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The State of Kubernetes 2022

Presented by: VMware

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Introduction

Kubernetes and cloud native technologies have experienced astonishing growth over the last several years. While our State of Kubernetes 2020 report saw plenty of reason for optimism, we used the phrase *"it's still early"* when describing Kubernetes adoption. Last year's report took a big leap in just 12 months, noting that Kubernetes was *"on its way to entering the IT mainstream."*

This year there's no doubt that Kubernetes has become a mainstream technology. And, don't just take our word for it. **The latest** CNCF Annual Survey **describes 2021 as "the year Kubernetes crossed the chasm."**

Our report this year examines the operational issues that arise as Kubernetes enters the IT mainstream, becoming increasingly hybrid and multi-cloud

along the way. With cyber crime now big business—and growing fast—we continue to investigate Kubernetes security as a top priority for operations teams.

Previous reports emphasized decision making and responsibility for Kubernetes operations, but those issues appear to be largely resolved. Choosing a Kubernetes distribution is now the domain of the *Infrastructure/ IT Ops team* (65% of respondents) and *Platform or cloud architects* (50%), as expected for a "mainstream" technology. Kubernetes operations are shifting away from development teams (down 7% from 2021 to 2022) and architecture teams (-4%) in favor of *Infrastructure/IT Ops* teams, *Site Reliability Engineering* teams (+7%), and *Security* teams (+6%).

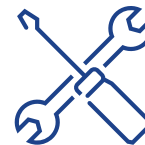## This report is divided up into four sections:

Kubernetes has Crossed the Chasm

The platform is now too big to ignore.

Multi-Cloud Predominates

On-prem only and single cloud operations are losing ground.

Is DIY DOA?

Kubernetes can no longer be treated like a science project.

Shifting Security Concerns

Multi-cluster, multi-cloud security is the new frontier.

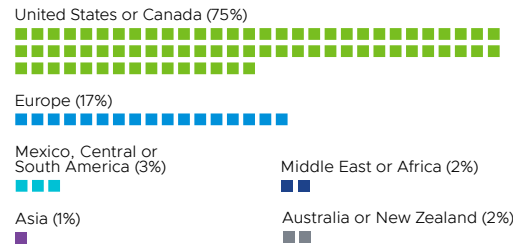**vm**ware®

THE STATE OF KUBERNETES 2022

Demographics

For the 2022 study, our goal was to significantly increase the number of people we reached. This year's survey included **776 qualified software development and IT professionals**—more than *double* the number from last year and by far the largest survey we've conducted since the inaugural State of Kubernetes report back in 2018. As in previous years, VMware commissioned Dimensional Research to conduct the survey. Our thanks to the Dimensional team for their diligent work and attention to detail.
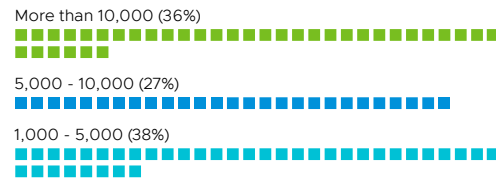
The survey is focused on individuals with responsibility for Kubernetes at companies with 1,000 or more employees, covering a wide range of roles, industries, regions, and job levels. This year's study achieves a more even distribution of companies across three size categories, significantly expanding the number of companies in the 5,000 to 10,000 employee range—which now accounts for 27% of the sample versus just 15% last year. Companies with 1,000 to 5,000 employees dropped to 38% from 46% last year, while companies with more than 10,000 employees make up 36% of this year's sample versus 39% last year.

As in previous years, all the organizations surveyed have a significant software development footprint. About 33% have between 100 and 1,000 developers, 9% have 1,000 to 2,500 developers, and 16% have more than 2,500 developers (versus 24% last year). This year we also asked how many operations and infrastructure staff are working with Kubernetes. The sweet spot was 11-20 employees (22% of companies) followed by 5-10 employees (16%), while 14% had *more than 200 employees* focused on Kubernetes.
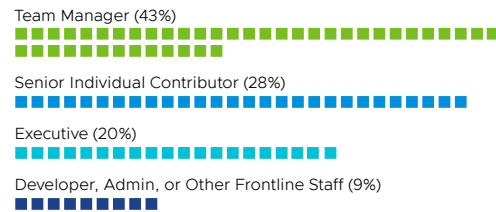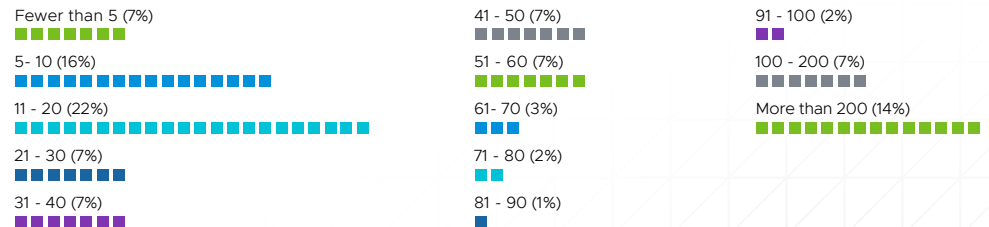
REGION

