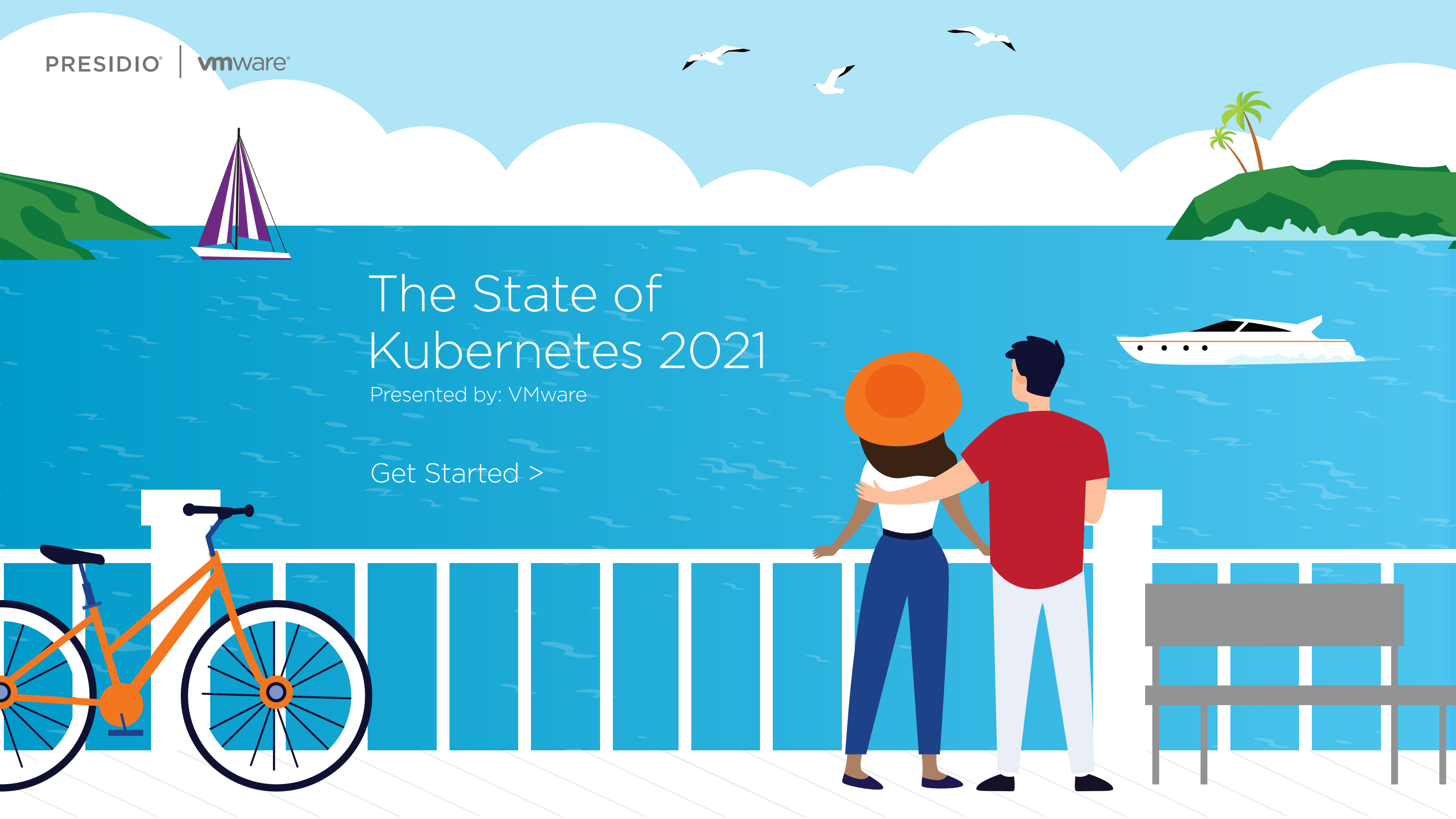


The State of Kubernetes 2021

Presented by: VMware

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Introduction

Kubernetes and cloud native technologies have continued to gain momentum since last year’s report. Kubernetes simplifies the work of developers and operators, increasing agility and accelerating software delivery. While Kubernetes has been popular with developers for a number of years, it’s now moving steadily into production environments and well on its way to entering the IT mainstream.

As enterprises accelerate digital transformation and embrace the Kubernetes ecosystem, some are experiencing growing pains due to a lack of expertise, complex deployments and challenges integrating new and existing systems. This year’s report examines the continuing evolution in the way enterprises are using Kubernetes—the benefits they’re seeing from the technology; continued complexity around decision making, deployment and operations; and progress against existing and new challenges.

This report is divided up into four sections:

 <p>KUBERNETES MOMENTUM</p> <p>Companies are using Kubernetes in production and reaping the benefits.</p>	 <p>MULTIPLE STAKEHOLDERS IS THE NEW NORMAL</p> <p>Teams across the business are involved in decisions and operations.</p>
 <p>SPEED BUMPS REMAIN</p> <p>While Kubernetes is getting easier to use, teams still face some challenges.</p>	 <p>TOWARD DEVSECOPS</p> <p>Security across the container lifecycle is becoming essential.</p>

