Flexera™

2021
STATE OF THE CLOUD REPORT

COVID-19 accelerates cloud plans and spend as more organizations adopt multi-cloud strategies

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FLEXERA™ 2021 STATE OF THE CLOUD REPORT

Cloud spend is rising as organizations adopt multi-cloud strategies and put more workloads and data in the cloud

Executive summary

Cloud adoption was expanding rapidly even before COVID-19. After the pandemic took hold, cloud plans and adoption increased even faster. Cloud trends can guide an organization's digital business decision processes, vendor and technology selection, and investment strategies. This tenth annual *Flexera 2021 State of the Cloud Report* (previously known as the *RightScale State of the Cloud Report*) delves into the details of what respondents had to say to reveal what's happening with all things cloud—from spend allocation to cost management to strategies. Leveraging this data can help IT professionals plan the next steps of their cloud journey.

The report explores the thinking of 750 global cloud decision-makers and users about the public, private and multi-cloud market. It shares their current and future cloud strategies, often showing year-over-year (YoY) changes to help identify trends. And it offers perspective on how some trends have changed over the years. The survey was conducted in October and November of 2020.

> **Terminology used throughout the report:**
>
> **Enterprises** are public- or private-sector organizations with 1,000 or more employees
>
> **SMBs** are small-to-midsized businesses with fewer than 1,000 employees
>
> **Organizations** refers to the combination of enterprises and SMBs participating in the survey

The highlights

The *Flexera 2021 State of the Cloud Report* survey captured insights into how organizations are progressing in their journey to cloud. This information includes their mix of public and private clouds, the volume of workloads and data in the cloud, top challenges and initiatives, cost management concerns, and the cloud providers, technologies and tools they're using. The following are some of the responses we found the most interesting:

Enterprises embrace multi-cloud

- 92 percent of enterprises have a multi-cloud strategy; 80 percent have a hybrid cloud strategy

- 49 percent silo workloads by cloud, with 45 percent integrating data between clouds

- Only 42 percent of all participating organizations use multi-cloud management tools

- Respondents use an average of 2.6 public and 2.7 private clouds

Public cloud adoption continues to accelerate

- 36 percent of enterprises spend more than $12 million per year on public clouds

- 55 percent of enterprise workloads are expected to be in a public cloud within twelve months

- 90 percent of respondents who answered a question about COVID-19 expect cloud use to exceed plans due to the pandemic

- The top challenge in cloud migration is understanding application dependencies

Understanding cloud initiatives and metrics

- 61 percent of organizations plan to optimize cloud costs in 2021, making it the top initiative for the fifth year in a row

- 59 percent of organizations plan to focus on cloud migration

- 76 percent of organizations use cost efficiency and savings to measure cloud progress

Organizations are taking a centralized approach to cloud

- 77 percent of enterprises have a central cloud team or cloud center of excellence (CoE)

- 54 percent of cloud teams are responsible for governing infrastructure-as-a-service (IaaS)/ platform-as-a-service (PaaS) usage and costs

- 63 percent of enterprises reported using cloud managed service providers (MSPs) to manage public cloud use

Top challenges are security, spend, governance and expertise

- Overall, 81 percent indicate that security is a challenge, followed by 79 percent for managing cloud spend and 75 percent each for governance, lack of resources/expertise and compliance

- 55 percent overall report that understanding cost implications of software licenses is a top cloud challenge

Organizations struggle to handle growing cloud spend

- Respondents estimate 30 percent of cloud spend is wasted

- Organizations are not taking advantage of all cloud provider discounting options, but adoption is growing

- Users are leveraging automated policies to shut down workloads after hours (49 percent) and rightsize instances (48 percent)

Adoption of cloud configuration tools is shifting

- Terraform (36 percent) and Ansible (31 percent) now show highest adoption of cloud configuration tools