United States or Canada (75%)
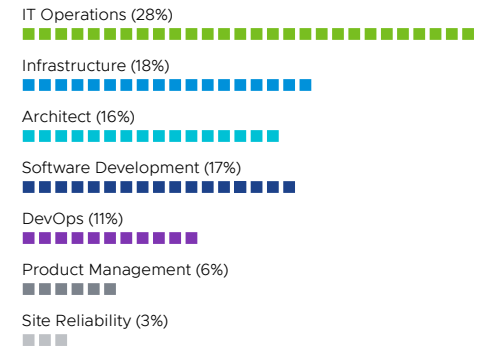
Europe (17%)

Mexico, Central or South America (3%)

Middle East or Africa (2%)

Asia (1%)

Australia or New Zealand (2%)

COMPANY SIZE (# OF EMPLOYEES)

More than 10,000 (36%)

5,000 - 10,000 (27%)

1,000 - 5,000 (38%)

JOB LEVEL

Team Manager (43%)

Senior Individual Contributor (28%)

Executive (20%)

Developer, Admin, or Other Frontline Staff (9%)

PRIMARY JOB RESPONSIBILITY

IT Operations (28%)

Infrastructure (18%)

Architect (16%)

Software Development (17%)

DevOps (11%)

Product Management (6%)

Site Reliability (3%)

NUMBER OF SOFTWARE DEVELOPERS

More than 2,500 (16%)

1,000 - 2,500 (9%)

500 - 1,000 (11%)

100 - 500 (22%)

10 - 100 (33%)

Less than 10 (9%)

NUMBER OF KUBERNETES OPERATIONS AND INFRASTRUCTURE STAFF

Fewer than 5 (7%)

5- 10 (16%)

11 - 20 (22%)

21 - 30 (7%)

31 - 40 (7%)

41 - 50 (7%)

51 - 60 (7%)

61- 70 (3%)

71 - 80 (2%)

81 - 90 (1%)

91 - 100 (2%)

100 - 200 (7%)

More than 200 (14%)

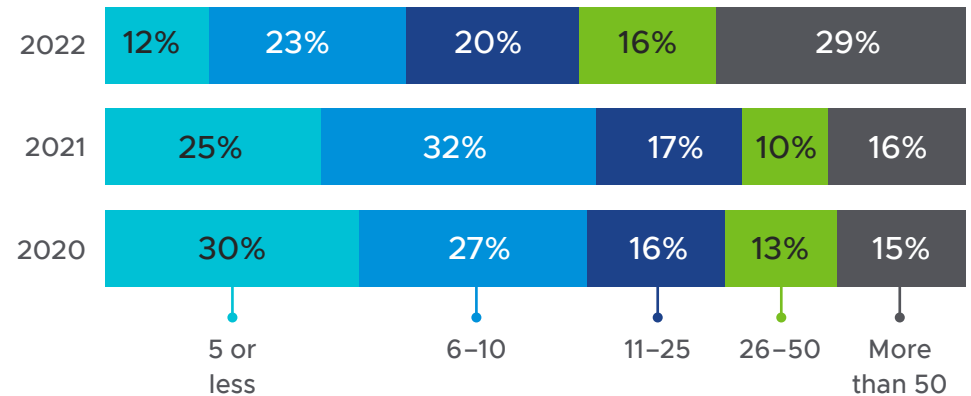**vm**ware®
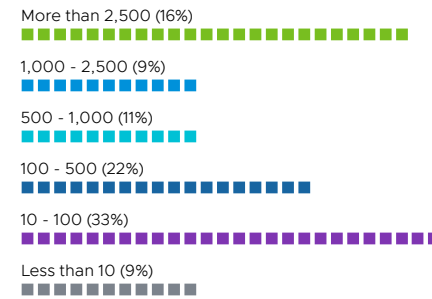
Kubernetes has Crossed the Chasm

