

Infrastructure-as-code and DevOps Automation:

The Keys to Unlocking Innovation and Resilience

SEPTEMBER 2023

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Research Overview

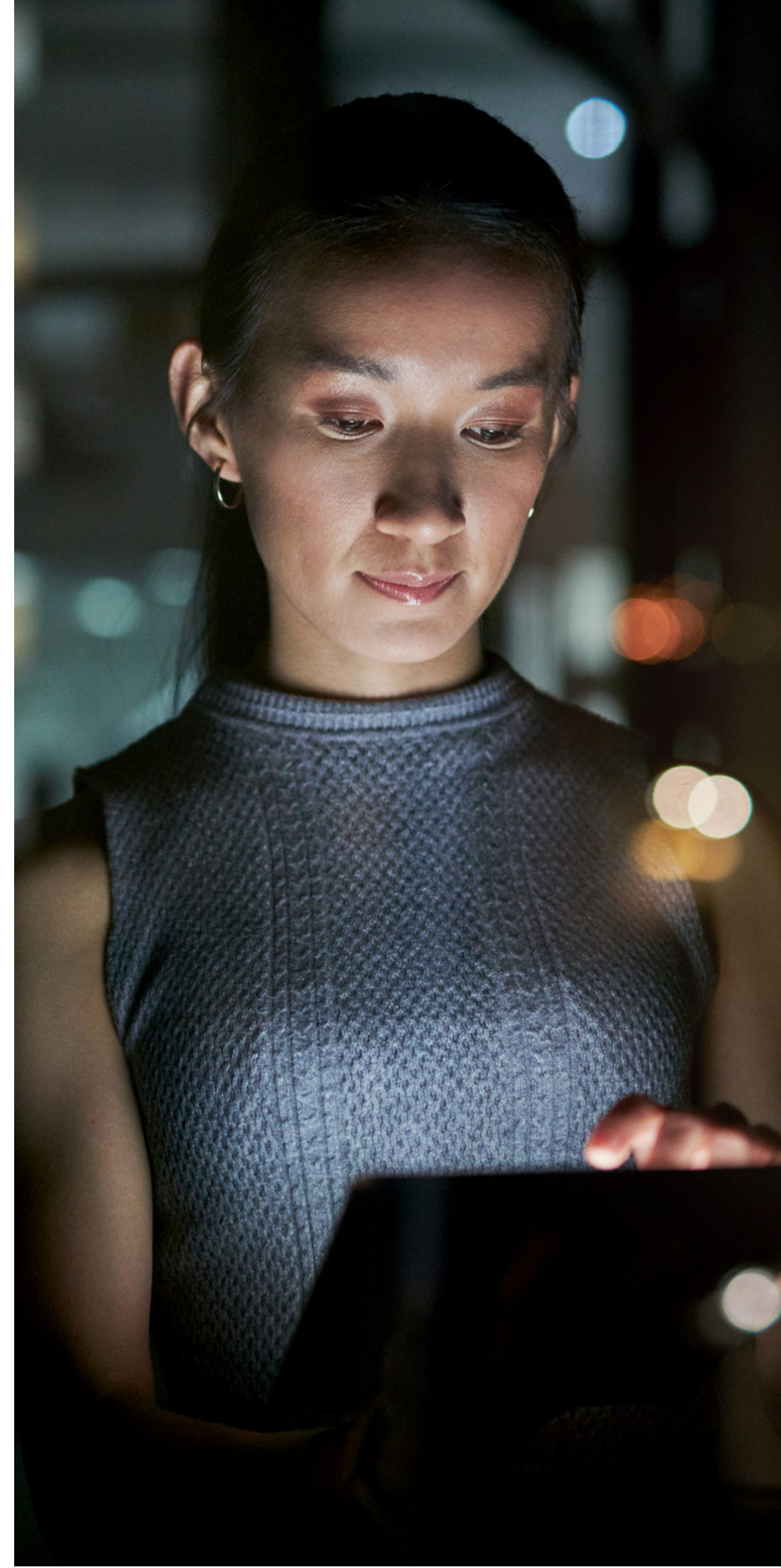
The current state of ITOps automation reveals that numerous organizations are currently undergoing transformation. Research from TechTarget's Enterprise Strategy Group indicates that a mere 24% of the organizations polled have achieved substantial levels of automation in their IT operations (ITOps) tasks across a broad set of IT operations workflows. Conversely, 60% report having a varied mix of automated and manual practices, and, encouragingly, just 16% report all IT operations tasks have a high degree of manual work associated with them.

Furthermore, there is a close correlation between the level of ITOps automation and the perception of DevOps maturity within these organizations. As automation in ITOps tasks progresses, it often goes hand in hand with application evolution and modernization processes. This trend suggests that organizations are recognizing the significance of integrating automation into their operations to enhance efficiency, modernization, and overall IT performance.

This research encompasses the viewpoints of N=250 ITOps staff, site reliability engineers (SREs), platform engineers, architecture teams, and developers at organizations in North America (US and Canada) currently using infrastructure-as-code tools.

This study sought to:

- Better understand market drivers for, adoption of, and impacts associated with infrastructure-as-code/automation technologies.
- Show that increased automation drives enhanced outcomes.



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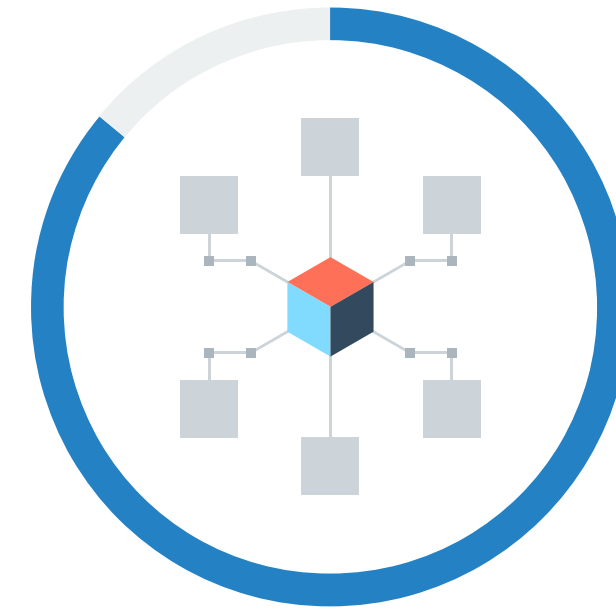
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Organizational Background and the State of ITOps Automation



Scaling Application Development (AppDev) Is Causing Cross-functional Pain for Most Organizations

In today's digital landscape, it is quite common for organizations to rapidly scale AppDev environments. Enterprise Strategy Group research shows that 86% of organizations have seen a growth in the number of applications they maintain compared to three years ago, with a significant 40% of them witnessing more than a twofold increase in their application count.



86%

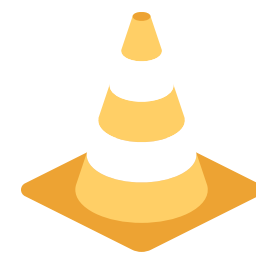
of organizations have seen a **growth in the number of applications they maintain** compared to three years ago.

As organizations strive to expand their AppDev scale, they have encountered various obstacles that impact a variety of roles: 75% of respondents expressed that it has been problematic for their ITOps teams to cope with the increasing demands. Similarly, developers, who play a pivotal role, have also faced difficulties, with 73% of respondents reporting challenges. Finally, 78% of respondents say DevOps staff/SREs and platform engineers also face difficulties.



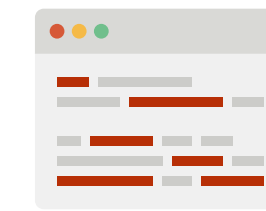
75%

of respondents expressed that it has been problematic for their ITOps teams to cope with the increasing demands.



73%

of respondents reported challenges.



78%

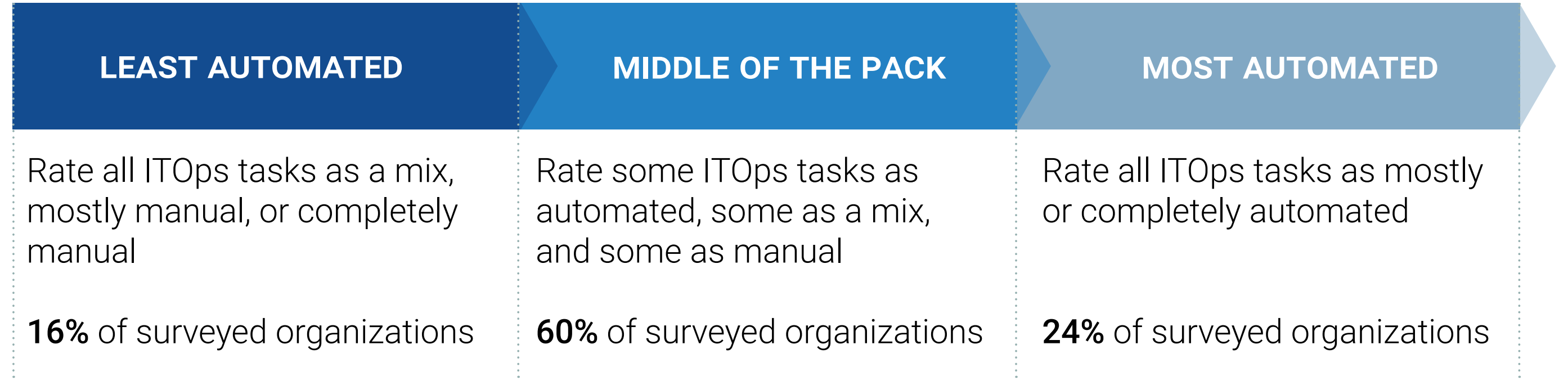
of respondents say DevOps staff/SREs and platform engineers also face difficulties.



This data underscores the importance of addressing these pain points and seeking effective solutions to enable organizations to thrive in the ever-evolving landscape of application development.