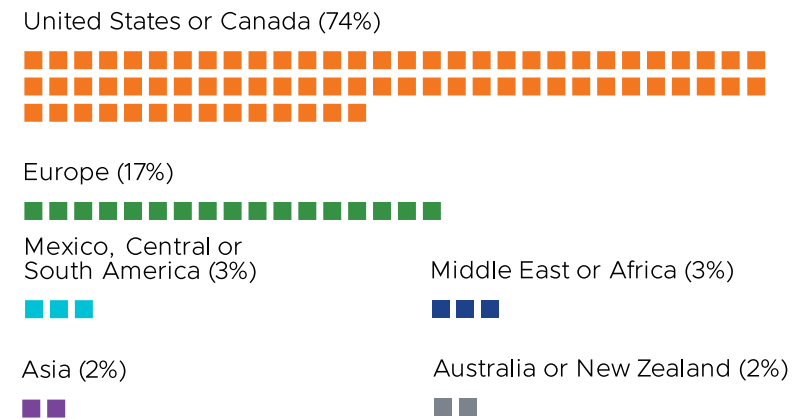
Demographics

Our 2021 study focused on individuals with responsibility for Kubernetes at companies with 1,000 or more employees. VMware commissioned Dimensional Research to survey the experiences of **357 qualified software development and IT professionals**. A wide range of roles, industries, regions, and job levels are represented.

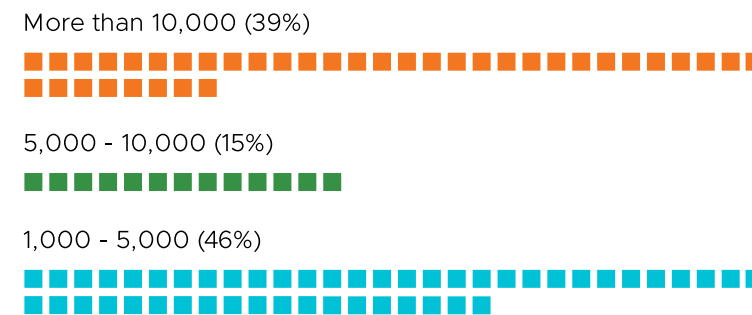
All the organizations surveyed have a significant software development footprint. About 29% have between 100 and 1,000 developers, 11% have 1,000 to 2,500 developers, and 24% have more than 2,500 developers.

Our sample skews toward technology companies (19%) and financial services companies (15%), but all major sectors are represented, including telecommunications (9%), healthcare (9%) and government (7%).

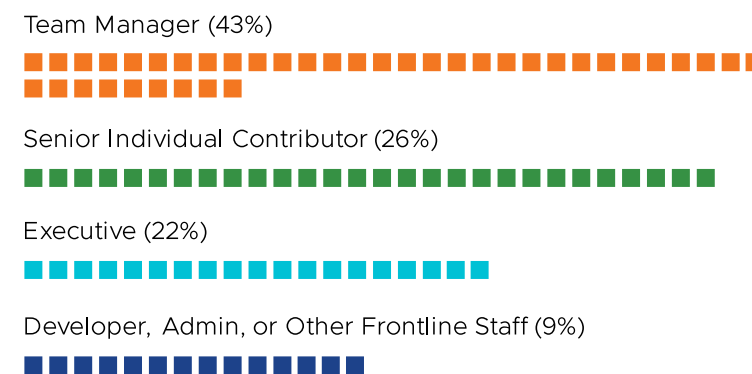
REGION



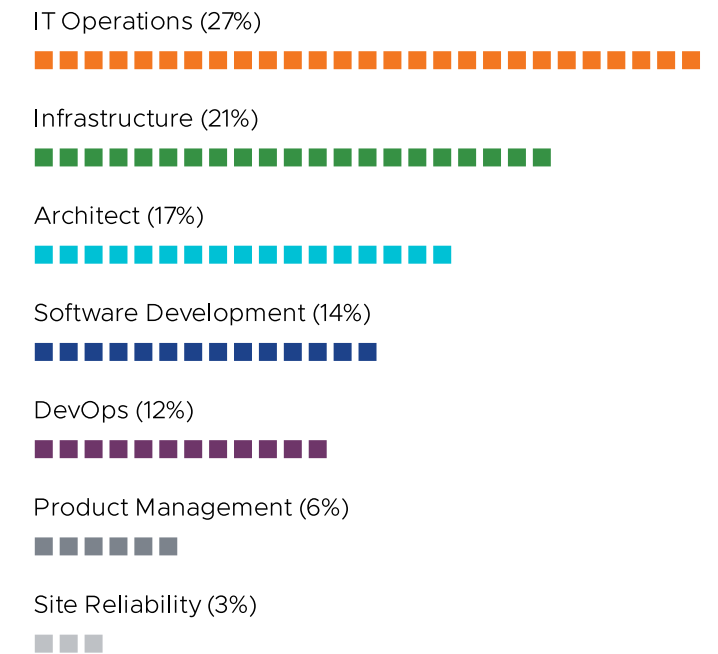
COMPANY SIZE (# OF EMPLOYEES)