This year's survey finds hypergrowth in the number of clusters companies are deploying in response to Kubernetes' proven benefits—particularly in the areas of software development and cloud adoption. Based on future plans, there will likely be even more explosive growth in the year to come.
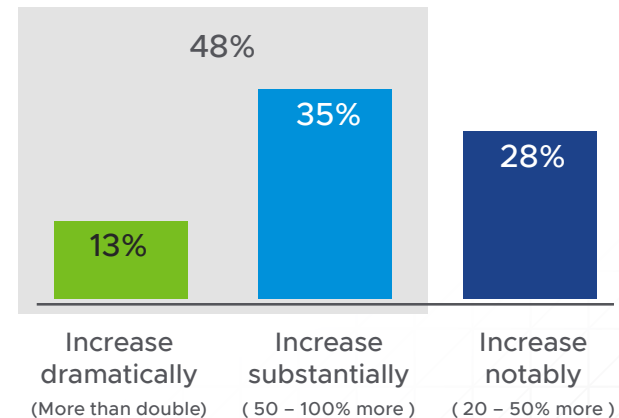
Hypergrowth in Cluster Deployments

One of the clearest signs that Kubernetes is mainstreaming is the rapid growth in the number of clusters being deployed. When we asked this question in 2020, almost a third (30%) had *5 or less* clusters and just 15% had *more than 50*. In the 2021 report, these numbers hadn't changed dramatically, but now the proportions have flipped. Our 2022 survey showed just 12% with *5 or less* clusters, while 29% have *more than 50*.

When we asked people about growth plans in the coming year, almost half (48%) expect the number of Kubernetes clusters they operate to *grow by more than 50%*; an additional 28% expect the number of clusters to *increase notably* (20% to 50%).

Number of Kubernetes clusters currently in operation

	5 or less	6–10	11–25	26–50	More than 50
2022	12%	23%	20%	16%	29%
2021	25%	32%	17%	10%	16%
2020	30%	27%	16%	13%	15%

Expected growth in Kubernetes clusters at your organization?

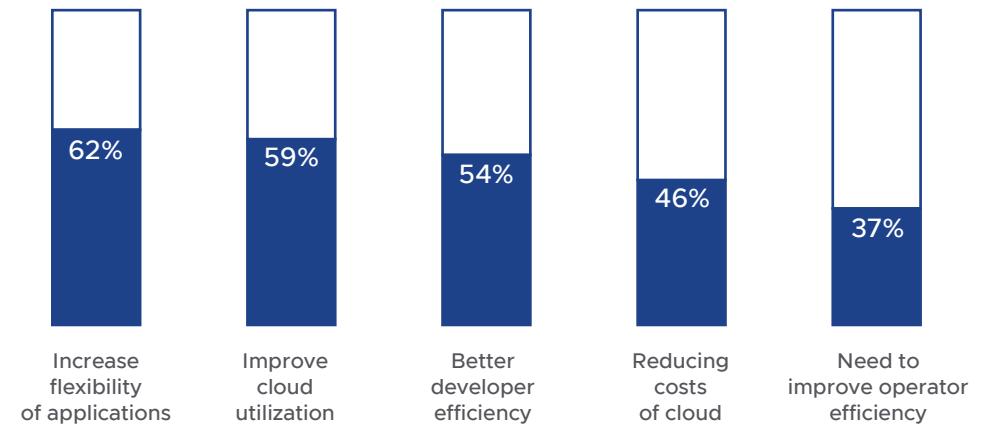| Increase dramatically (More than double)	Increase substantially (50 – 100% more)	Increase notably (20 – 50% more)
13%	35%	28%

48%

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Enhanced Application Development and Cloud Leverage

With Kubernetes growing so rapidly, what factors contribute most to adoption? Improving software development rose to the top of the list, with 62% choosing *increase flexibility of applications* and 54% selecting *better developer efficiency*. Companies seem to like the portability Kubernetes gives them. You can develop an application and run it on-premises or in the cloud without needing to re-platform or re-factor, saving developer time.

Cloud is another clear part of the equation; 59% of respondents chose *improve cloud utilization* and 46% picked *reducing cost of cloud* as important factors in adoption. The pandemic caused many companies to increase cloud use to bring digital services closer to customers and employees—causing cloud expenditures to rise. Kubernetes not only makes the cloud easier to use, it increases infrastructure efficiency and helps control spiraling costs.

Finally, more than a third (37%) said *need to improve operator efficiency* was a selection factor. This will become even more important as hybrid and multi-cloud operations continue to expand, and operators need to manage Kubernetes clusters across many environments.

Main factors driving adoption of Kubernetes

| 62% | 59% | 54% | 46% | 37% |
| Increase flexibility of applications | Improve cloud utilization | Better developer efficiency | Reducing costs of cloud | Need to improve operator efficiency |

Growth Begets Growth

Two-thirds of companies currently operating *More than 100* clusters expect the number of Kubernetes clusters to grow by more than 50% in 2022, while just 28% of those with *5 or less* expect that level of growth.

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Clear Operational Benefits

This year, 99% of respondents said they had realized benefits from deploying Kubernetes. The top two benefits remain: *improved resource utilization* (59%) and *eased application upgrades and maintenance* (49%). *Enabled our move to the cloud (42%)* moved into third place followed by *enabled a hybrid cloud model (40%),* further underscoring the importance of cloud. *Reduced public cloud costs* (34%) also saw a 6% bump from last year.