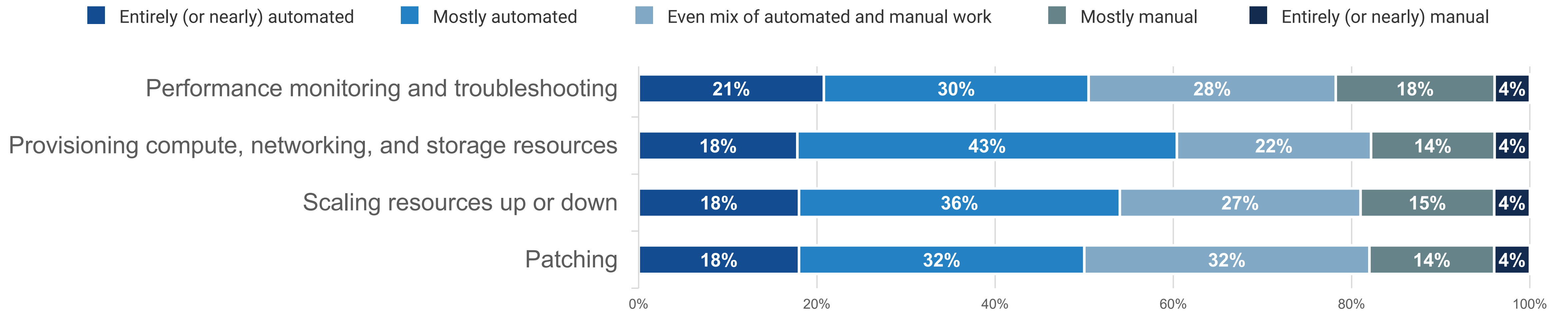
The State of Automation for Infrastructure Ops Workflows

When respondents were asked how automated specific infrastructure management tasks supporting developers were, only about 1 in 5 respondents said each was entirely (or nearly entirely) automated, showing that many organizations have material room for improvement.



Enterprise Strategy Group segmented the organizations represented in this survey into three groups: **The most automated** organizations are those that report each workflow was mostly or completely automated. While each individual workflow was rated as highly automated by a slight majority of respondents, just 24% of respondents (and the organizations they represent) said **all** workflows met this threshold. Conversely, **the least automated** organizations are those that report all tasks are an even mix of automated and manual work, mostly manual, or completely manual; encouragingly just 16% of organizations fall into this camp. Finally, the majority of organizations today fall in **the middle of the pack**, meaning that some tasks are automated, some are a mix, and some are manual. Enterprise Strategy Group believes this 60% of the market is in a state of transformation, moving from less automated to more automated.

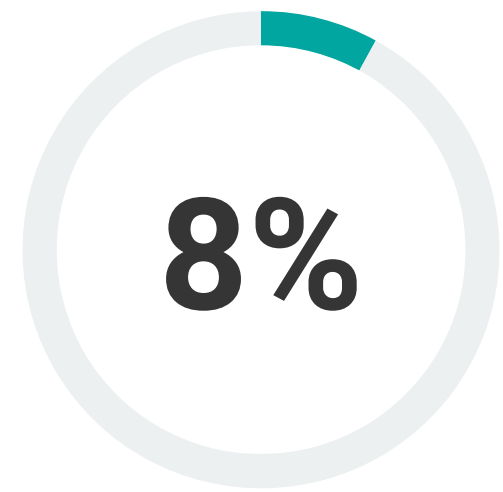
| Degree of automation in infrastructure management processes that support organizations' internally developed applications



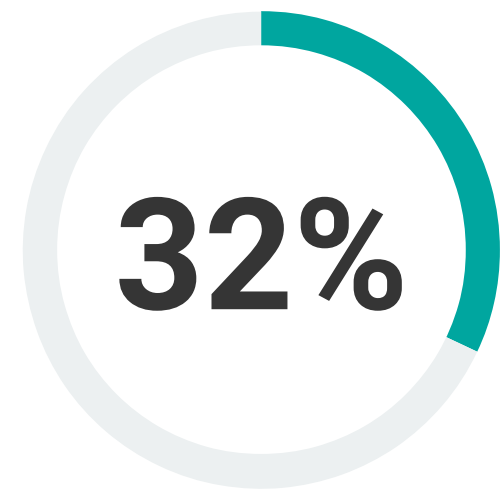
The Surge in Development Operations Over the Past Three Years

The majority of organizations (86%) have experienced growth in their application count over the past three years, indicating a significant trend in application expansion. An impressive 40% of these organizations have witnessed a particularly substantial surge, with their application numbers more than doubling during this period. Only a small 7% of the surveyed organizations reported a contraction, indicating that the overall trend is toward application proliferation rather than reduction.

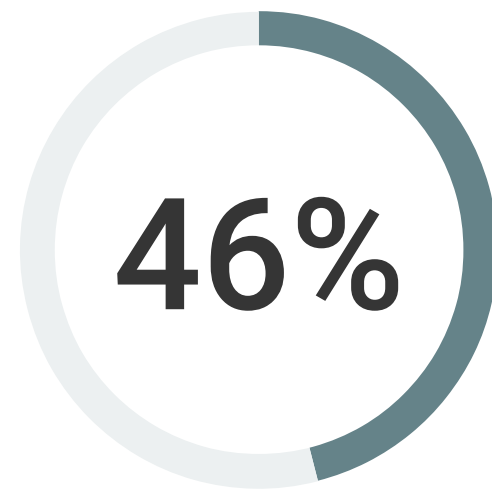
| Change in the number of internally developed applications versus three years ago



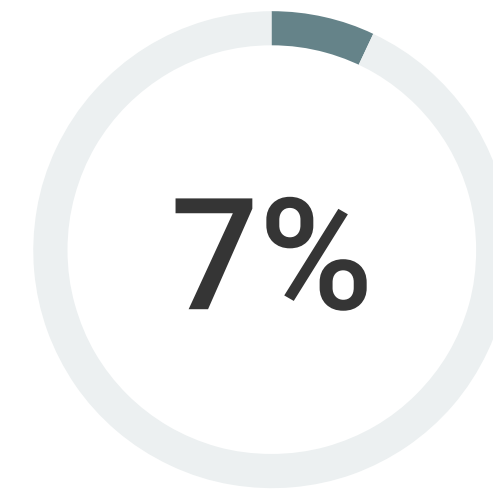
It has increased by 5x or more



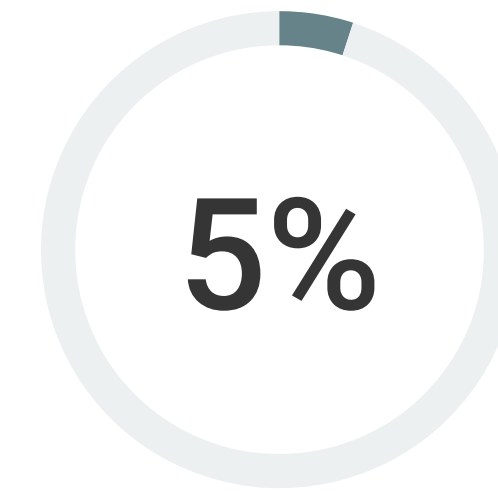
It has more than doubled but increased by a factor less than 5x



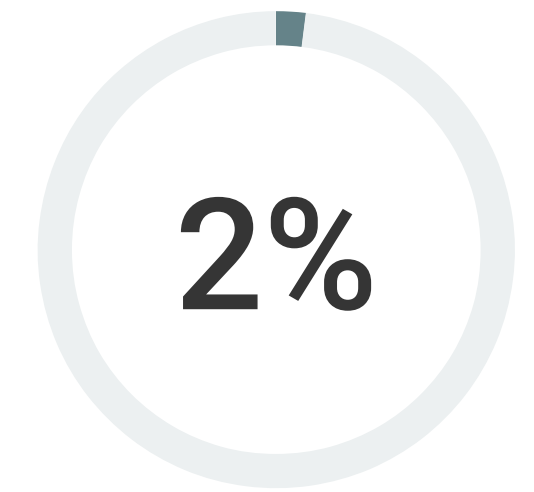
It has increased but by less than double



It has remained relatively flat



It has decreased but by less than 25%



It has decreased by 25% to 49%

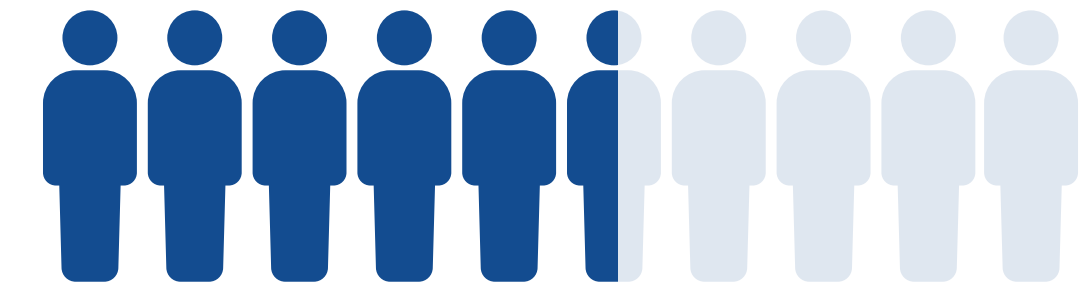


40%

of these organizations have witnessed a particularly substantial surge, with their application numbers more than doubling during this period.

Driving Automation Supports Increased Developer Scaling and Fuels Innovation

The synergy between driving automation and increasing developer scaling plays a pivotal role in fostering innovation. As developer scaling expands to meet the demands of the market, automation helps to optimize workflows and streamline repetitive tasks. This enables developers to focus on more strategic aspects of their work, resulting in heightened productivity and accelerated development cycles. This relationship is clear in the data, as organizations with more ITOps automation have also tended to see a greater increase in application count.