- Terraform leads among both enterprises and smaller organizations

Public cloud adoption is evolving

- AWS, Azure and Google Cloud remain the top three public cloud providers

- Azure continues to narrow the gap with AWS for enterprise users

Use of public cloud PaaS services is increasing

- Data warehouse has the highest adoption, used by 54 percent of organizations

- 28 percent of enterprises are experimenting with machine learning/AI, which is more than any other PaaS services

Private cloud adoption plays important role

- VMware vSphere continues to lead in private cloud (36 percent currently use). Microsoft Azure Stack usage is at 35 percent; AWS Outpost and OpenStack each have 28 percent

- Private cloud adoption by SMBs is lower overall than for enterprises

Methodology

A total of 750 technical professionals from around the globe and across a broad cross-section of organizations participated in the *Flexera 2021 State of the Cloud Report* survey. The participants provided insights into their adoption of cloud infrastructure. The independent panel is rigorously maintained and comprises vetted respondents with detailed profiles.

Most respondents are cloud decision-makers and users from organizations ranging from 100 employees to more than 10,000 employees. Their answers provide a comprehensive perspective on the state of the cloud today

Respondent demographics

Organizations of all sizes are using the cloud to help manage IT workloads. However, this survey skews toward larger organizations. As **Figure 1** shows, 85 percent of participating organizations are enterprises that employ at least 1,000 people. The top challenges that these larger enterprises face are security, managing cloud spend and governance; SMBs often struggle with security, managing cloud spend and lack of resources/expertise.

Terminology used throughout the report:

- All respondents = 750

- Enterprise respondents (at least 1,000 employees) = 637

- SMB respondents (less than 1,000 employees) = 113
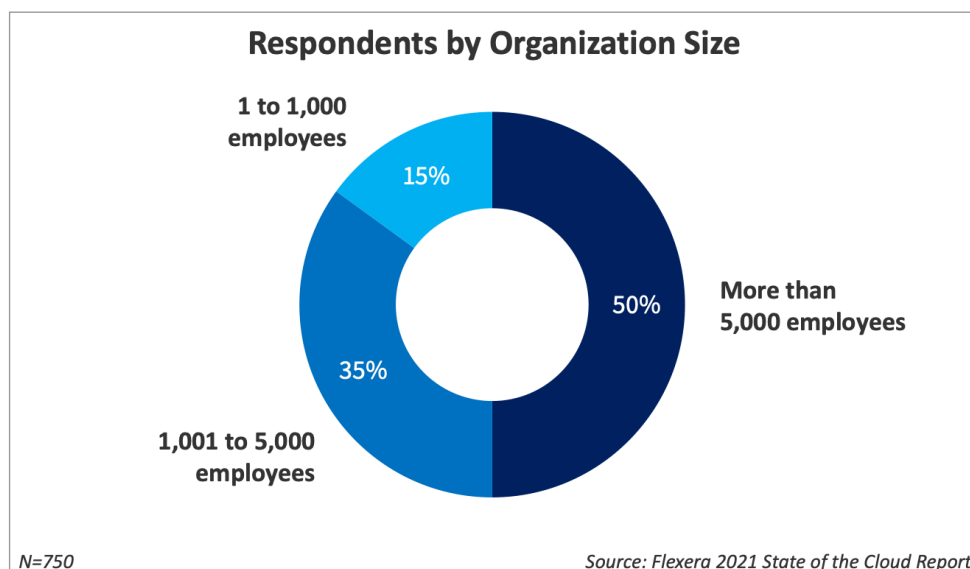
Figure 1. Respondents by organization size

Businesses in almost all industries leverage cloud computing. As **Figure 2** indicates, the report covers a broad range of industries. The *Other* category includes those industries that represent less than three percent of respondents.

