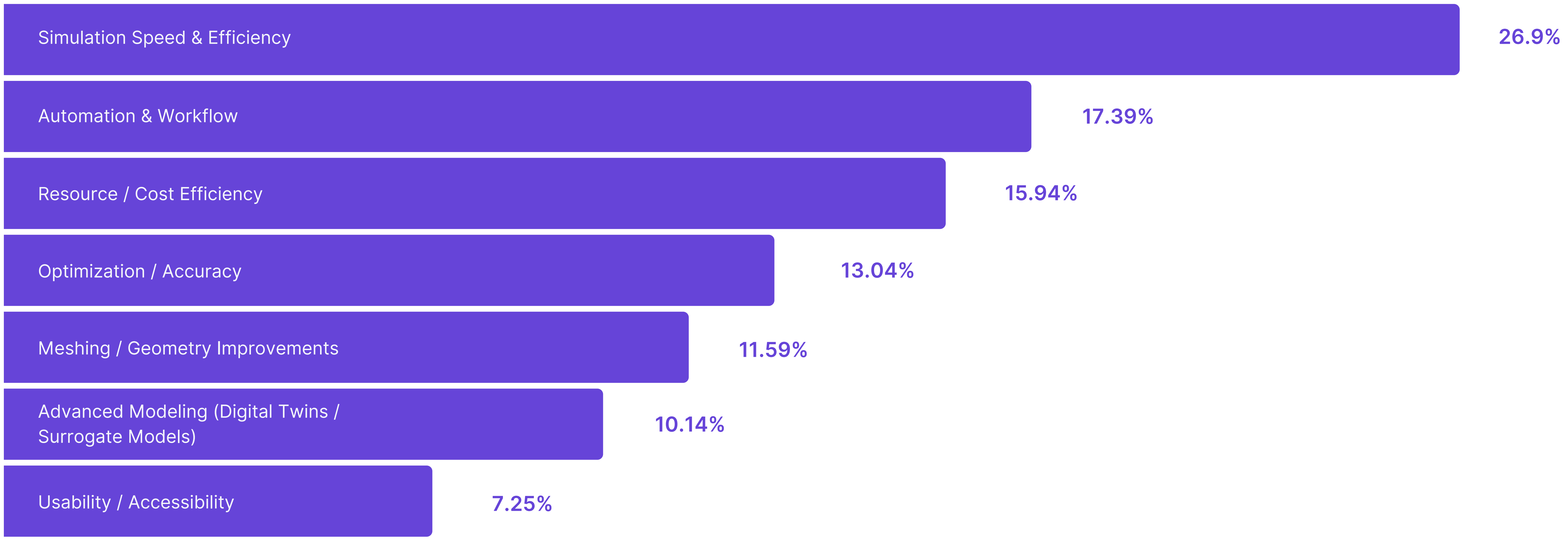
What users hope simulation technologies will deliver

Simulation speed is the area that most respondents expect new technologies to improve

Fig. 28 Areas the technological advancement will improve



Our key takeaways

Reflecting challenges we're actively addressing

As a company building a cloud-native multiphysics simulation platform, we read the results of this study with deep interest.

Many of the core challenges users face today—manual workflows, long runtimes, limited accessibility—are exactly the pain points we set out to eliminate.

It's clear that the industry is in need of modern simulation tools that are fast, flexible, and designed for modern R&D workflows.

5 key takeaways

1 Simulation speed remains the top bottleneck

Reducing simulation runtimes is both the top challenge and the most desired improvement.

2 Automation isn't a nice-to-have anymore—it's expected

From AI-guided setup to intelligent meshing and post-processing, users are asking for tools that minimize repetitive work.

3 Accessibility is limited even with enterprises

Access to computing power, flexible licensing, and adaptable tools remains a barrier, limiting who can simulate what, when, and how effectively.

4 AI/ML is driving interest—but usability is key

With 70% of mentions focused on AI/ML, users are eager—but the value lies in ease-of-use, guidance, and results.