56%

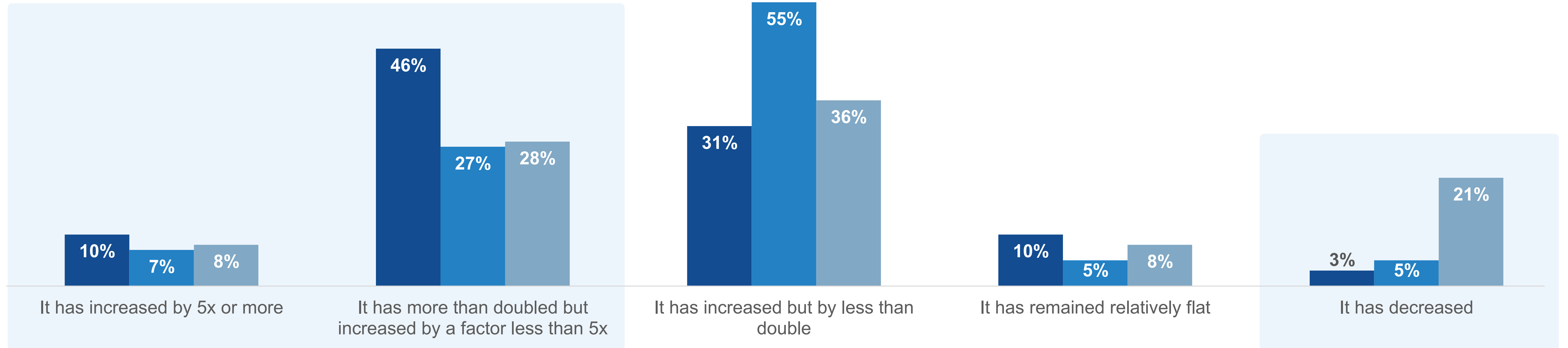
of organizations with the highest level of automation have seen their app portfolios **more than double in the past three years** (versus 34% and 36% of their peers)

| The correlation between ITOps automation and increasing application development scale

■ Most automated organizations (N=61)

■ Middle-of-the-pack organizations (N=150)

■ Least automated organizations (N=39)



Unlocking DevOps Maturity and the Correlation Between ITOps Automation and Improved Perceptions

The data shows the connection between ITOps automation and how organizations perceive their DevOps maturity. As ITOps tasks become increasingly automated, organizations tend to experience a positive shift in their perception of their DevOps maturity. This highlights the significance of automation in shaping a more mature and efficient DevOps ecosystem within businesses.

| The correlation between ITOps automation and the attainment of a mature DevOps practice

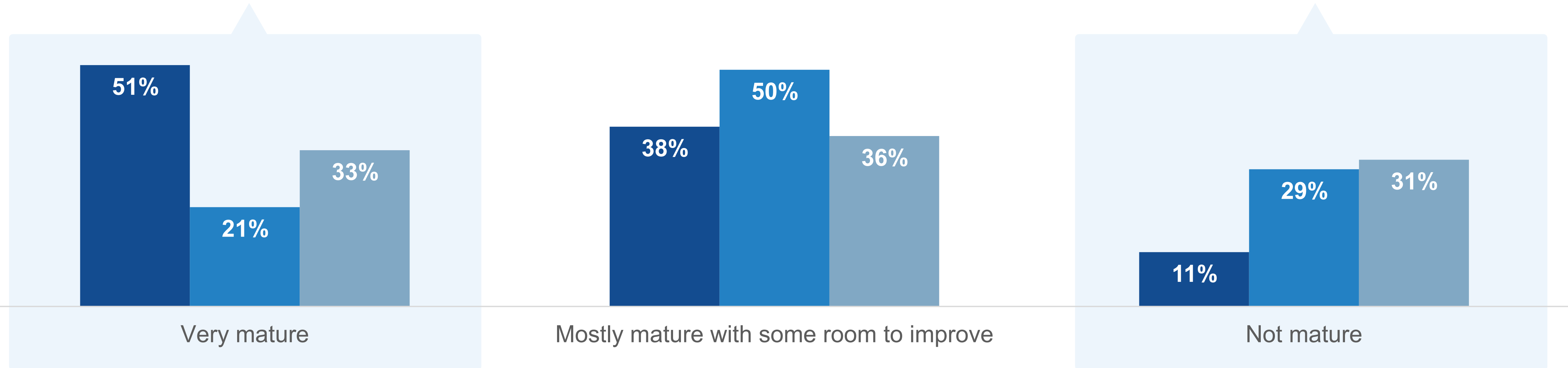
■ Most automated organizations (N=61)

■ Middle-of-the-pack organizations (N=150)

■ Least automated organizations (N=39)

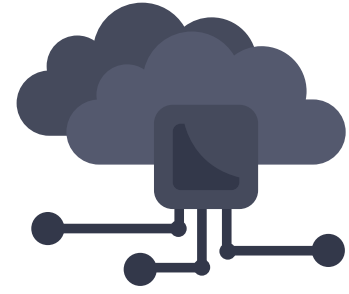
The highest level of automation is linked to a **55%+ likelihood of perceiving DevOps practice as very mature**

The organizations with the least automated ITOps environments are **2.8x more likely to see their DevOps practice as immature**

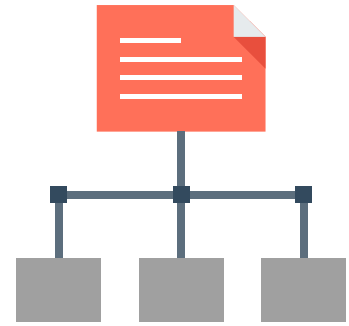


Modern AppDev Evolution and Challenges





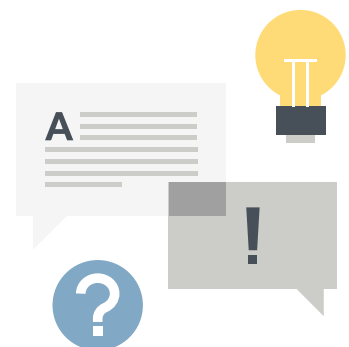
ITOps automation plays a crucial role in helping organizations achieve their cloud-native goals. The data shows that highly automated organizations have a significant advantage, **with a 37% higher likelihood of operating cloud-native applications today.**



By automating various ITOps tasks, organizations can streamline their processes, reduce manual intervention, and accelerate application development and deployment. This increased efficiency enables them to embrace cloud-native practices more effectively, leveraging the scalability, flexibility, and resilience offered by cloud technologies.



A high degree of ITOps automation is also correlated with developer enablement: **The most automated organizations are 3x as likely to have implemented a robust and widely available developer self-service catalogue.** However, in the aggregate, only 20% of organizations have provided their developers with this resource, the lack of a comprehensive self-service platform can hinder developer productivity and agility.



When looking toward their future cloud-native goals, the data shows organizations need to overcome challenges related to complexity, collaboration friction, and legacy infrastructure. By prioritizing and investing in solutions that promote seamless collaboration, modernize legacy systems, and simplify development workflows, organizations can enhance their developer experience, foster innovation, and unlock the full potential of cloud-native environments.

| Organizations' propensity to have developed cloud-native applications



Yes, one or more of our internally developed applications is cloud-native.



23%

No, but we are **currently in the process** of building our first cloud-native application

15%

No, but we are planning to build our first cloud-native application **within the next 12 months**

3%

No, but we are interested in building our first cloud-native application **sometime in the future**

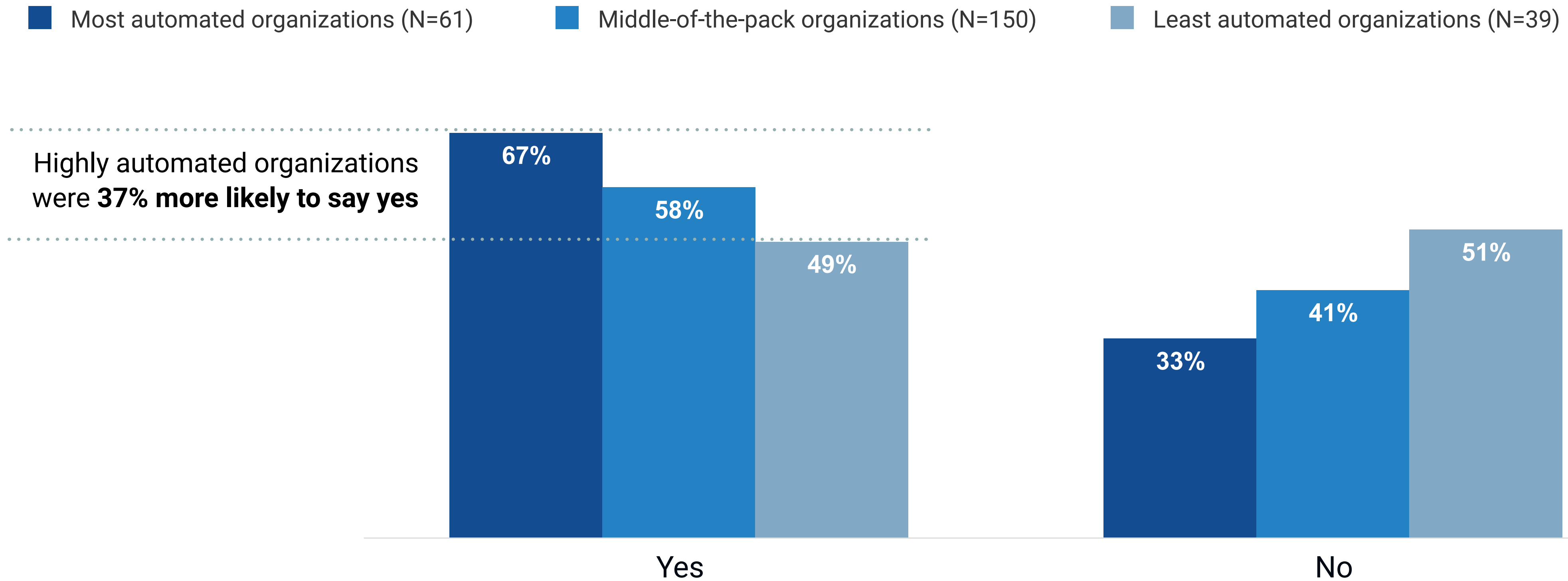
Cloud-native Approaches Have Passed the Tipping Point

The majority of respondents in the survey report that one or more of their internally developed applications is cloud-native. This finding reflects the growing trend of organizations adopting cloud-native architectures, technologies, and practices to drive innovation and scalability in their software development processes. Embracing cloud-native approaches enables businesses to harness the benefits of cloud computing, such as enhanced agility, cost efficiency, and seamless scalability, to stay competitive in the rapidly evolving digital landscape.