Respondents by Industry

N=750   *Source: Flexera 2021 State of the Cloud Report*
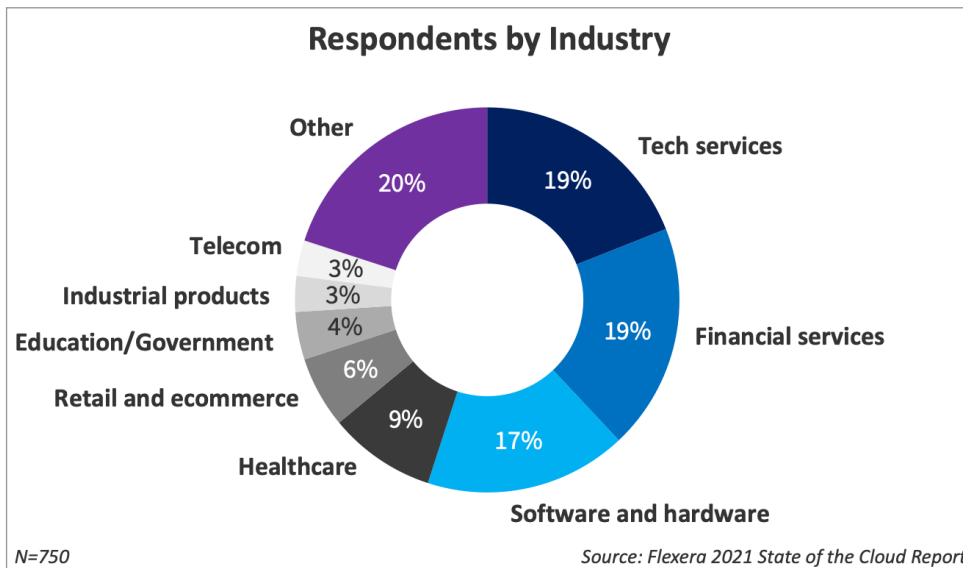
Figure 2. Respondents by industry

Figure 3 shows the locations of participating organizations around the world:

- The Americas include respondents from the United States, Canada, Mexico and Brazil

- Europe includes respondents from a broad set of countries

- The Asia-Pacific region comprises respondents from Australia, India, Japan, Singapore and South Korea

- Rest of world includes respondents not included in countries above, including African countries
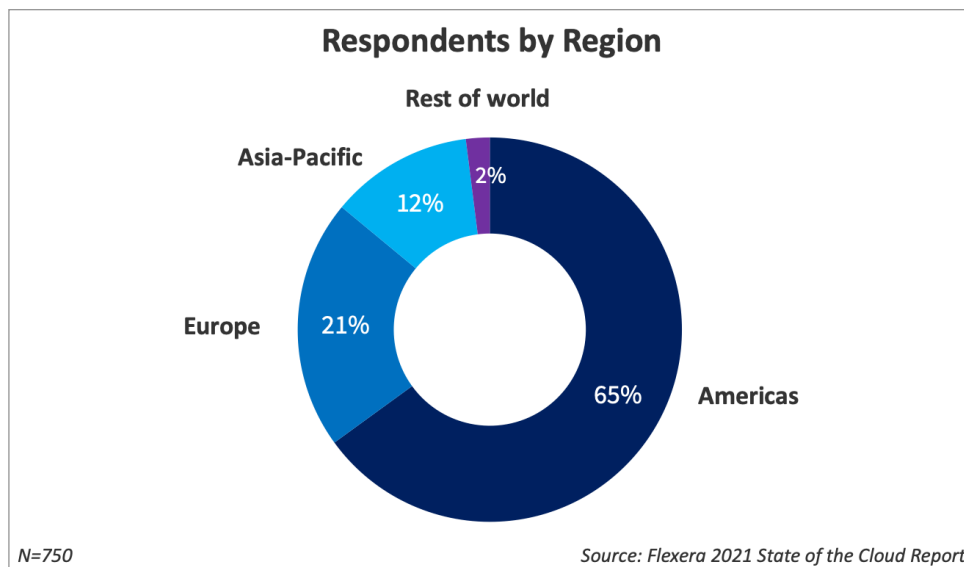
Figure 3. Respondents by geography

Figure 4 indicates the breakdown of respondents by level within the organization and by business role.