Two new additions to this year's options were each selected by almost a third of respondents: *effective use of operational team members and skills* (32%) and *eliminate the inefficiencies of a previously siloed team* (28%). Kubernetes is reducing the friction that can slow operations, helping maximize utilization of IT resources, and enabling teams to work together more efficiently and collaboratively.

Benefits from operating Kubernetes

Benefit	%
Improved resource utilization	59%
Eased application upgrades and maintenance	49%
Enabled our move to the cloud	42%
Enabled a hybrid model between public cloud and on-prem	40%
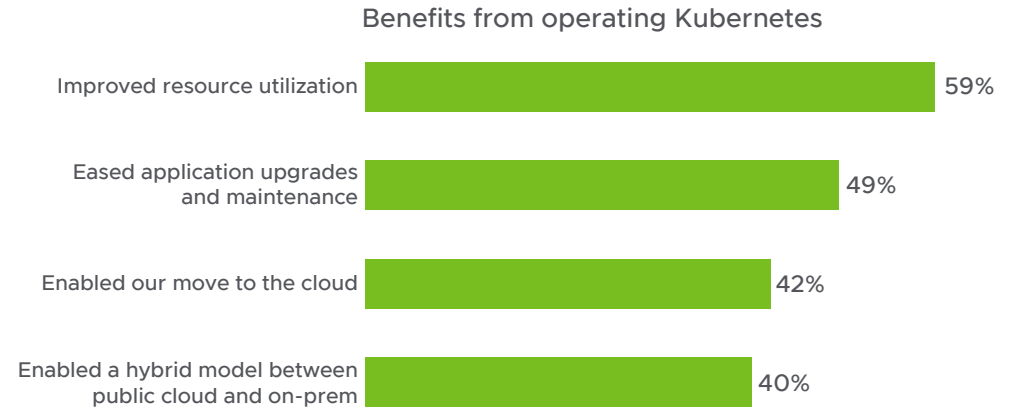
What's Your Sweet Spot?

We continue to ask about the *average number of nodes per Kubernetes cluster* to find the sweet spot. This year, there's a continued trend away from both *5 or less* clusters and *more than 50*. A surprising 61% say average cluster size is between 6 and 20 nodes.

99%
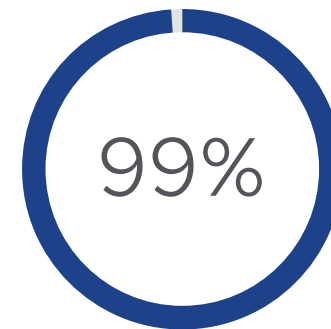
Almost all respondents recognize clear benefits from Kubernetes

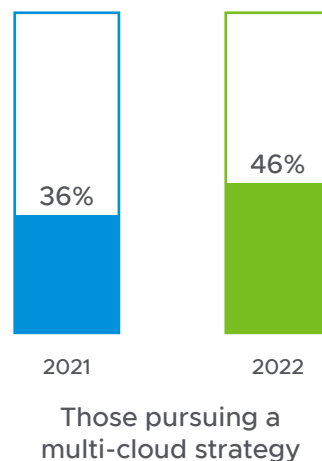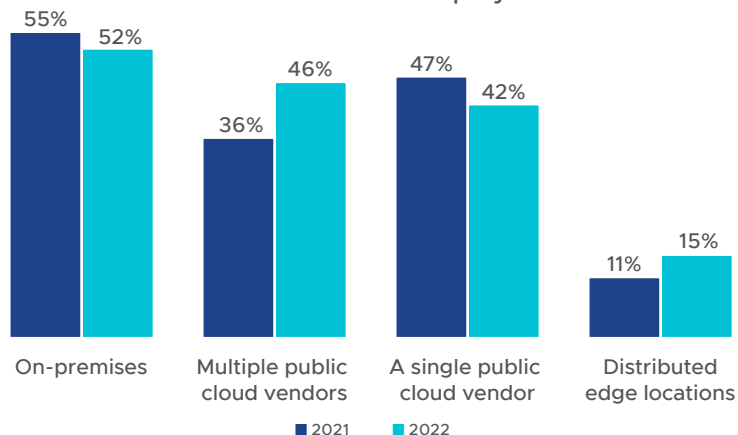**vm**ware®

Multi-Cloud Predominates

One of the main reasons that organizations are adopting Kubernetes is because it delivers clear benefits for rapidly expanding cloud operations. There is an accelerating trend away from on-premises and single-cloud Kubernetes deployments in favor of hybrid and multi-cloud.