Cloud-native Progress Is Correlated With Increasing ITOps Automation

Increasing levels of ITOps automation have shown a clear correlation with a higher likelihood of organizations pivoting to cloud-native application development approaches. As automation streamlines ITOps and reduces manual interventions, it enables teams to focus more on modernizing their applications and adopting cloud-native practices. This shift toward cloud-native development approaches is driven by the desire for greater agility, scalability, and efficiency, which are key benefits offered by cloud technologies.

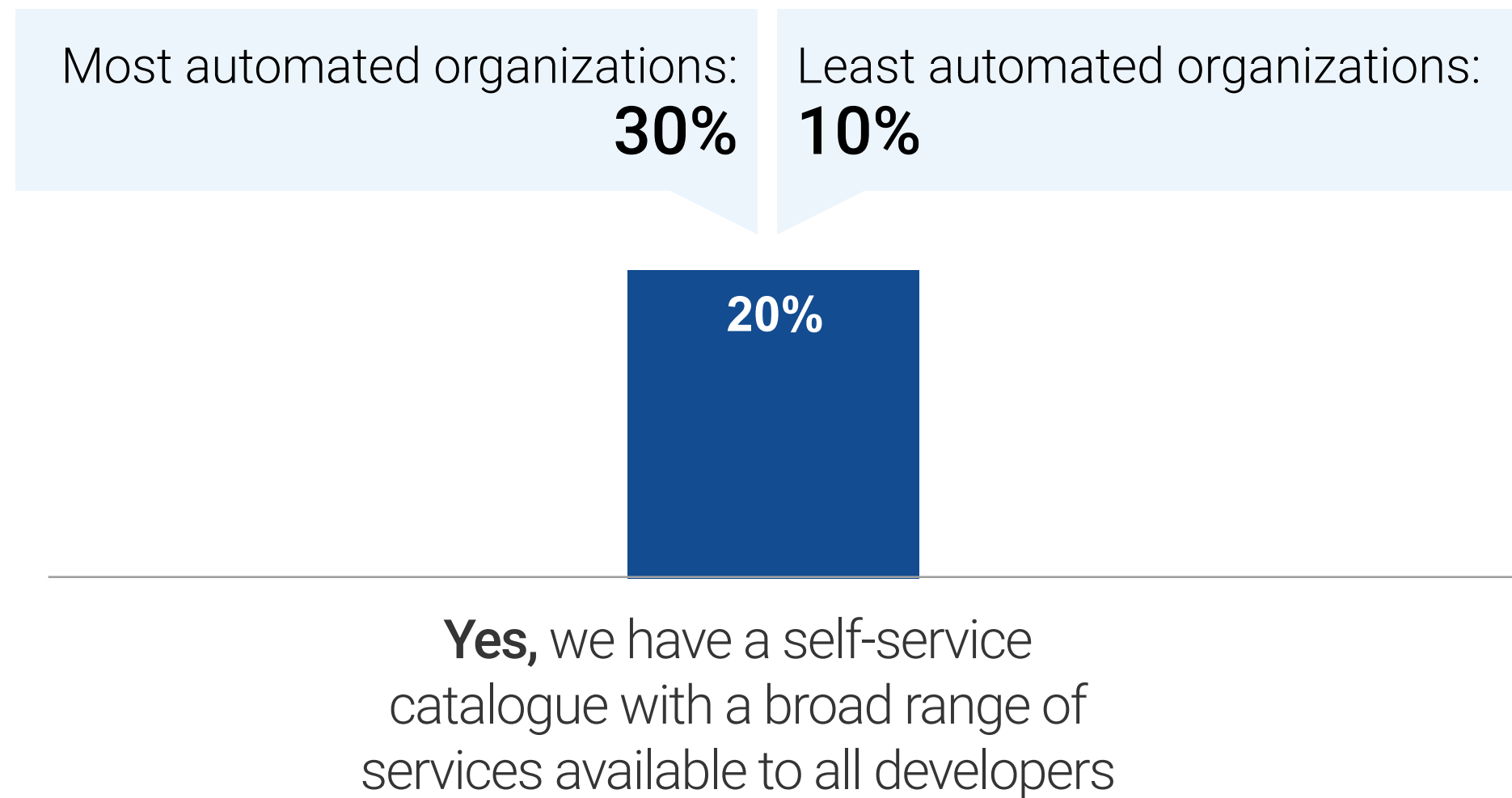
| The correlation between ITOps automation and increasing application development scale



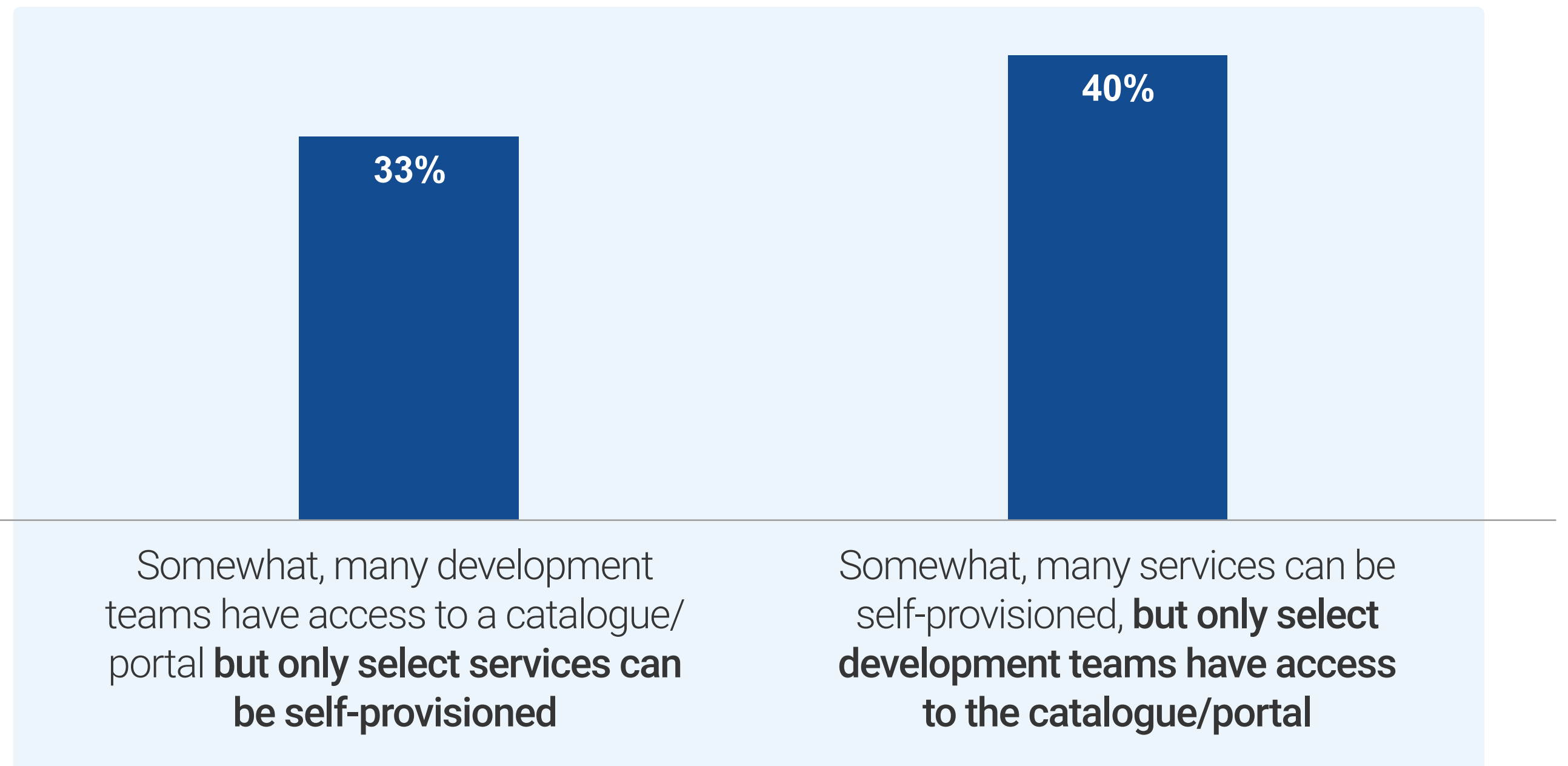
Fragmented State of Developer Self-service and Assessing the Landscape

Only 20% of organizations have managed to implement a comprehensive self-service catalogue of IT services accessible to all developers. However, the majority of respondents (73%) indicate that their self-service capabilities fall into one of two categories: “broad but shallow” or “deep but narrow.” This fragmented state highlights the need for organizations to bridge the gap and develop more robust and versatile self-service platforms to empower their developer teams effectively.