Respondents by Level

- Architect 47%
- Dir/Mgr 26%
- Exec 14%
- Other 9%
- IT/Dev 4%

N=750

Respondents by Role

- IT/Op 48%
- Cloud architect 33%
- Dev 11%
- Business 8%

Source: Flexera 2021 State of the Cloud Report
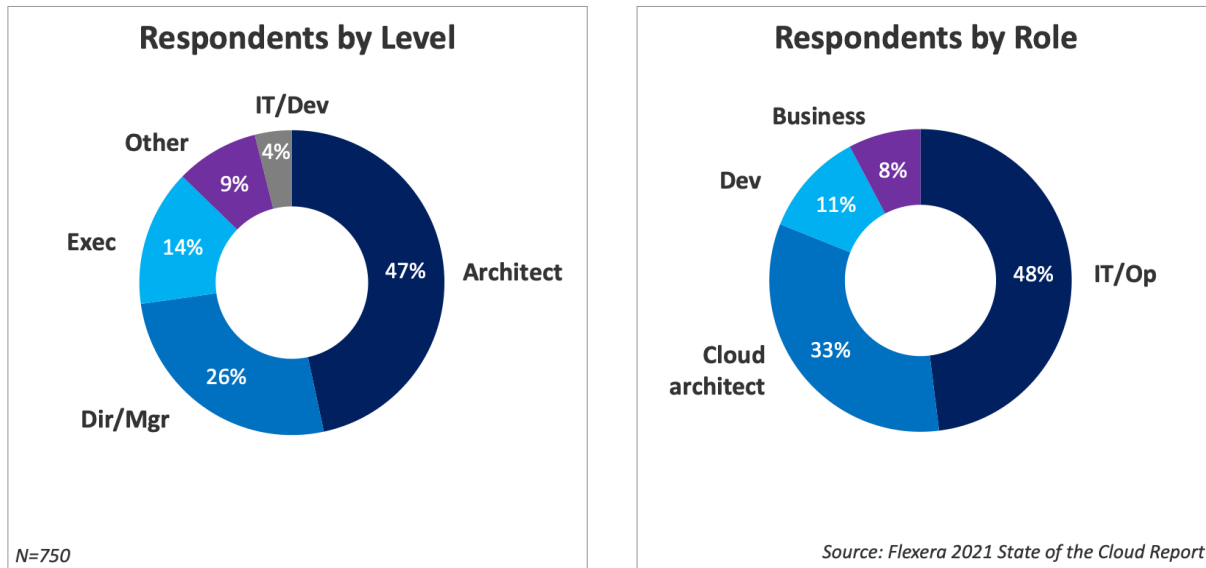
Figure 4. Respondents by level and by role

Cloud has now become mainstream. As **Figure 5** shows, more than half of respondents use cloud heavily and have reached the advanced cloud maturity level. Twenty-one percent of organizations are at the intermediate maturity level, and 19 percent are beginners.

Cloud Maturity of Respondents
% of all respondents

19%	21%	59%
Beginner *First projects*	**Intermediate** *Apps running*	**Advanced** *Heavy use*