Hybrid and Multi-Cloud Deployments Flourish…

Last year's study pointed to a notable increase in cloud adoption as an indication that Kubernetes operations are maturing, noting that 36% of those surveyed were already utilizing Kubernetes in multiple public clouds.

This year, the number using *multiple public cloud vendors* grew even faster, gaining 10%. For companies with 5,000 to 10,000 employees, that number is 57%. While the largest companies (10,000+ employees) were somewhat less likely to be multi-cloud (49%), they were more likely to operate Kubernetes in edge locations (21%).

Current Kubernetes deployments

	On-premises	Multiple public cloud vendors	A single public cloud vendor	Distributed edge locations
2021	55%	36%	47%	11%
2022	52%	46%	42%	15%

■ 2021   ■ 2022

36% (2021)   46% (2022)

Those pursuing a multi-cloud strategy

Where Do You Run Kubernetes for App Development and Production?

Respondents whose Kubernetes footprint is mostly for development favor *on-premises* (62%) or *a single public cloud vendor* (42%). Just 32% selected *multiple public cloud vendors*.
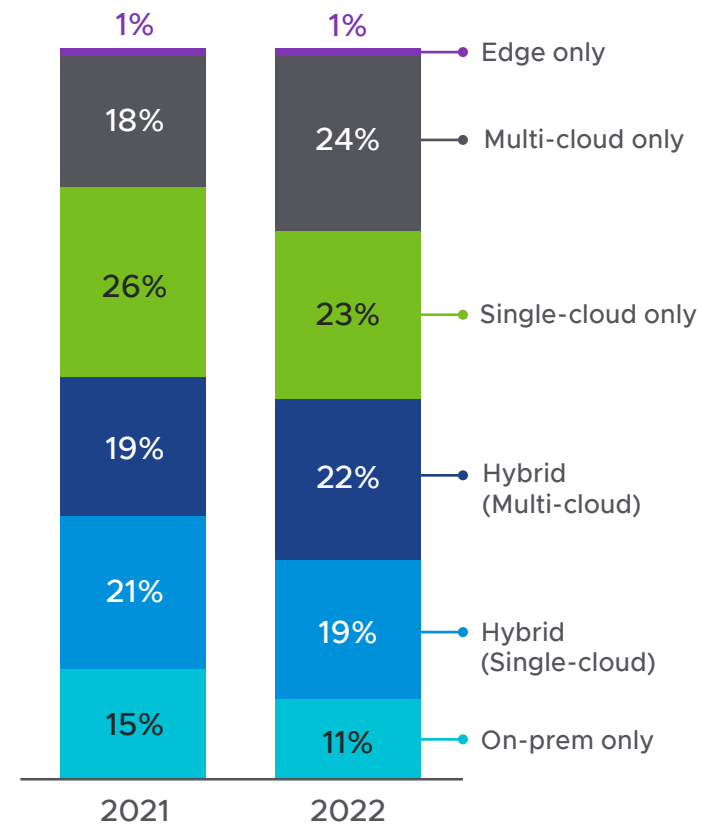
By comparison, those whose Kubernetes footprint is geared toward production prefer *multiple public cloud vendors* (52%) followed by *on-premises* (47%) and *a single public cloud vendor* (42%).

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And On-Prem and Single-Cloud Lost Ground

The percentage of respondents with on-premises Kubernetes dropped another 3% this year—dipping to 52%—while the number who are ONLY on-premises dropped to just 11%. More than 40% of respondents utilize hybrid cloud (combining on-prem and public cloud), while almost 50% are now cloud-only. Hybrid cloud deployments using a single public cloud lost ground to hybrid clouds with multiple public clouds. Similarly, cloud-only deployments with a single public cloud lost ground to those using multi-cloud.

When asked where respondents intend to deploy additional clusters in the coming year, 52% chose *multiple public cloud vendors*, while just 39% chose *on-premises* and 38% chose *a single public cloud vendor*. This data makes it pretty clear that multi-cloud is rapidly becoming the preferred operating model, likely for reasons of availability, geographic reach, and avoiding vendor lock-in.

Current Kubernetes deployments

	2021	2022	
Edge only	1%	1%	
Multi-cloud only	18%	24%	
Single-cloud only	26%	23%	
Hybrid (Multi-cloud)	19%	22%	
Hybrid (Single-cloud)	21%	19%	
On-prem only	15%	11%	

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Is DIY DOA?

Our 2021 report posed the question, "Is DIY DOA?" As the number of Kubernetes clusters continues to grow—and the Kubernetes footprint expands across data centers, public clouds, and the edge—teams have to streamline operations and find solutions to cope with hiring challenges and operational complexity. Unless you were an early adopter or a large organization that has already made the necessary investments, do-it-yourself (DIY) approaches—like building Kubernetes from upstream code, rolling your own infrastructure, and developing tooling in house—have become impractical if not impossible. Teams are increasingly looking for Kubernetes distributions and tools that offer services and support.