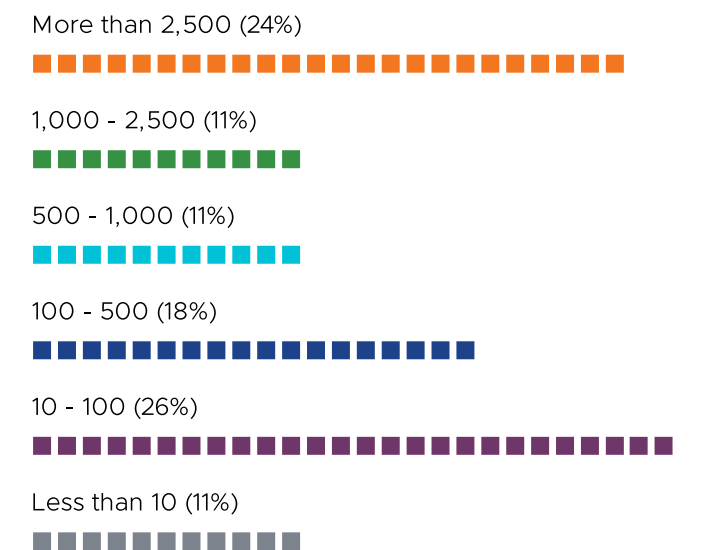
JOB LEVEL

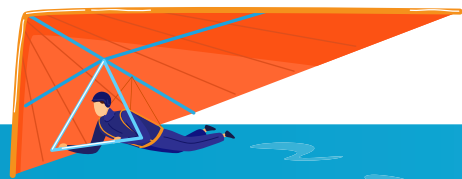


PRIMARY JOB RESPONSIBILITY



NUMBER OF SOFTWARE DEVELOPERS





Kubernetes Momentum

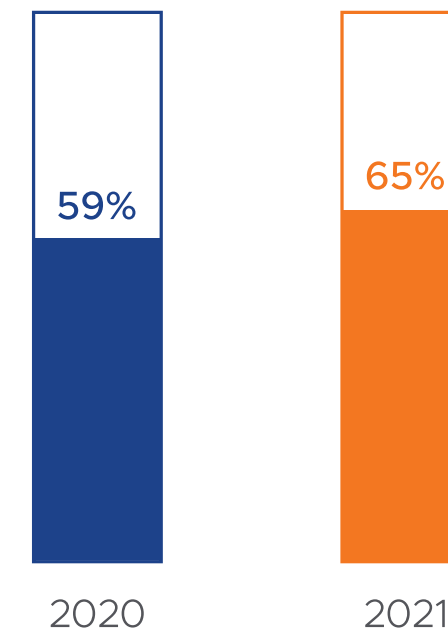
Kubernetes continues to gain momentum and is thriving across all industries. Companies are quickly figuring out how to operationalize Kubernetes, some software companies are mainstreaming the technology, and everyone is seeing clear benefits as the Kubernetes ecosystem matures.

A Distinct Shift to Kubernetes in Production

An important sign of Kubernetes momentum is the continuing shift to production, growing from 59% in the 2020 report to 65% this year. Companies with more than 500 developers were more likely to be running all or most containerized workloads in production (78%). In our first State of Kubernetes report in 2018, less than a third (30%) reported running Kubernetes in production.

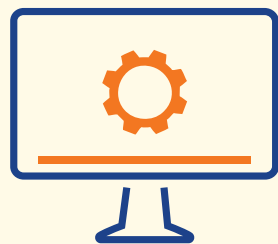
While there's no "right" number of nodes per cluster, the companies with the most clusters have the most nodes per cluster and are also more likely to be using Kubernetes in production. In companies with more than 10 clusters, 41% report having 20+ nodes per cluster. For these companies, it's likely that Kubernetes is already becoming a mainstream technology.

Use of Kubernetes in production



SOFTWARE INDUSTRY LEADING THE CHARGE TO KUBERNETES

Companies whose primary business is software development saw even greater benefits from Kubernetes, ranking every benefit from 2% to 12% higher than other industries. In particular, they ranked *reduced public cloud costs* 11% higher (63% in total) and *eased application upgrades* 12% higher (58% in total), suggesting that the more Kubernetes is integrated into your operations, the better the outcomes.



Respondents from software companies ranked all benefits 2 - 12% higher

Clear Benefits for Everyone...

Almost everyone surveyed (98%) sees significant benefits from Kubernetes. The top benefit this year was *improved resource utilization* (selected by 58%). Second was *eased application upgrades and maintenance* (48%), edging out last year's number two choice, *shortened software development cycles*, which came in a close third this year at 46%.

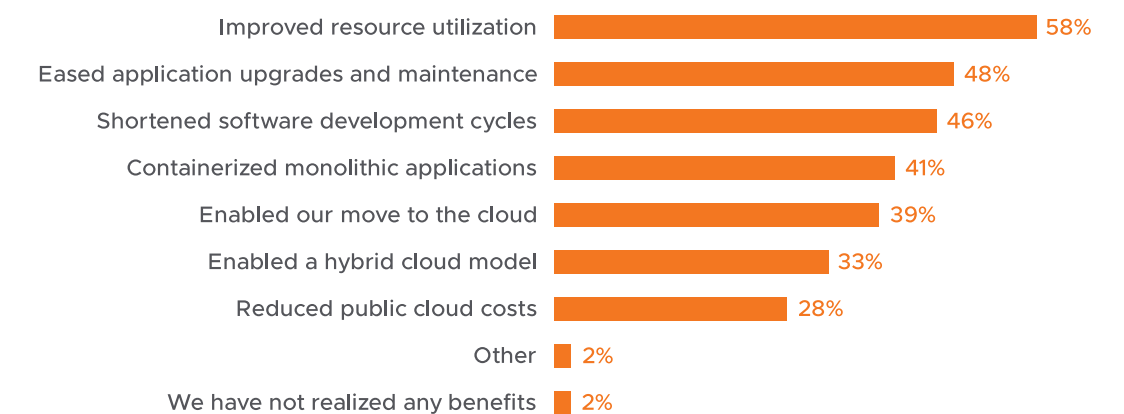
This year's top two benefits are important KPIs for operations teams, while shortened development cycles obviously benefit software and DevOps teams—not to mention internal and external customers.