N=750

Source: Flexera 2021 State of the Cloud Report
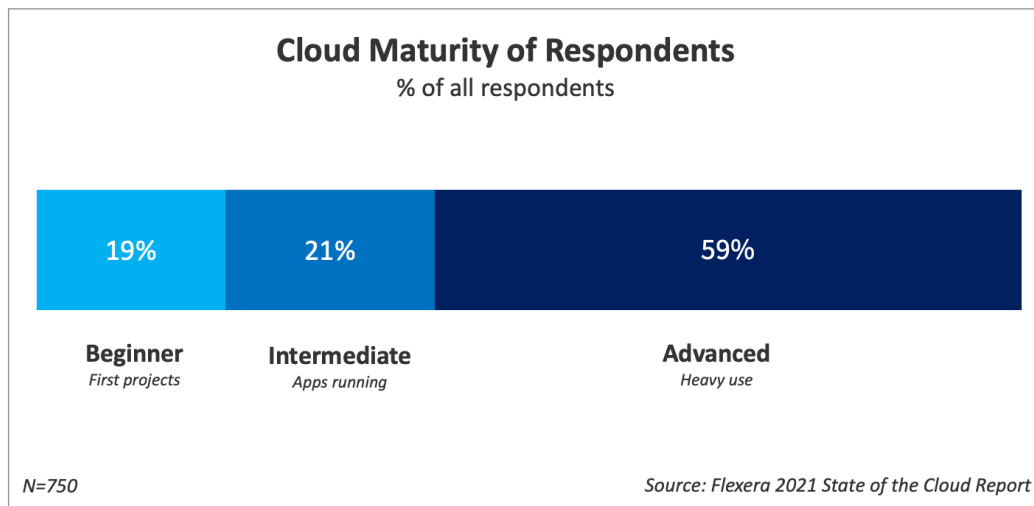
Figure 5. Cloud maturity levels for all organizations

Enterprises embrace multi-cloud

Enterprises have almost entirely embraced multi-cloud. As **Figure 6** indicates, 92 percent of respondents reported having a multi-cloud strategy. Eighty-two percent are taking a hybrid approach, combining the use of both public and private clouds.

Enterprise Cloud Strategy
% of enterprise respondents

Single public — 7%

Single private

Multi-cloud 92%

Multiple public — 10%

Hybrid cloud — 82%

N=750

Source: Flexera 2021 State of the Cloud Report
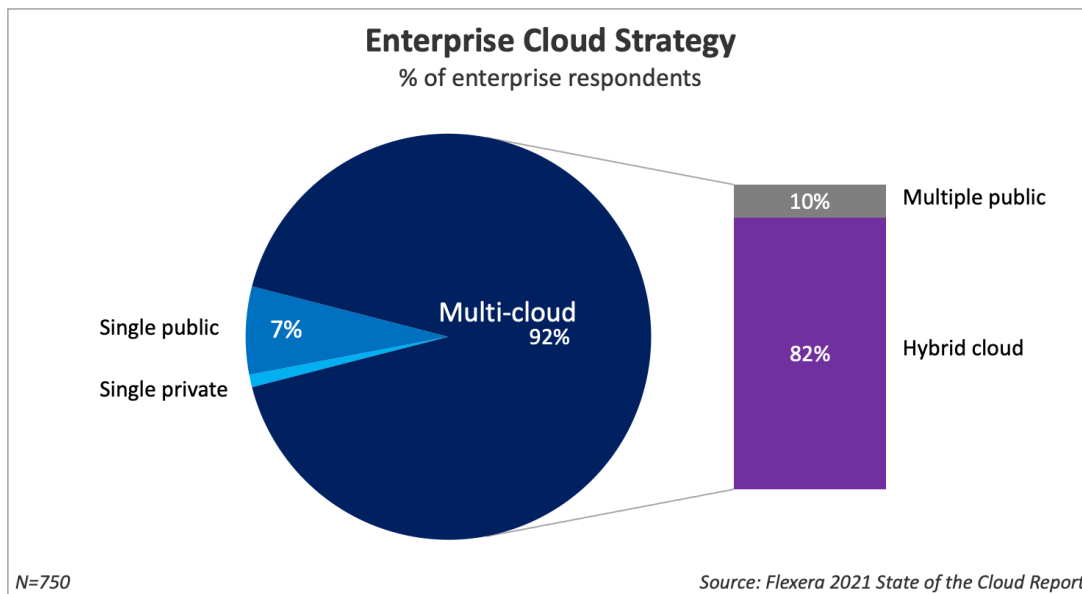
Figure 6. Enterprises have a multi-cloud strategy