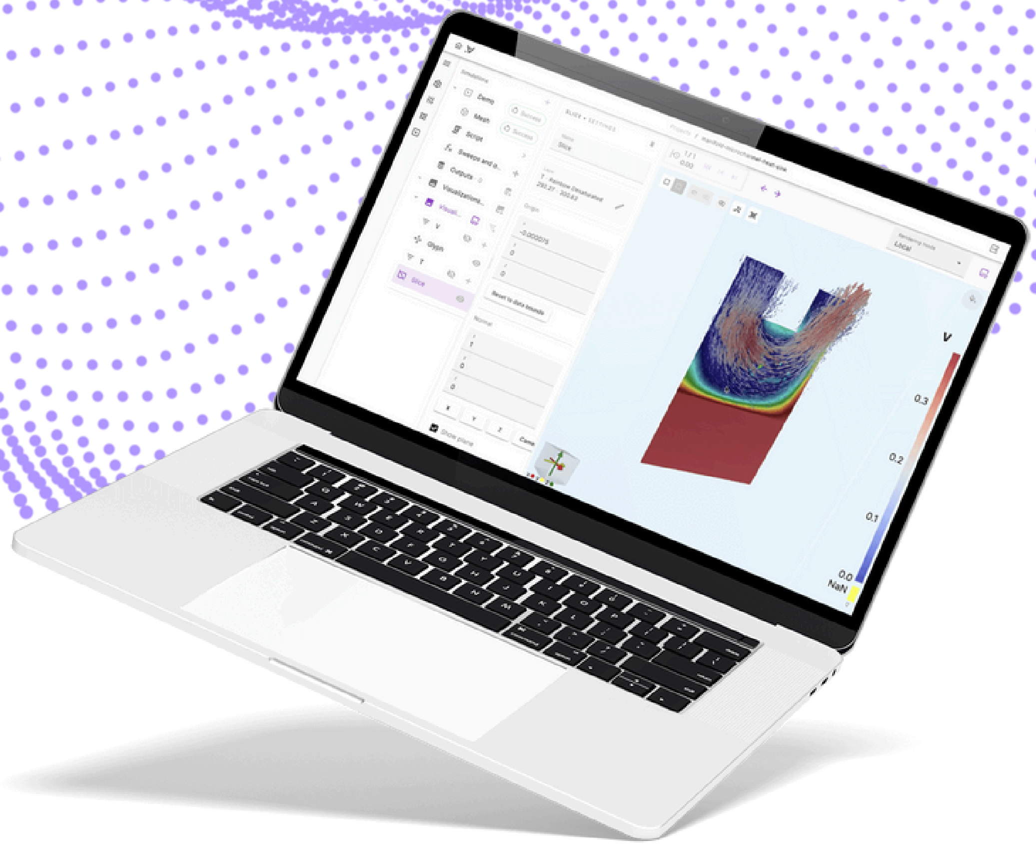
5 Cloud computing is still underused

While utlilized still by the minority, the vast majority described challenges that the cloud inherently solves.

Our vision

“We enable a future where engineers can rapidly explore and refine thousands of design options for the world's most complex challenges—equipping them to choose the optimal solution with precision and confidence.”

Quanscient Allsolve



Quanscient Allsolve

The powerful and scalable multiphysics simulation platform

Run fast, accurate, and complex multiphysics simulations at a massive scale

Confident design decisions with more data

Increase your engineering throughput with more accurate simulations. Make design decisions confidently with more data.

Accelerated productivity with 100x faster simulations

Reduce your runtimes by 99% without compromising accuracy. Explore more design options and optimize performance without local constraints.

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Scale your simulation resources up or down with no license or hardware restrictions. Use the Quanscient API to build and automate efficient design workflows.

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Our Quantum Labs is the **world-leading research team** in the quantum lattice Boltzmann method (QLBM), specializing in computational fluid dynamics (CFD).

We have **already proven meaningful CFD simulations** on current quantum computers, driving continuous progress towards more sophisticated and reliable outcomes.

We offer custom algorithm development and licensing options for our pilot customers.

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