Organizations’ implementations of IT self-service catalogues/portals



“ 73% indicate that their self-service capabilities fall into one of two categories: **“broad but shallow” or “deep but narrow.”**”



Challenges Organizations Face When Striving to Achieve Cloud-native Goals

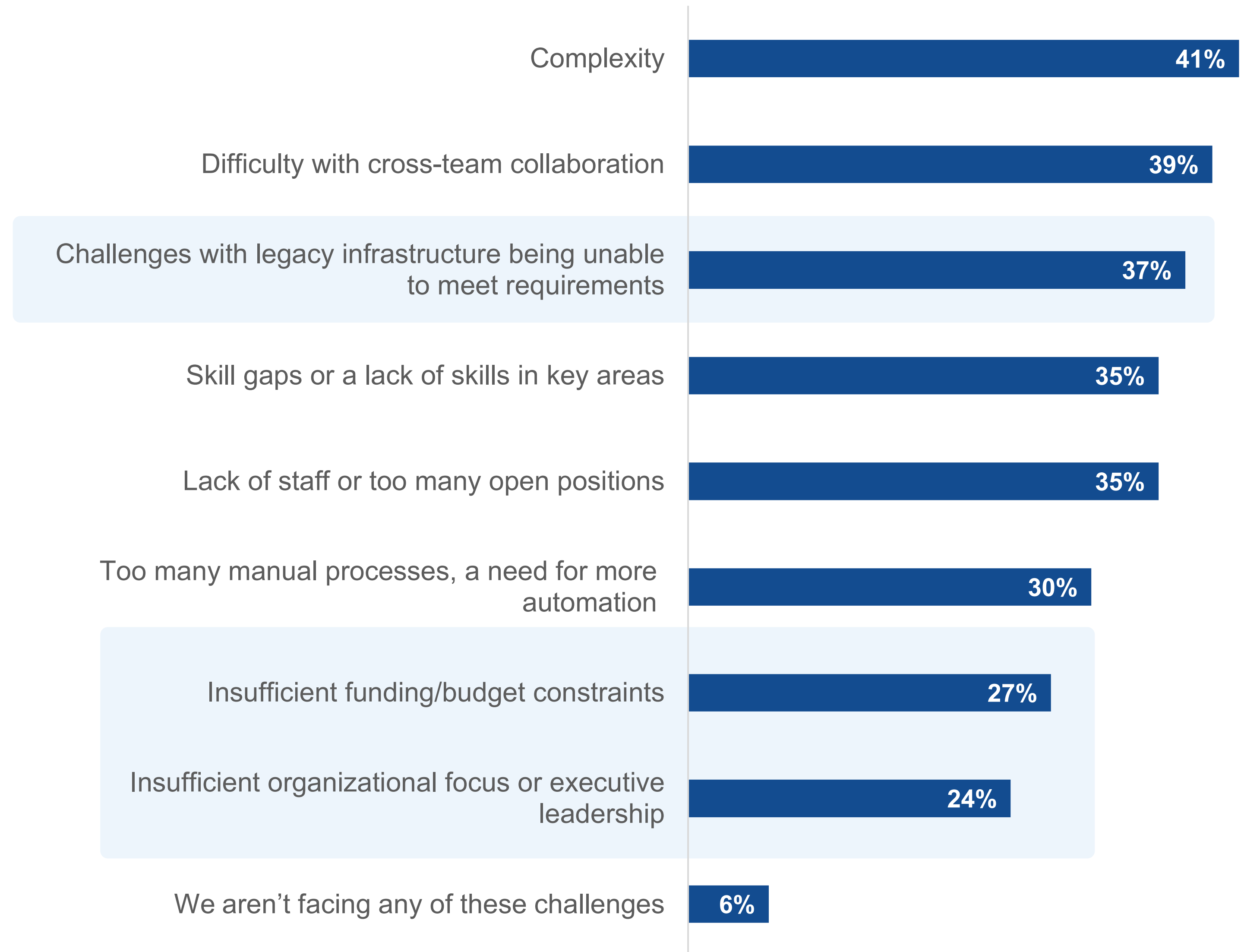
Organizations striving to achieve cloud-native goals often encounter various challenges along the way. The complexity of modernizing legacy systems and applications to fit cloud-native architectures presents a significant obstacle.

Additionally, collaboration friction between different teams and departments can hinder the seamless integration and adoption of cloud-native practices.

While complexity and collaboration friction are key challenges, many organizations also appear to need major infrastructure refreshes.

On the flip side, budget and leadership buy-in are least often reported as challenging, indicating overall organizations are highly motivated to achieve their cloud-native goals.

| Challenges organizations face with respect to cloud-native goals and objectives



Infrastructure-as-code Perceptions and Progress

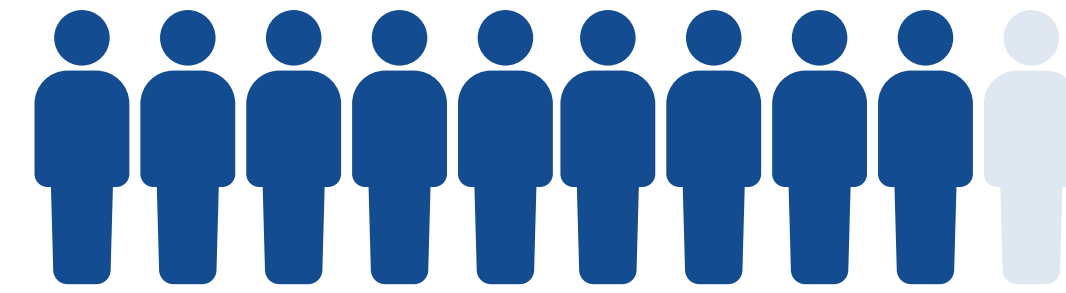


Infrastructure-as-Code Can Be the Lynchpin to Application Modernization Success

The survey results reveal a strong consensus among respondents, with 90% recognizing infrastructure-as-code approaches as critical for modernization and innovation in their organizations. The shift toward infrastructure-as-code enables businesses to treat infrastructure provisioning and management as code, enabling greater flexibility, scalability, and agility in the deployment process.

However, despite the recognition of its importance, 70% of respondents expressed concerns about skill gaps within their ITOps team when it comes to effectively implementing and utilizing infrastructure-as-code practices. This skills shortage underscores the need for organizations to invest in training and upskilling their IT professionals to fully leverage the potential of infrastructure-as-code and derive the utmost benefits from its adoption.

Apart from facilitating modernization and innovation, infrastructure-as-code tools offer a host of other advantages. According to the survey, 73% of respondents believe that infrastructure-as-code leads to lower infrastructure costs, while 72% highlight its positive impact on accelerating development times.



90%

recognizing infrastructure-as-code approaches as **critical for modernization and innovation in their organizations.**



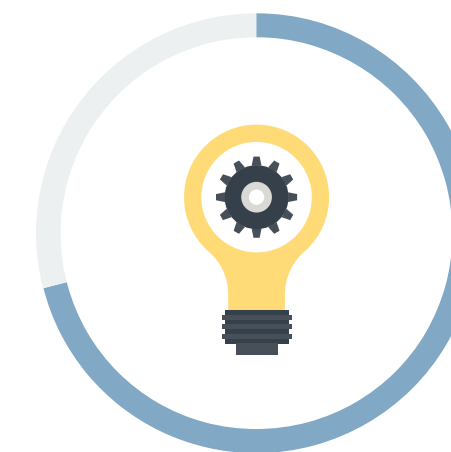
73%

of respondents believe that infrastructure-as-code leads to **lower infrastructure costs.**



72%

highlight its **positive impact** on accelerating development times.



71%

report **improved application reliability** as a direct result of adopting infrastructure-as-code practices.

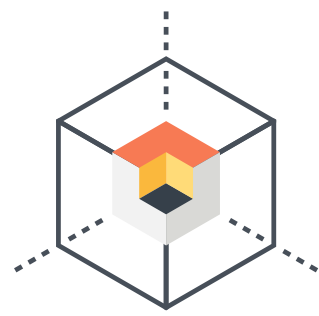
Additionally, 71% report improved application reliability as a direct result of adopting infrastructure-as-code practices. These benefits further emphasize the significance of automation in infrastructure management and the pivotal role it plays in optimizing operational efficiency and driving organizational success. As organizations increase their automation efforts, they can expect to reap even more benefits, making infrastructure-as-code an indispensable aspect of their technology stack.

Drivers for Infrastructure-as-code Tool Investment

The majority of respondents say scale, collaboration, and process automation were top of mind for organizations as they weighed and made infrastructure-as-code tool investments. The adoption of infrastructure-as-code tools is primarily driven by several key factors.

First, organizations seek to enhance their operational agility and flexibility by treating infrastructure provisioning and management as code, enabling faster and more reliable deployments. Secondly, the desire to reduce operational costs and optimize resource utilization motivates organizations to invest in infrastructure-as-code, as it streamlines processes and minimizes manual intervention. Lastly, the increasing demand for scalable and automated infrastructure solutions in modern, cloud-native environments fuels the investment in infrastructure-as-code tools, enabling organizations to meet the challenges of a rapidly evolving digital landscape.

| Organizations' desired outcomes from investment in infrastructure-as-code tools



56%

Improved
scalability



55%

Enhanced
collaboration



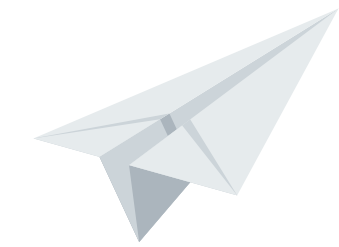
52%

Process
automation



44%

Compliance with
best practices



42%

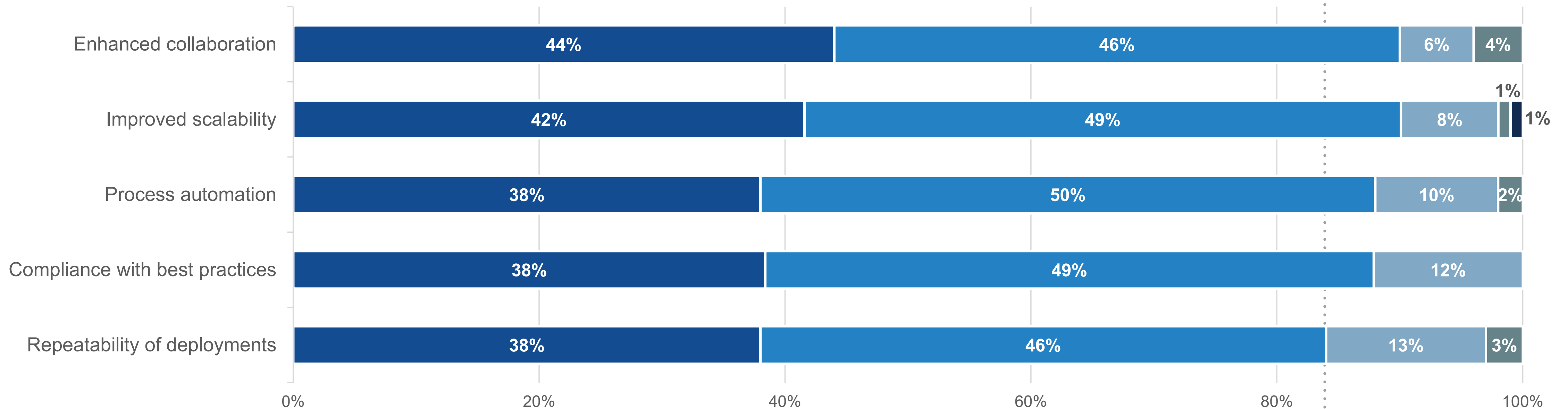
Repeatability of
deployments

The Impact of Infrastructure-as-code Tools on Ops Outcomes

Organizations are reaping numerous benefits from their usage of infrastructure-as-code tools. These advantages include improved operational efficiency, accelerated development cycles, and enhanced application reliability. Furthermore, organizations are experiencing cost savings, increased scalability, and the ability to adapt quickly to changing business needs, making infrastructure-as-code a valuable asset in their technology stack.