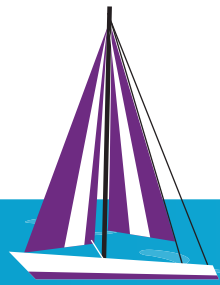
One of the strengths of Kubernetes is that you can run clusters on-premises and in the cloud and move containerized workloads between clusters easily. This gives a significant boost to companies' cloud migration efforts with 39% selecting *enabled our move to the cloud*, 33% choosing *enabled a hybrid model*, and 28% saying Kubernetes *reduced public cloud costs*. The latter benefit likely results from the fact that Kubernetes utilizes resources efficiently and elastically.

Almost all respondents see clear benefits from Kubernetes



What benefits has your organization realized from operating Kubernetes?



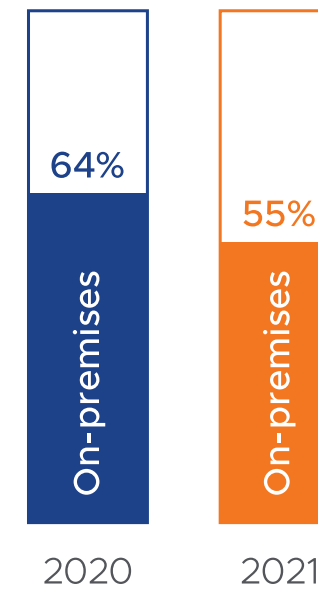


A Decided Shift from On-Prem to Multi-Cloud

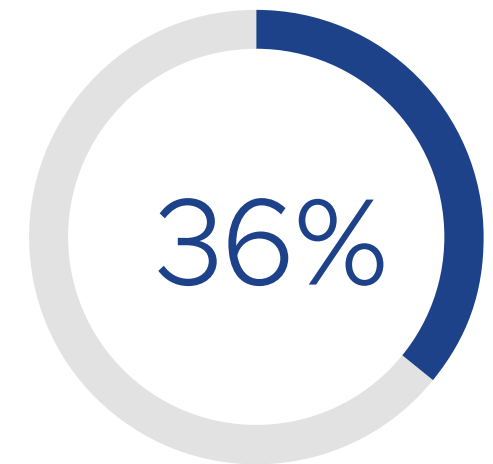
Given Kubernetes' multi-cloud benefits, perhaps it's not surprising that this year's survey shows a shift away from on-premises deployments. On-premises was selected by just 55% of respondents this year, a decrease of 9% relative to 2020. Single and multi-cloud deployments each increased by 5%, with more than a third (36%) of respondents utilizing multiple public clouds and intentionally pursuing a multi-cloud strategy.

These results suggest that teams are becoming more familiar with Kubernetes and are comfortable running it in cloud environments. The relative ease of deploying Kubernetes as a cloud service may simplify operations for companies still building internal expertise.

Kubernetes' workload portability and automated scaling put it front and center as companies build out hybrid and multi-cloud strategies. Standalone on-premises deployments are transitioning to become part of hybrid and multi-cloud operations.



55% of respondents reported on-premises deployments, down 9% from last year



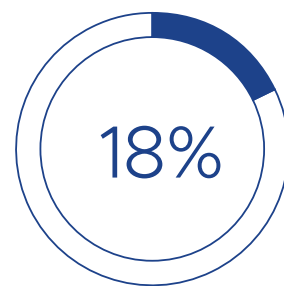
36% of respondents are pursuing a multi-cloud strategy

Clear Winners and Losers...

In another clear sign that enterprise use of Kubernetes is maturing, there are indications that winners and losers are emerging. Roughly half of respondents are now using Amazon EKS (54%) and/or Microsoft AKS (49%), while VMware Tanzu saw 6% growth since last year. Other Kubernetes platforms—both on-premises platforms and cloud offerings—were flat or declining

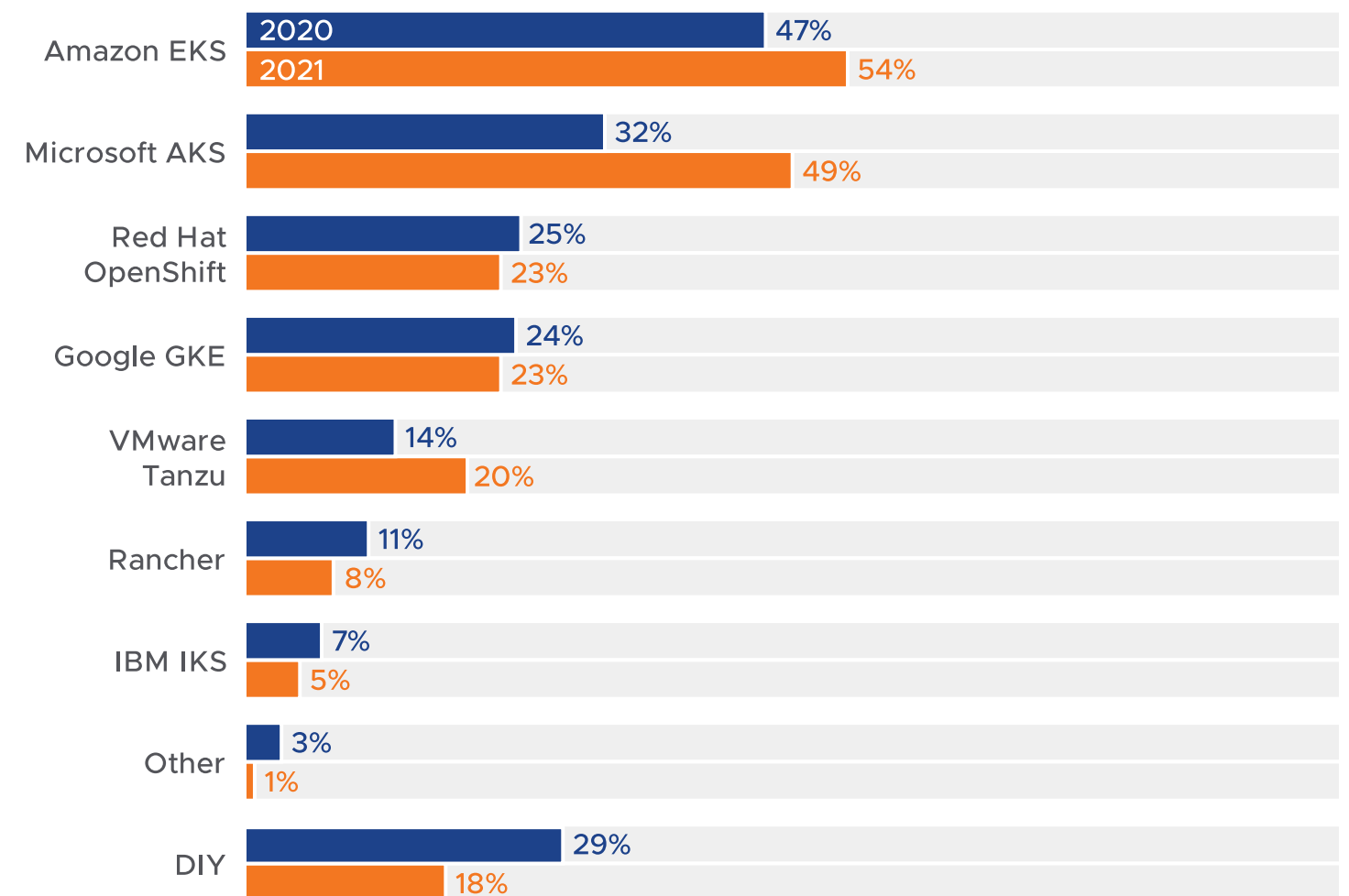
Is DIY DOA?