Expertise in Short Supply

This year's number one challenge when selecting a Kubernetes distribution remains *inadequate internal experience and expertise,* chosen by 51%. The number two challenge also stayed the same: *hard to hire needed expertise* (37%).

With Kubernetes growing so rapidly and evolving quickly, many organizations are struggling—both to bring existing staff up to speed (and keep them there) and to hire people with the required Kubernetes skills.

With expertise in short supply, many teams are seeking to fill the gaps with simpler Kubernetes solutions combined with support and services.

Challenges encountered in selecting a Kubernetes distribution

51%	37%	34%
Lack of internal experience and expertise	Hard to hire needed expertise	Kubernetes/ Cloud Native speed of change

95%
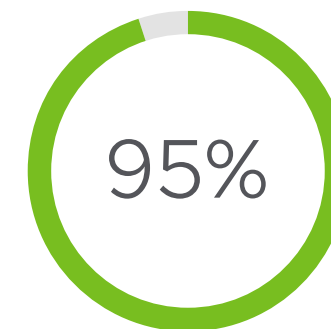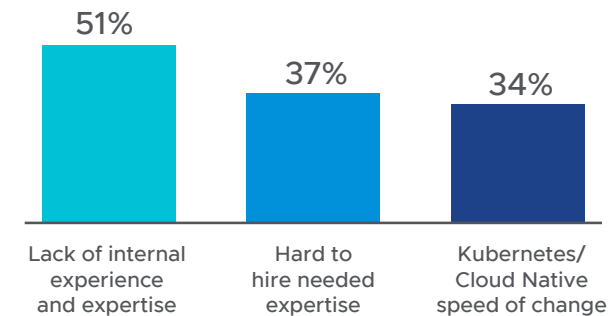
Have difficulty selecting, deploying and managing Kubernetes

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How Do Teams Choose Kubernetes?

The top three criteria for choosing a Kubernetes distribution remained the same as last year: *easy to deploy, operate and maintain* (selected by 51%), *product capabilities and roadmap meet our needs* (45%), and *works in a hybrid cloud environment* (41%). Moving up to number four (40%), is *availability of commercial support or professional services*.

Organizations want Kubernetes solutions to be simpler, provide the capabilities they need, work in hybrid cloud environments, and they want support and services—the opposite of DIY.

Criteria for selecting a Kubernetes distribution

Criteria	%
Easy to deploy, operate and maintain	51%
Product capabilities and roadmap meets our needs	45%
Works in a hybrid cloud environment	41%
Availability of commercial support or professional services	40%
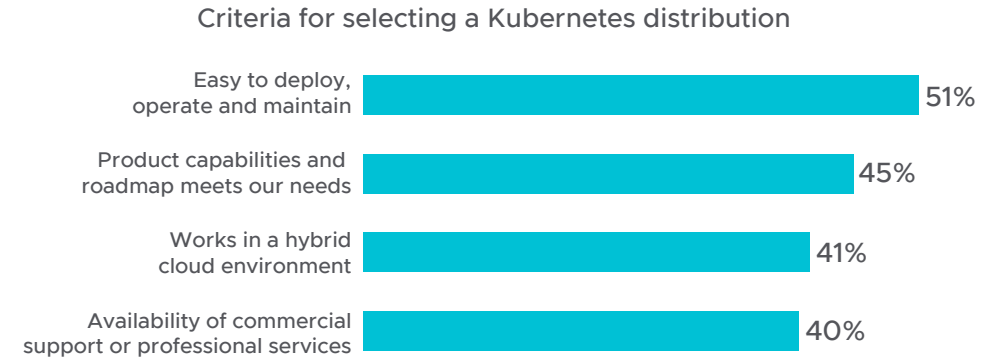
### Kubernetes Management Challenges Continuing to Grow

When comparing Kubernetes management challenges year over year, only two challenges saw declines in 2022: *inadequate internal experience and expertise* (44%, down 9% from last year) and *no clear ownership* (15%, down 4%). All other challenges grew substantially this year, including *difficult to manage cluster lifecycle and upgrades* (41%, up 5% from last year), *difficult to integrate with current infrastructure* (36%, up 6%), and *meeting security and compliance requirements* (47%, up 4%). This may be a sign that teams need to be more proactive about addressing the increased challenges due to growing cluster counts and multi-cloud operations.

Tools Grow in Importance

What tools are most important for operating a rapidly growing Kubernetes environment? The top four tool categories in this year's survey were: *data security, protection, and encryption* (36%), *cluster lifecycle management* (34%), *platform monitoring and alerting* (30%), and *GitOps and platform automation* (24%). As organizations move to Kubernetes operations at scale, they need more and better tools to address management needs while avoiding unnecessary toil.