Impact of organizations' use of infrastructure-as-code tools

■ Significant positive impact ■ Moderate positive impact ■ No impact ■ Negative impact ■ Don't know/too soon to say



84%+
report infrastructure-as-code tools have had an impact in each area.

Automation and Infrastructure-as-code Impact Are Connected

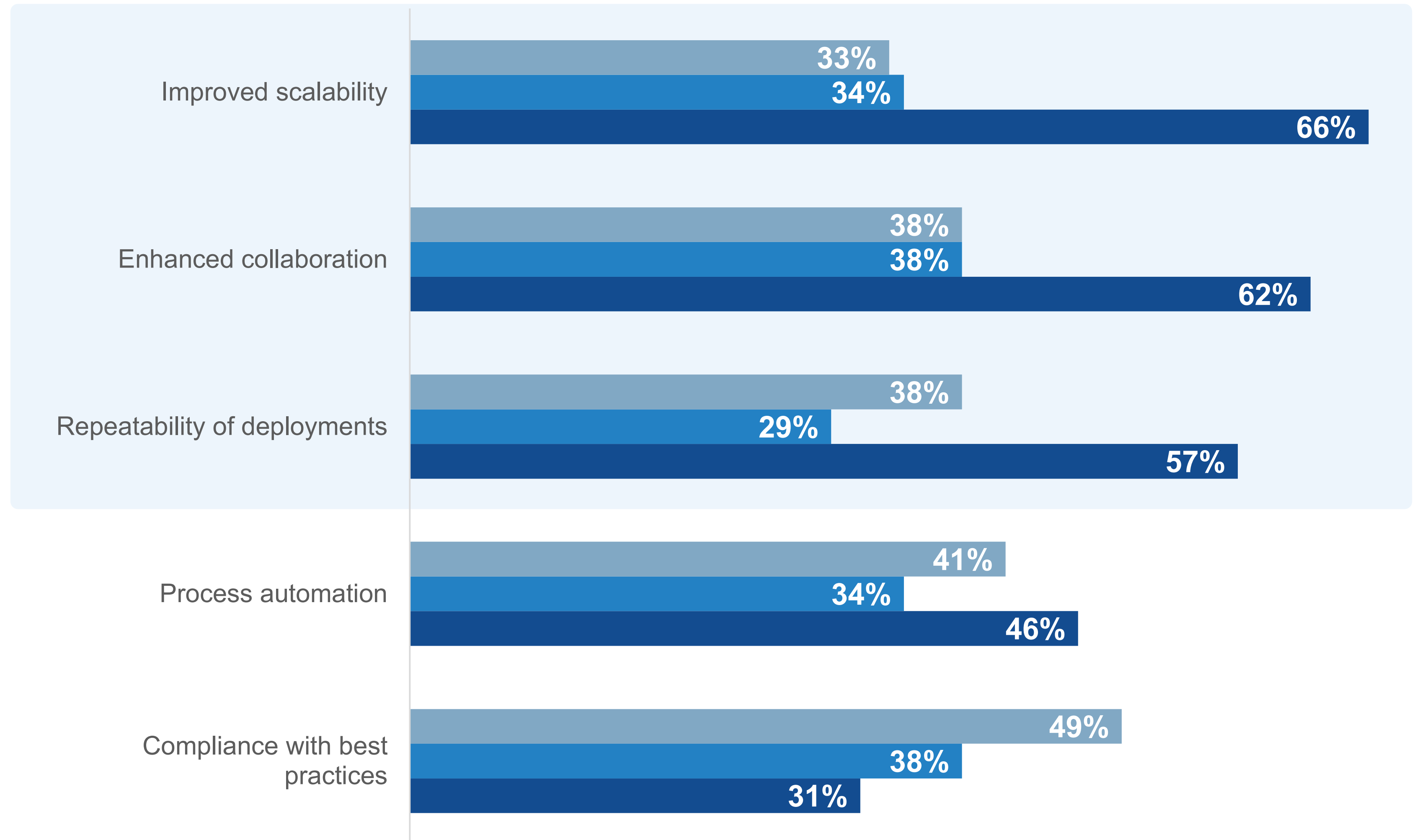
Not surprisingly, organizations automating more ITOps processes (enabled by infrastructure-as-code tools) are much more apt to say infrastructure-as-code tools are having a significant positive impact in areas like scalability, collaboration, and deployment repeatability.

Automation and infrastructure-as-code are closely connected, with one significantly impacting the other. Infrastructure-as-code enables organizations to automate the provisioning, configuration, and management of their infrastructure, streamlining the deployment process and reducing the need for manual interventions.

As automation is integrated into infrastructure-as-code practices, organizations can achieve greater operational efficiency, increased consistency, and faster time-to-market, ultimately driving successful cloud-native transformations and delivering more robust and reliable applications.

Impact of organizations' use of infrastructure-as-code tools, by level of automation

■ Least automated organizations (N=39) ■ Middle-of-the-pack organizations (N=150) ■ Most automated organizations (N=61)



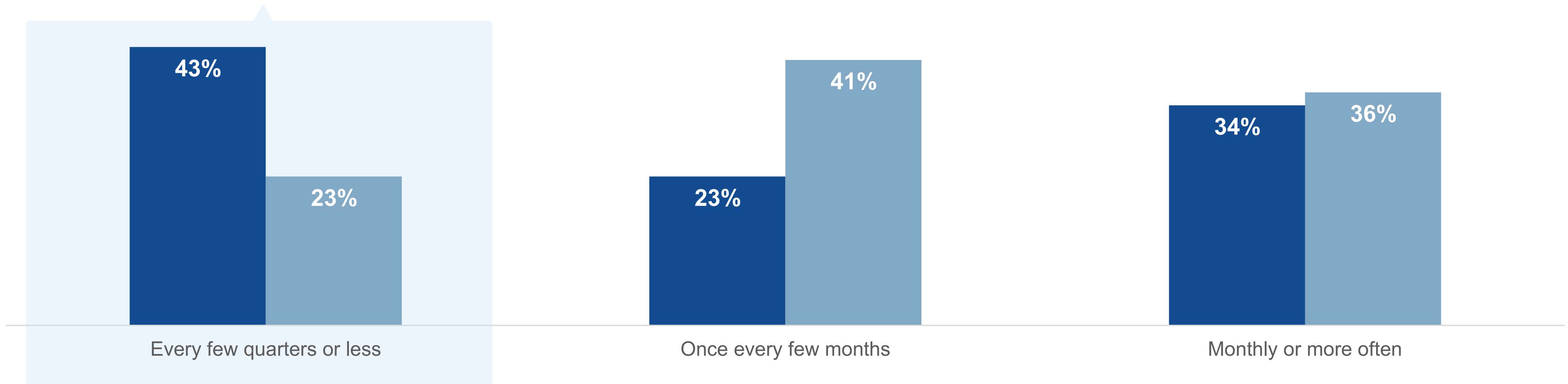
ITOps Automation Is Correlated With a Greater Likelihood of an Organization Achieving More Resilient App Operations

Organizations that have achieved the highest level of automation are also experiencing the benefit of reduced downtime. The seamless integration of automation in ITOps enables more efficient monitoring, incident response, and issue resolution, leading to improved system reliability and availability. Consequently, these organizations can maintain higher levels of productivity and service continuity, resulting in increased customer satisfaction and a competitive edge in the market.

| Frequency with which business-critical, internally developed applications suffer from downtime or significant performance degradation

■ Most automated organizations (N=61) ■ Least automated organizations (N=39)

Organizations with the highest level of automation **are almost twice as likely to report downtime is infrequent**