A final sign of Kubernetes momentum and maturity is that do-it-yourself (DIY) Kubernetes deployments dropped 11%, from 29% in the last report to 18% here. This suggests that enterprises have moved beyond the experimentation phase of Kubernetes deployment. It may also be a sign that the available Kubernetes offerings now fulfill most companies' needs.



DIY Kubernetes dropped to just 18% this year

Which of the following Kubernetes offerings are currently being used at your organization?





Multiple Stakeholders is the New Normal

As companies accelerate digital transformation, more stakeholders are getting involved in decisions involving cloud native technologies like Kubernetes—as well as day-to-day operations. While the days when technology decisions were largely the domain of IT are a thing of the past, teams appear to be adapting to having multiple cooks in the kitchen.

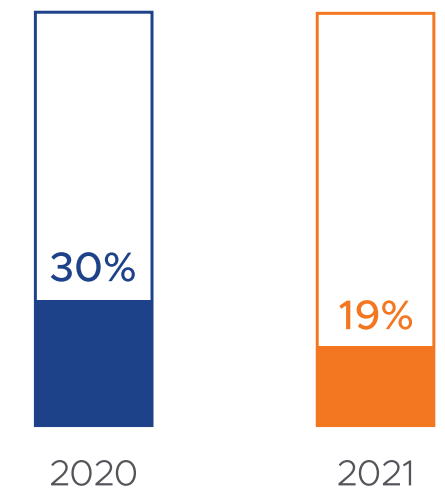
OWNERSHIP OF KUBERNETES HAS BECOME CLEARER

When we asked about management challenges, *lack of clear ownership* showed an 11% drop versus the previous survey, from 30% down to 19%. Although some confusion around ownership of decisions and operations remains, it's clear that teams are figuring out how to collaborate.

EVERYONE (STILL) WANTS A SEAT AT THE TABLE

When it comes to actually choosing a Kubernetes distribution, multiple teams get involved there too. About 83% of respondents indicated that more than one team is involved in these decisions. Operations (62%), and development teams (55%) are most often in the mix, but application owners (29%) and even C-level executives (16%) are getting involved.

Management challenges are decreasing

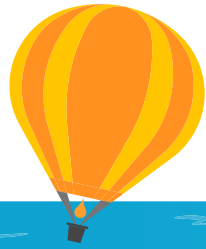


Lack of clear ownership showed an 11% drop versus last year

83%

of respondents say multiple teams are involved in selecting a Kubernetes distribution





WHEN EVERYONE BENEFITS, EVERYONE WINS

All these owners, influencers and stakeholders may sound like a recipe for disaster, but diverse teams—from developers and DevOps to architects to IT operations and beyond—all reported seeing role-specific benefits from Kubernetes. While the relative importance of each benefit varied by role, everyone recognizes the benefits and importance of Kubernetes to the company. This may help smooth the transition to more collaborative and cross-functional ways of working.

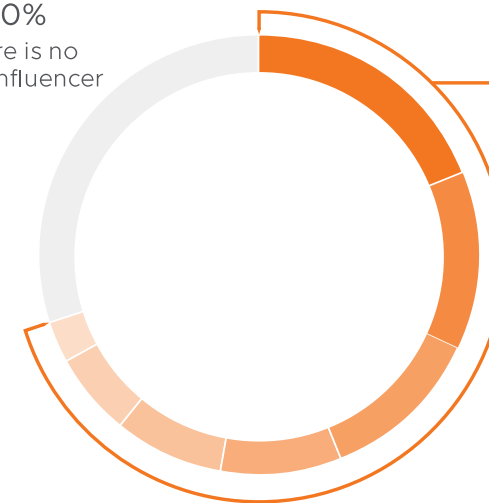
According to 70% of respondents, key influencers are involved in Kubernetes decisions in addition to the primary buyer. Development teams take the influencer role most often (19%) followed by infrastructure/IT Ops teams (12%).