Of those surveyed, 97% said they would pay for support and services for important Kubernetes tools.

Most important tools or capabilities when operating Kubernetes in production

Data security, protection and encryption	36%
Cluster lifecycle management	34%
Platform monitoring and alerting	30%
GitOps and platform automation	24%
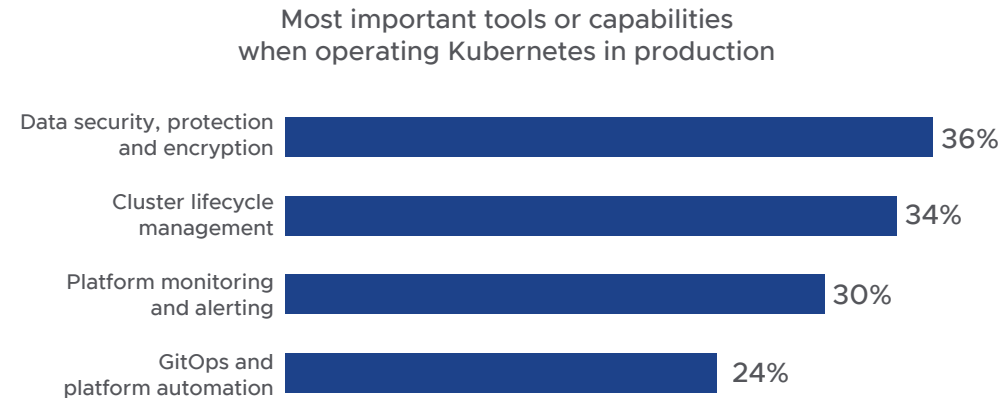
How Can You Streamline Multi-Cluster, Multi-Cloud Operations?

As the number of clusters your team operates increases, its becoming essential to identify tools that can streamline multi-cloud operations while increasing automation and providing deeper visibility. *VMware Tanzu for Kubernetes Operations* is designed to deliver a simplified, consistent approach combining the right tools with automation, security and data-driven insights.

97%
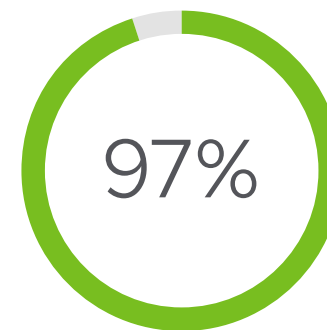
Almost everyone would pay for services and support for important Kubernetes tools

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Shifting Security Concerns

Given the growth in the number of Kubernetes clusters and multi-cloud deployments—and a continued increase in cyber threats—security challenges are front and center for teams deploying and managing Kubernetes. This year the focus has shifted to security for multi-cluster, multi-cloud operations.

#1 Kubernetes Challenge: Meeting Security and Compliance Requirements

While this report has avoided in depth discussions of security up to this point, as with other data center and cloud operations, security has become a dominant concern for Kubernetes as well; 97% of organizations have concerns about Kubernetes security.

Meeting security and compliance requirements is the number one challenge for both deploying Kubernetes (59% of respondents) *and* managing Kubernetes (47%).

While the challenges associated with selecting a Kubernetes distribution generally declined this year, *doesn't meet security standards* was a notable exception. This challenge grew 5% (22% of those surveyed). As you saw on the previous page, *data security, protection, and encryption* tools topped the list of critical Kubernetes tools.

97%
of organizations
have concerns about
Kubernetes security

59%

Deploying
Kubernetes

47%

Managing
Kubernetes

Meeting security and compliance requirements

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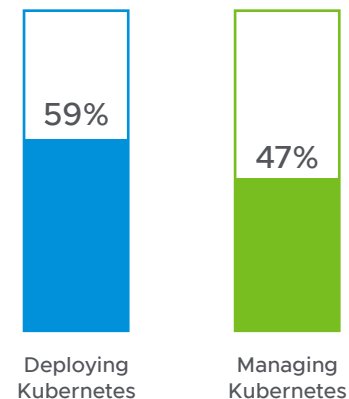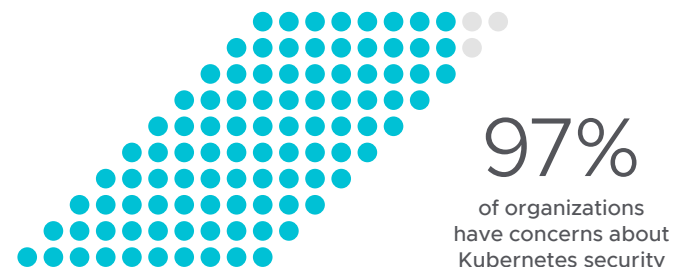
Multi-Cluster and Multi-Cloud Now a Dominant Factor in Kubernetes Security

The growth in multi-cloud deployments and the number of clusters under management are causing a shift in the security focus. While most security concerns decreased slightly or remained flat, *applying policy consistently across clusters and teams* saw a 9-point jump to 46%. *Controlling access to clusters* jumped 6%, claiming the number two spot at 35%.