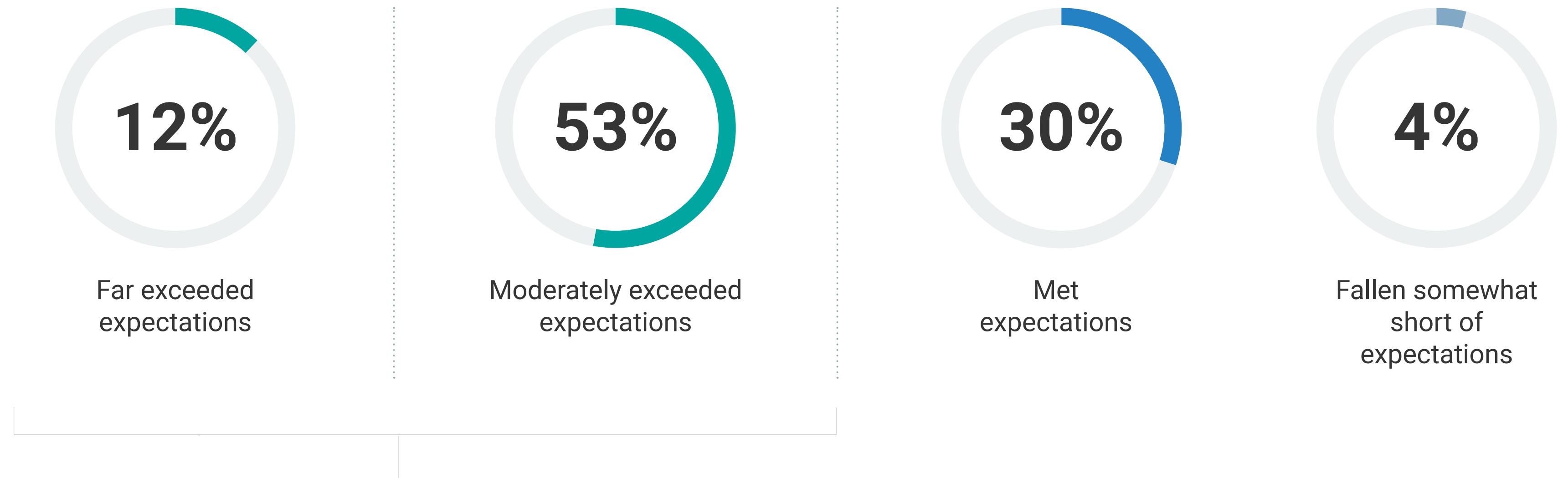
Return-on-investment (ROI) Perceptions of Infrastructure-as-code Tool Investments

Roughly two-thirds of respondents say the ROIs of their organization's infrastructure-as-code tools has exceeded expectations.

Infrastructure-as-code tools are widely recognized for their positive impact on measurable key performance indicators such as cost efficiency, development times, system uptime, and risk reduction.

By streamlining infrastructure provisioning and management, infrastructure-as-code enables organizations to optimize resource utilization, accelerate development cycles, maintain higher uptime rates, and enhance overall system security, ultimately driving significant improvements across various critical metrics.

Organizations' assessments of the ROI of infrastructure-as-code tools



ROUGHLY TWO-THIRDS

of respondents say the ROIs of their organization's infrastructure-as-code tools have exceeded expectations.

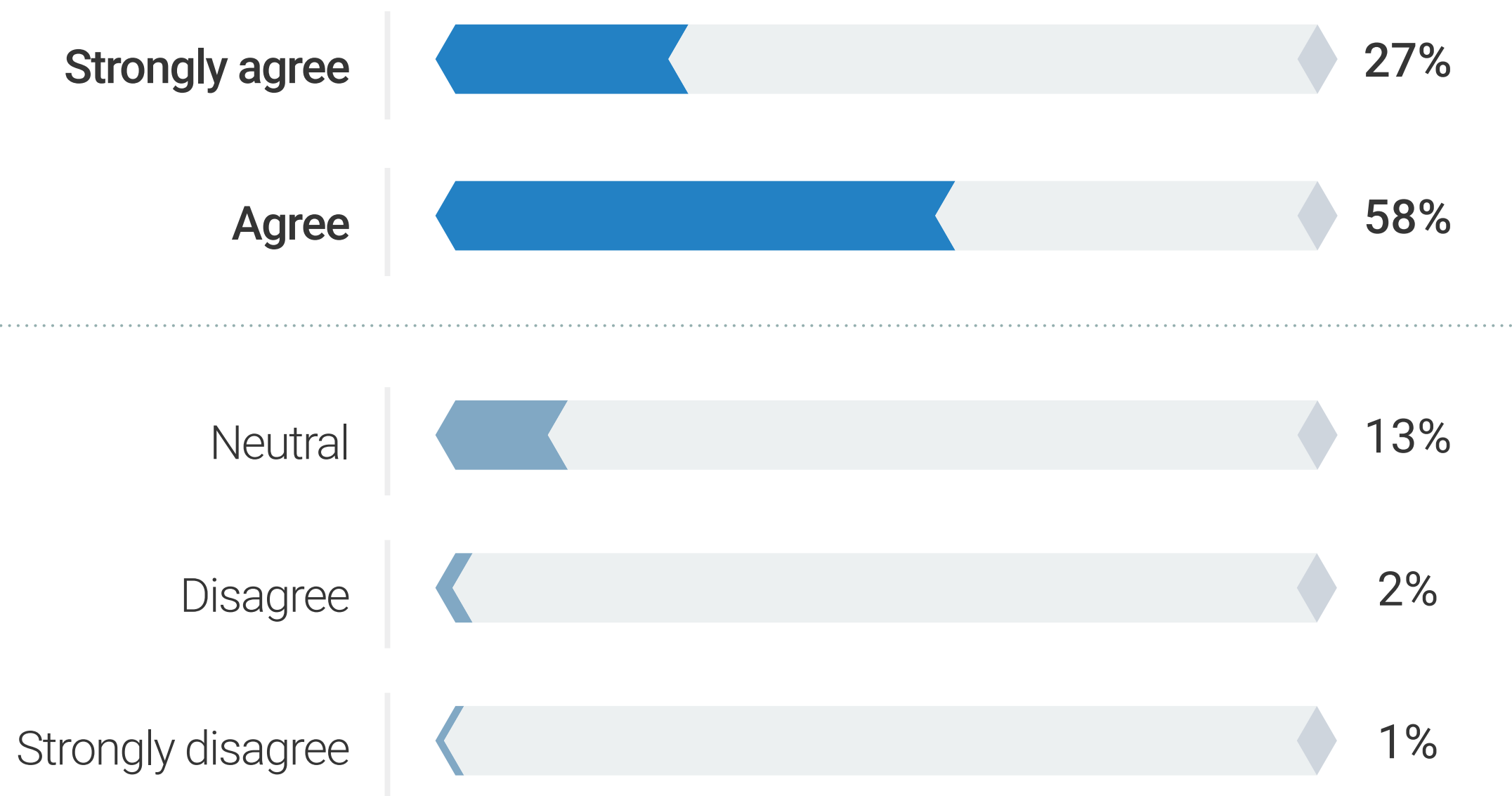
From an Infrastructure Perspective, the Ability to Integrate Is Seen as a Must-have

More than four out of five respondents agree: The ability to integrate into DevOps/automation tool chains is a must-have requirement for infrastructure vendors (i.e., they would be replaced otherwise).

From an infrastructure perspective, the ability to seamlessly integrate with different systems and technologies is considered a must-have feature. Organizations prioritize integration capabilities to ensure smooth interactions between various components of their infrastructure stack, fostering interoperability and enhancing overall operational efficiency and flexibility.

Note: this level of agreement is consistent regardless of current automation levels or functional role.

| Organizations' agreement that the ability to integrate is a must-have requirement for infrastructure-as-code tools



MORE THAN 4 OUT OF 5 RESPONDENTS AGREE:

The ability to integrate into DevOps/automation tool chains is a must-have requirement for infrastructure vendors (i.e., they would be replaced otherwise).



How Dell Can Help

Dell Technologies creates technologies that drive human progress. Our story began with a belief and a passion that everybody should have easy access to the best technology anywhere in the world. Today, Dell Technologies is instrumental in changing the digital landscape the world over. Dell Technologies is among the world's leading technology companies helping to transform people's lives with extraordinary capabilities. From hybrid cloud solutions to high-performance computing to ambitious social impact and sustainability initiatives, what Dell Technologies does impacts everyone, everywhere.

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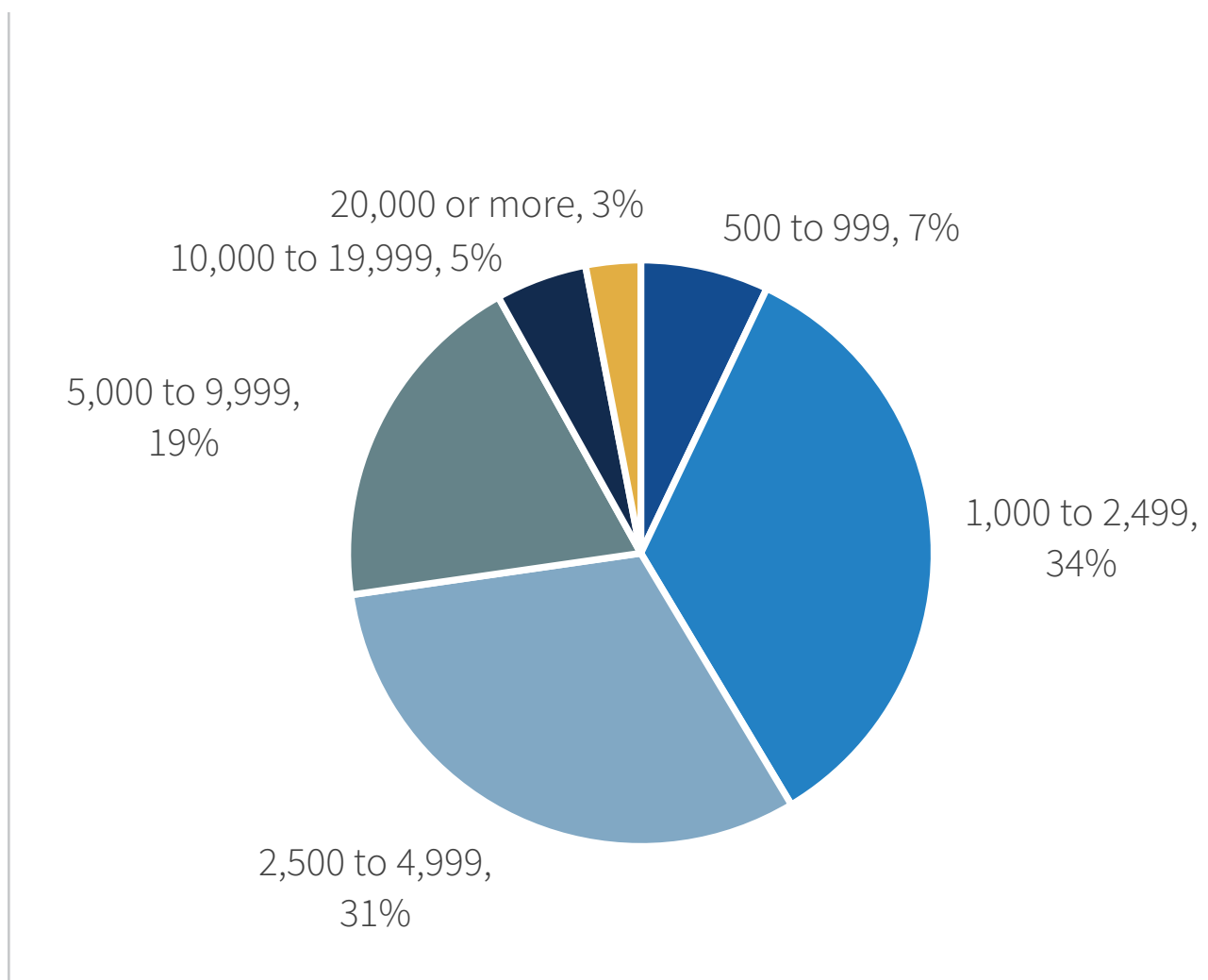