Enterprises combine multiple public and private clouds

This year's survey delved into the various cloud combinations used by enterprises with a hybrid strategy, as **Figure 7** shows. Of those enterprises, 76 percent said they're incorporating multiple public clouds, while 56 percent report using more than one private cloud. The most common combination is a mix of various public and private clouds, with 43 percent taking this approach.
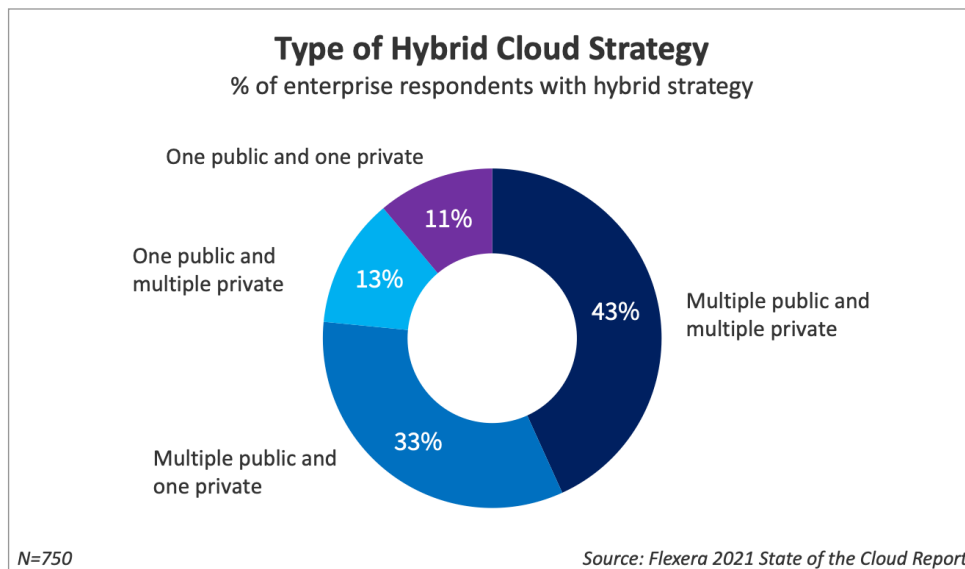
Figure 7. Enterprise hybrid cloud strategies

Applications often are siloed on different clouds

While organizations are using multiple clouds, this doesn't necessarily mean individual applications are spanning clouds. As **Figure 8** shows, *apps siloed on different clouds* is the most common multi-cloud implementation, with 49 percent of respondents saying they use it. *Data integration* is the most common type of architecture that spans clouds. However, more than one-third of respondents are using more advanced architectures, such as *workload mobility between clouds* and *individual apps that span public and private clouds*.

Multi-Cloud Architectures Used
% of all respondents

Architecture	%
Apps siloed on different clouds	49%
Data integration between clouds	45%
Workload mobility between clouds	42%
DR/Failover between clouds	34%
Individual apps span public and private cloud	34%
Workload bursting (cloud-bursting)	31%
Intelligent workload placement	29%
Cloud brokering	22%

N=750

Source: Flexera 2021 State of the Cloud Report

Figure 8. Use of multi-cloud architectures by all organizations

Use of multi-cloud cost management tools grew by nine percent

Multi-cloud architectures are more complex and, therefore, more challenging to manage. Multi-cloud tooling is essential for managing cloud resources cost-effectively and ensuring strong governance and security. Forty-two percent of organizations are taking advantage of *multi-cloud management tools*, as **Figure 9** indicates. This is a nine percent increase over last year's findings.