STAKEHOLDERS ARE ALSO INVOLVED IN KUBERNETES OPERATIONS

It's not just decision-making where stakeholders are involved; multiple teams now own the operation of Kubernetes. As you might expect, Infrastructure/IT Ops teams are most often involved in operations (67%), followed by development teams (48%), platform or cloud architects (42%), and application owners (21%).

Aside from the primary buyer, who is the main influencer in selecting Kubernetes for use?

30%
There is no main influencer



70% of respondents said influencers are involved in buying decisions

- 19% Development Team
- 13% Platform or cloud architecture
- 12% Infrastructure/IT Ops Team
- 9% Application owner
- 8% Security
- 6% Site Reliability Engineering (SRE)
- 3% C-level exec (CIO, CTO, etc.)



Speed Bumps Remain

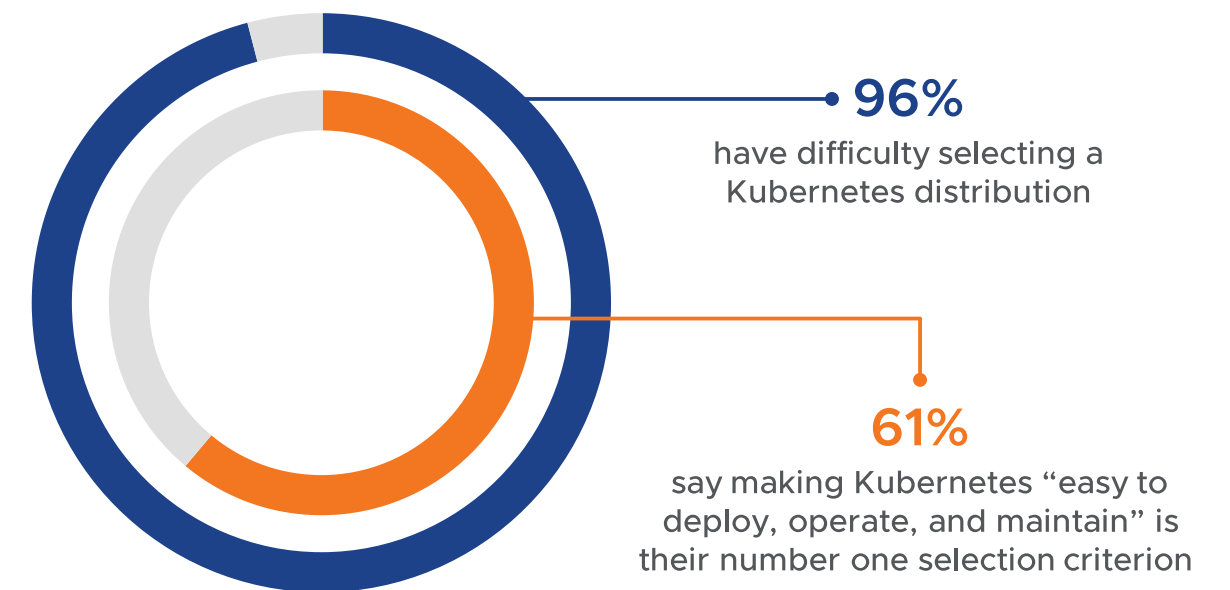
Although lack of expertise is still an issue for many enterprises, Kubernetes is becoming easier to select, deploy and manage. While the trends are largely positive, important challenges remain. Some new challenges are emerging as the Kubernetes footprint in an organization expands.

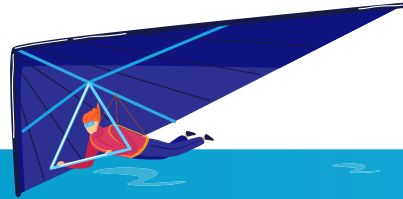
LACK OF EXPERTISE REMAINS THE NUMBER ONE CHALLENGE WHEN CHOOSING A DISTRIBUTION

Almost all survey respondents (96%) still report difficulties selecting a Kubernetes distribution. *Lack of internal experience and expertise* remains the biggest challenge when making the choice (55%), but it has dropped 14% since last year, suggesting rapid improvement.

Other notable challenges included: *hard to hire needed expertise* (37%), *Kubernetes/cloud native speed of change* (32%), and *too many solutions to choose from* (30%). Most of these challenges are likely to take care of themselves as more people gain familiarity and the ecosystem continues to mature.

Given that lack of expertise is the biggest challenge when choosing a Kubernetes distribution, perhaps it's not surprising that *easy to deploy, operate and maintain* is the most important factor in Kubernetes selection (61%), followed closely by *product capabilities and roadmap* (45%). In keeping with the shift toward multi-cloud, 41% selected *works in a hybrid cloud* as an important factor. *Vendor maturity, access to services and support, and avoiding lock-in* also ranked highly.