Research Methodology and Demographics

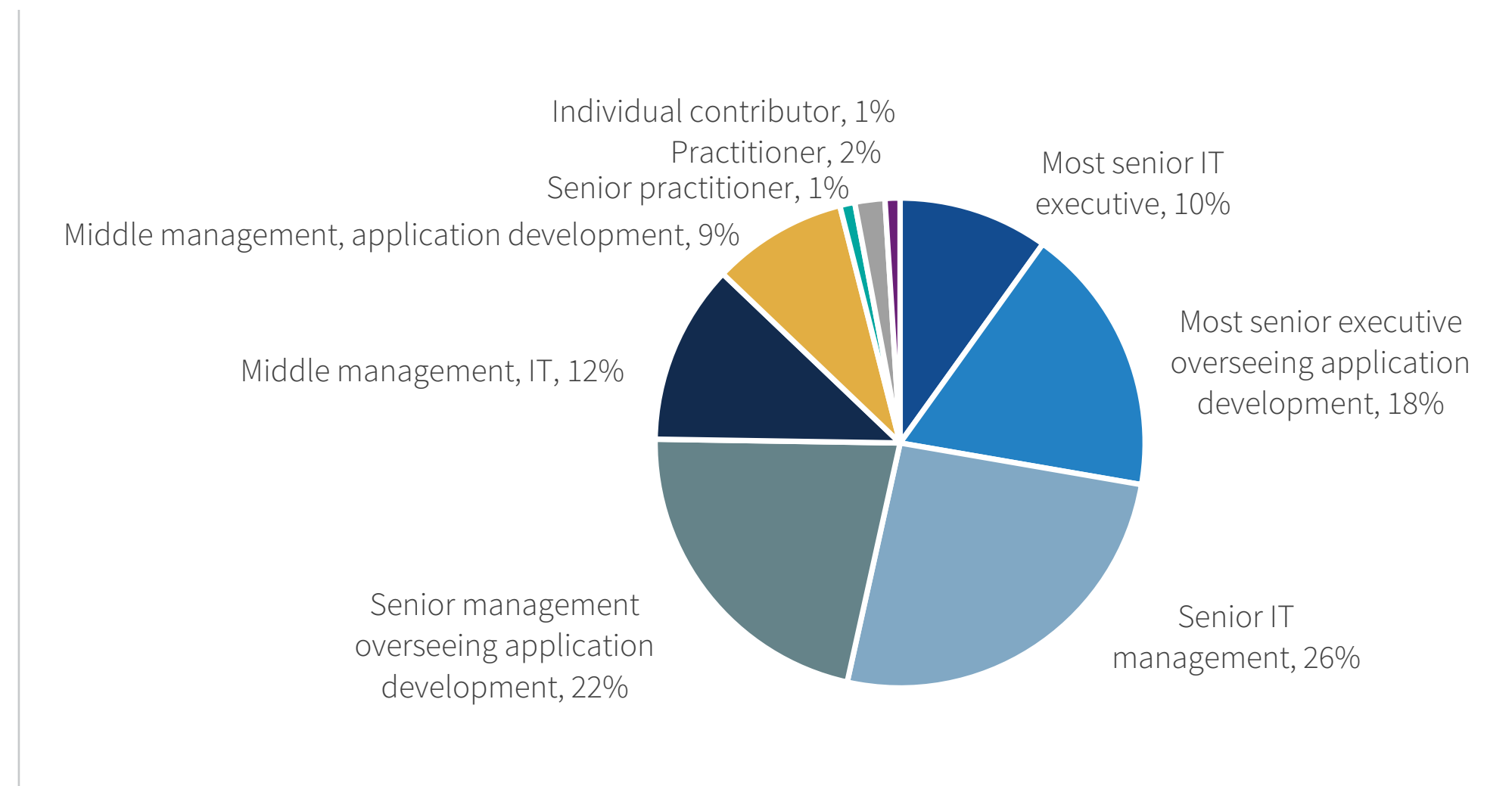
To gather data for this eBook, Enterprise Strategy Group conducted a comprehensive online survey of ITOps staff, SREs, platform engineers, architecture teams, and developers at organizations currently using infrastructure-as-code tools in North America between May 23, 2023, and June 12, 2023. To qualify for this survey, respondents were required to be employed in the roles noted above. IT-centric individuals must have reported that they spend the majority of their time supporting internally developed applications while development-centric roles were required to be knowledgeable about the IT infrastructure environment underpinning their apps. All respondents were provided an incentive to complete the survey in the form of cash awards and/or cash equivalents.

After filtering out unqualified respondents, removing duplicate responses, and screening the remaining completed responses (on a number of criteria) for data integrity, we were left with a final total sample of 250 ITOps staff, SREs, platform engineers, architecture teams, and application development professionals.

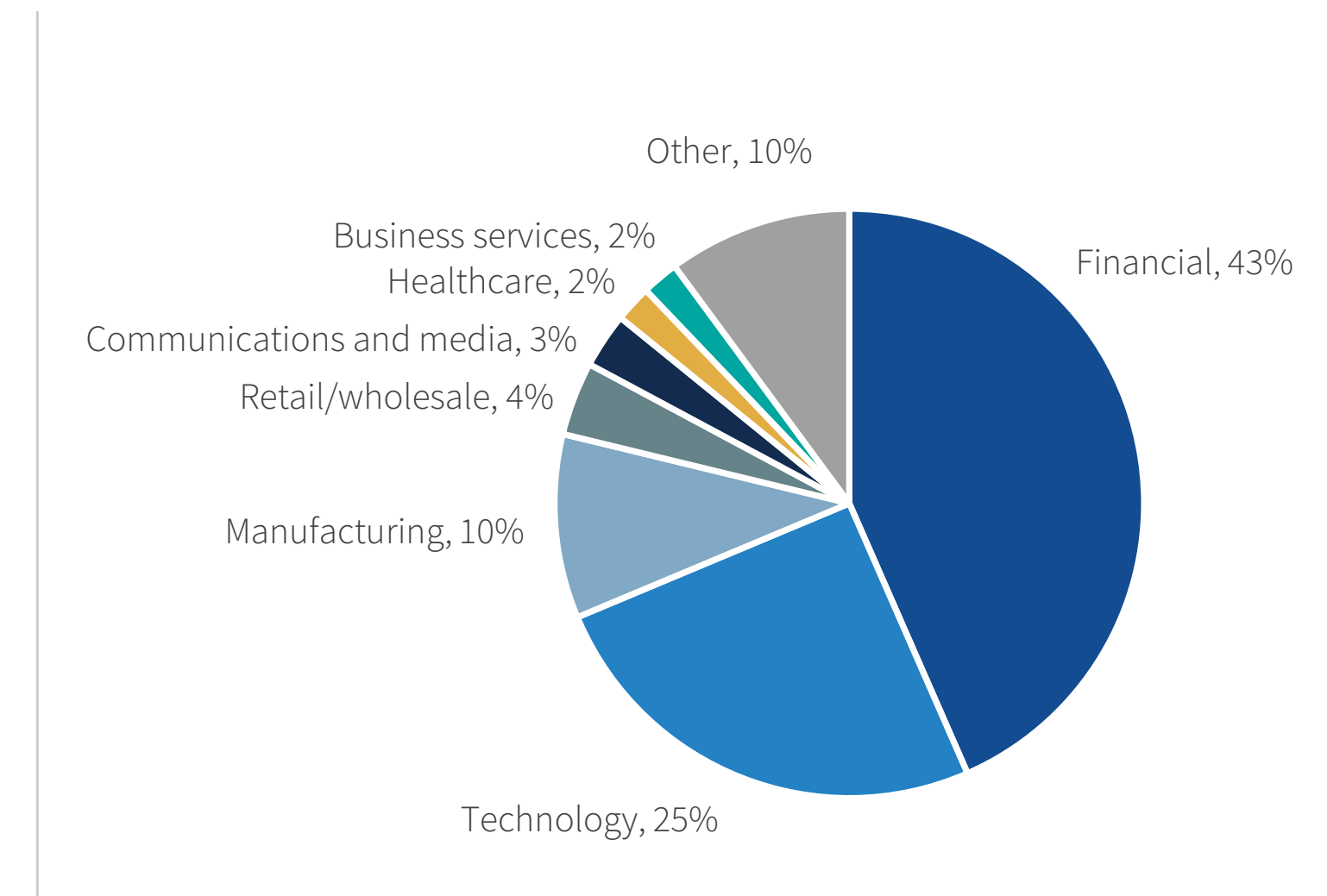
RESPONDENTS BY NUMBER OF EMPLOYEES



RESPONDENTS BY SENIORITY



RESPONDENTS BY INDUSTRY



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