Use of Multi-Cloud Management Tools
% of all respondents

Tool	Use	Don't use
Multi-cloud cost management tools	42%	58%
Multi-cloud security tools	38%	62%
Multi-cloud management tools	33%	67%
Multi-cloud governance tools	33%	67%

- Use
- Don't use

N=750   Source: Flexera 2021 State of the Cloud Report
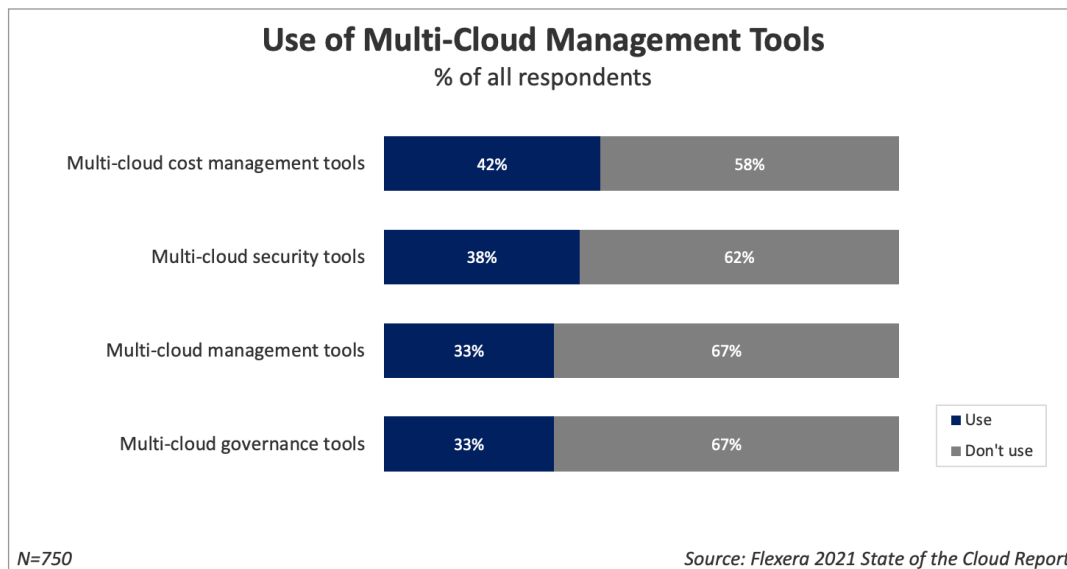
Figure 9. Use of multi-cloud management tools for all organizations

Almost all organizations are using at least one cloud

As **Figure 10** indicates, 99 percent of respondents are using at least one public or private cloud. Ninety-seven percent of respondents utilize at least one public cloud, while 80 percent have at least one private cloud. Seventy-eight percent of respondents are using hybrid cloud.

Types of Clouds Used
% of all respondents

Public cloud only — 19%

78%
Hybrid
public and private

2% — Private cloud only

Public = 97%   Private = 80%

N=750   *Source: Flexera 2021 State of the Cloud Report*
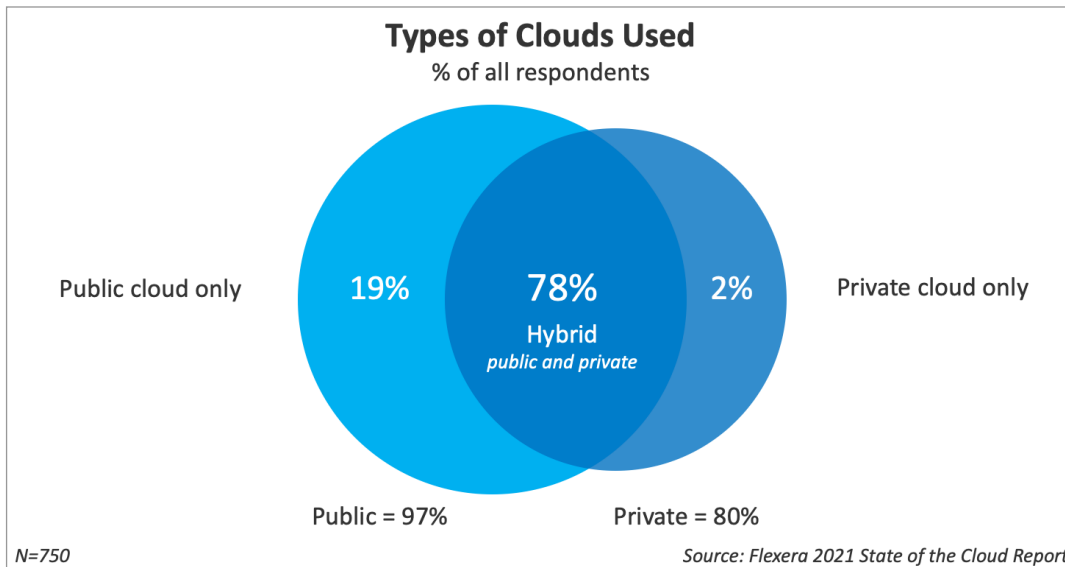
Figure 10. Breakdown of cloud types used for all organizations