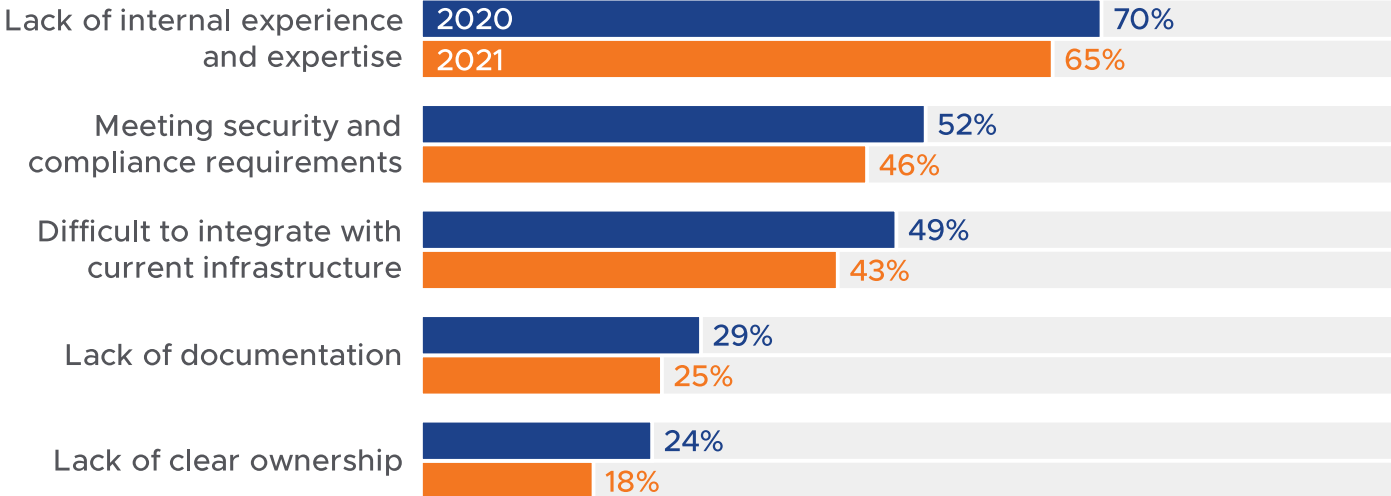


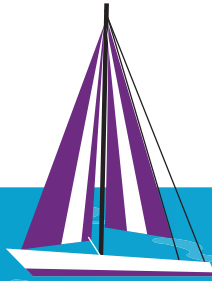
DEPLOYMENT AND MANAGEMENT CHALLENGES DECREASED ACROSS THE BOARD

The good news for our 2021 report is that respondents experienced fewer Kubernetes deployment and management challenges than previously, with 4-6% reductions across the board on deployment challenges and up to 14% decreases on management challenges. In particular, respondents that saw lack of expertise as a management challenge dropped by 14%, from 67% to 53% (not shown in figure).

While challenges haven't disappeared, none of the deployment and management challenges we asked about last year got worse in the intervening 12 months.

What challenges has your organization encountered in deploying Kubernetes?





 KUBERNETES MOMENTUM

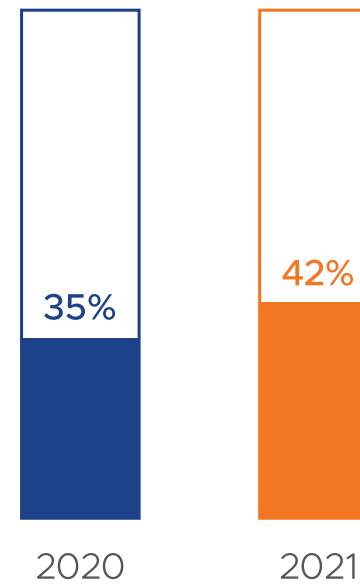
 MULTIPLE STAKEHOLDERS IS THE NEW NORMAL

 SPEED BUMPS REMAIN

 TOWARD DEVSECOPS

INTEGRATION CHALLENGES ARE IMPEDING DEVELOPER PROGRESS

Turning to developer productivity, most of the common impediments ranked the same as last year or decreased slightly. However, integrating new technologies with existing systems jumped from 35% in our 2020 report to 42% this time. While that number is headed in the wrong direction, it may also be the result of continued momentum. As Kubernetes expands to support more applications in more parts of the company, integration challenges are probably to be expected—as they would be with any technology change.



Integration of new and existing technology was the only impediment to developer productivity that grew since last year



KUBERNETES
MOMENTUM



MULTIPLE STAKEHOLDERS
IS THE NEW NORMAL



SPEED BUMPS
REMAIN



TOWARD
DEVSECOPS



WHAT IS DEVSECOPS?

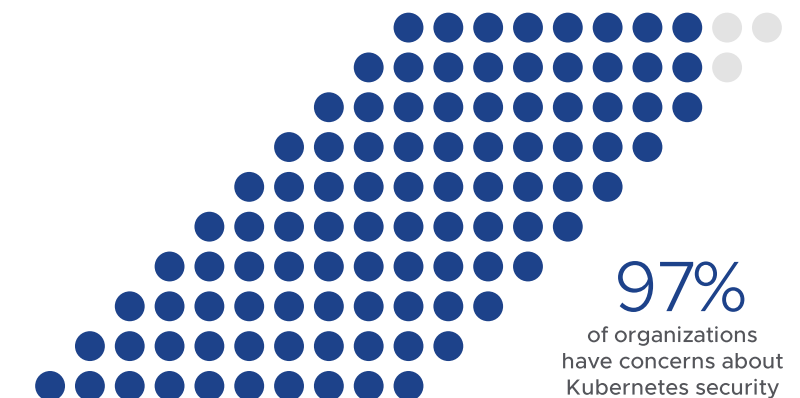
Security often poses challenges when you're trying to achieve frequent, rapid releases to production. Integrating security measures throughout the development and deployment lifecycle aligns the goals of DevOps and security. DevSecOps has emerged as a unifying approach for enterprises, defining the additional security requirements necessary in the cloud native ecosystem.