These moves signal an increasing awareness of the importance of security as part of multi-cloud, multi-cluster fleet management. Teams managing tens or even hundreds of clusters *need to be* concerned with standardizing operations, applying consistent security policies, and making sure that only authorized personnel have access to important clusters.

Biggest security concerns about using Kubernetes

Top two security concerns

■ 2021 ■ 2022
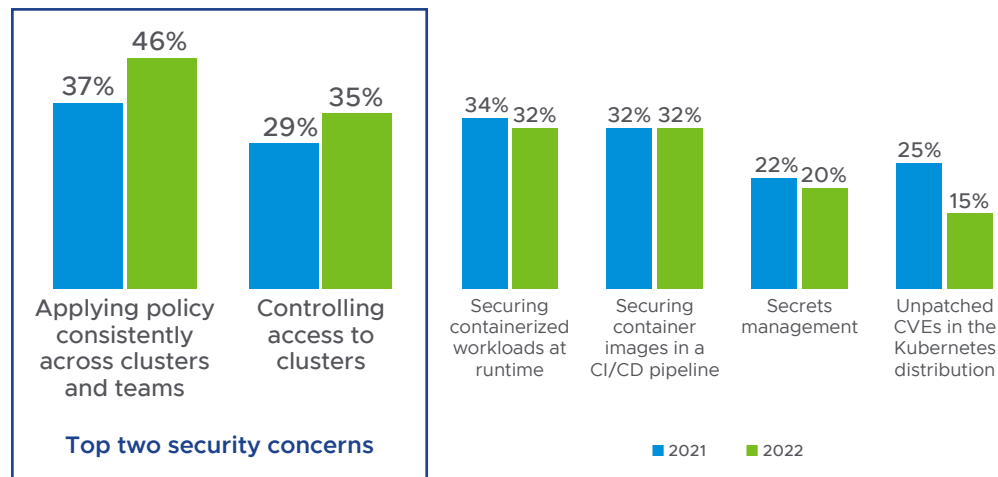
Progress with DevSecOps

The 2021 report included a section on DevSecOps—a practice that integrates security measures throughout the development and deployment lifecycle, aligning the goals of DevOps and security. Based on this year's data, organizations appear to be making progress against DevSecOps-related security challenges (or at least are not losing ground):

- *Securing containerized workloads at runtime* (down 2%)
- *Securing container images in a CI/CD pipeline* (no change)
- *Secrets management* (down 2%)
- *Unpatched CVEs in the Kubernetes distribution* (down 10%)

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Summary and Recommendations

Kubernetes has been on a wild ride, moving from science project to mainstream IT in the span of just a few years. Almost a third of stakeholders surveyed in this 2022 report are operating *50 or more clusters*. And almost half expect the number of Kubernetes clusters they have to increase *more than 50%* in the coming year. With *46% pursuing a multi-cloud strategy*, new Kubernetes clusters are in diverse cloud environments, and much of the growth in the coming year is expected to be multi-cloud.

Cluster growth and multi-cloud deployment are changing the nature of Kubernetes operations. A do-it-yourself strategy and homegrown processes and tools may have worked well up until now but may no longer be enough, especially given the fact that *lack of adequate experience and expertise* remains a challenge for more than half of those surveyed. Teams are turning to Kubernetes ecosystem tools to fill gaps, prioritizing tools for *data security, protection, and encryption*; *cluster lifecycle management*; *platform monitoring and alerting;* and *platform automation*.

Even with the challenges on the horizon, it's still a bit surprising to us that 97% of respondents are now willing to pay for support and services for important Kubernetes tools—especially security tools that can enable you to *apply policy consistently across clusters* and *gain control over cluster access*.

If the findings of this survey resonate for your organization, consider looking at next-generation tools that can enable you to deploy, manage and monitor clusters across multi-cloud environments while requiring less expertise in each individual cloud and less manual toil. Critical capabilities include multi-cloud operations support, end-to-end security, automation, and the ability to centrally log operational data for compliance and increased insight.

The right partners can provide help where and when you need it and enable you to continue to succeed in the next phase of Kubernetes growth. Look for partners who understand Kubernetes deployment, management, and security in multi-cluster, multi-cloud environments with the expertise to help you identify and remediate operational weaknesses.

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Learn how to set up a secure,
multi-cloud Kubernetes platform
that simplifies, secures and
optimizes your operations.

VMware Tanzu for Kubernetes Operations

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