Toward DevSecOps

Assuming teams gain expertise and ease of use continues to improve over time, security becomes the biggest concern for Kubernetes in the enterprise. Adopting DevSecOps practices to control security across the end-to-end container lifecycle is the key to enhancing security and gaining agility.

MOST ORGANIZATIONS HAVE SECURITY CONCERNS

Developers and architects recognize Kubernetes as the best way to shorten software development cycles and accelerate delivery of new applications and services. However, 97% of organizations still have Kubernetes security concerns. That's probably a surprise to no one given the prevalence of data breaches and other cybercrimes in the news.



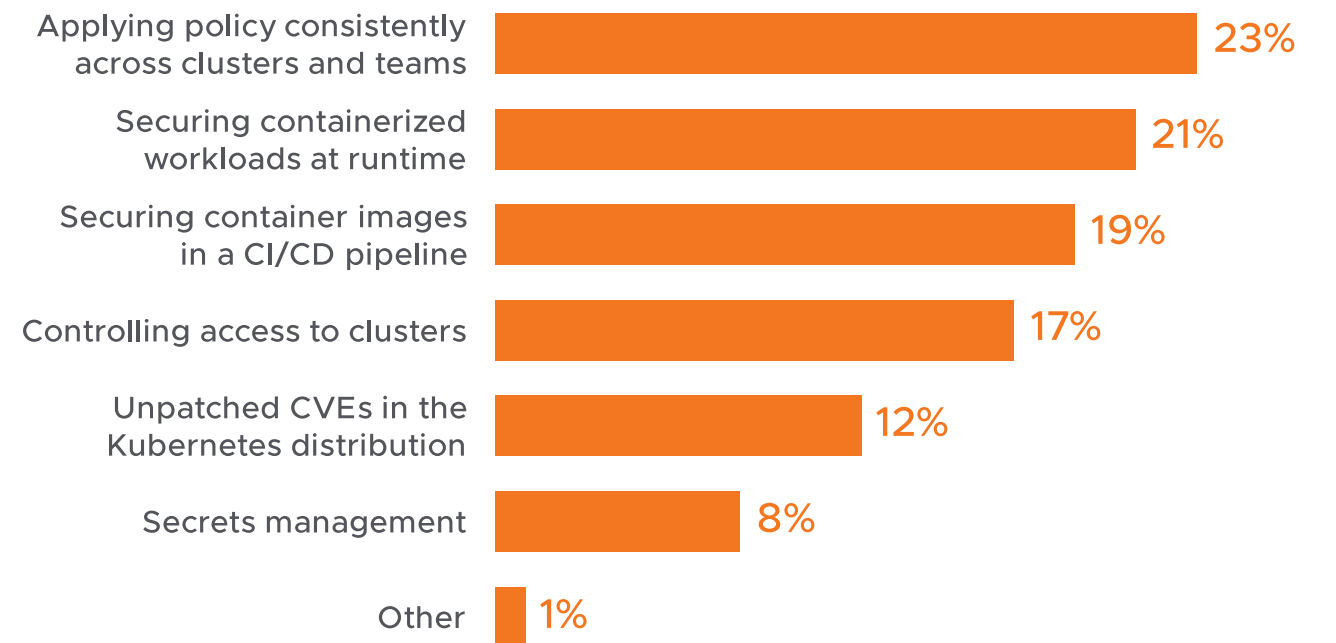


Several of the top security concerns in this year’s survey, such as *applying consistent security policies*, *controlling access* and *unpatched CVEs* are familiar issues that exist in any computing environment. When asked to select their single biggest security concern, *applying consistent policies* was the number one concern for respondents in IT operations (24%).

Concerns number two and three, *securing container images in a CI/CD pipeline* and *securing containerized workloads at runtime*, are directly related to Kubernetes, modern development practices, and the needs of developers and DevOps teams. These concerns have an outsized effect on your company’s overall security posture as you push containerized applications to production. *Securing containerized workloads at runtime* was the number two concern for IT operators (22%) and the number one concern for both infrastructure staff (23%) and architects (23%).

A single container may incorporate libraries and other code from a wide range of sources. Well-defined processes are needed across the entire end-to-end container lifecycle to ensure that CVEs aren’t accidentally incorporated into containers, that any new CVEs are identified, and that production containers are efficiently patched. Many organizations are turning to DevSecOps to integrate security, development and operations practices to address these concerns.

What is your single biggest security concern about using Kubernetes?





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SUMMARY AND RECOMMENDATIONS

Whether your organization is part of the 64% already running Kubernetes in production or not, there are clear lessons you can take away from this survey. Kubernetes momentum is undeniable, and 98% of those surveyed see clear benefits, including *shorter software development cycles, improved resource utilization and simplified application upgrades*. As the Kubernetes ecosystem matures, winners and losers are emerging. While this should help simplify choices in the long term, decision making remains a challenge; 83% of respondents said that multiple stakeholders are involved in Kubernetes selection. Multiple teams are also taking ownership of Kubernetes operations.

Lack of internal experience and expertise remains the biggest challenge when it comes to choosing (55%) and managing (53%) Kubernetes; 61% of organizations are looking for solutions that are *easy to deploy, operate and maintain* and many will need assistance to bridge existing skills gaps and speed the transition to modern practices. The right partners can provide help where and when you need it and simplify your path to production.

Look for partners with experience working with multiple stakeholders—from traditional IT teams to developers to line-of-business teams—who understand Kubernetes deployment and management at scale in multi-cluster, multi-cloud environments. Given the outsized importance of cybersecurity, the ideal partner should also be able to help you address security concerns in cloud native application environments and secure the end-to-end container lifecycle using the latest DevSecOps practices.



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