Organizations use multiple clouds

As **Figure 11** shows, organizations currently use an average of 2.6 public and 2.7 private clouds. They're also experimenting with an additional 1.1 public clouds and 2.2 private clouds.

Number of Clouds Used on Average	PUBLIC	PRIVATE
Currently using	2.6	2.7
Experimenting with	1.1	2.2
Total	3.7	4.9

N=688

Source: Flexera 2021 State of the Cloud Report

Figure 11. Average number of public and private clouds used for all organizations

Public cloud adoption continues to accelerate

The increasing use of public cloud is driving up cloud spend for organizations of all sizes. Public cloud spend is now a significant line item in IT budgets, especially among larger organizations.

As **Figure 12** indicates, 31 percent of respondents (nearly double last year's 16 percent) reported annual spend of at least $12 million ($1 million per month) on public cloud, while 76 percent spend $1.2 million or more per year ($100,000 per month).

Annual Public Cloud Spend
% of all respondents

N=750

Source: Flexera 2021 State of the Cloud Report
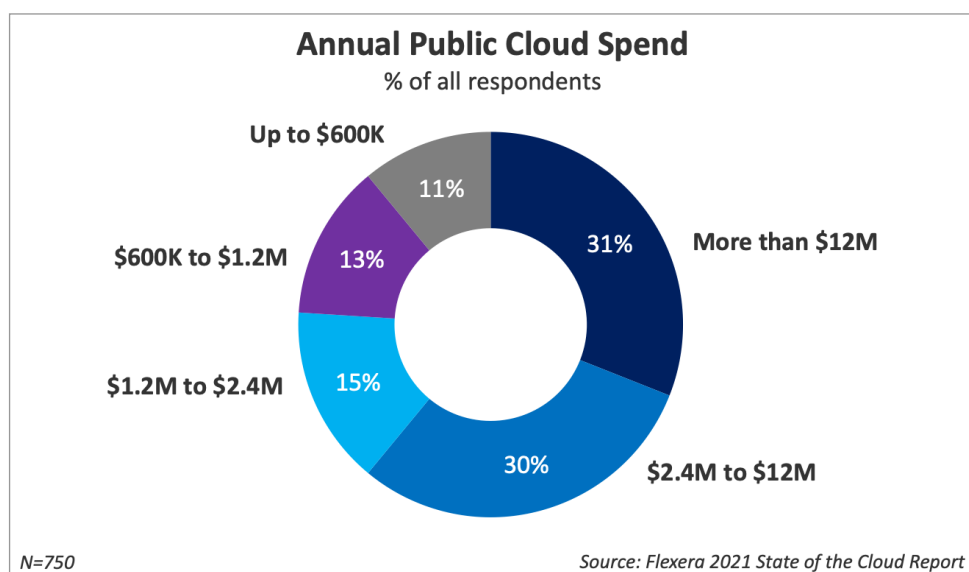
Figure 12. Public cloud spend for all organizations

36 percent of enterprises spend more than $1 million monthly

As **Figure 13** shows, 36 percent of enterprises said their annual spend exceeded $12 million and 83 percent reported that cloud spend exceeds $1.2 million per year. These figures represent an increase over last year, when 20 percent of enterprises reported an annual spend of more than $12 million and 74 percent reported yearly spend of more than $1.2 million.

Annual Public Cloud Spend by Enterprises
% of enterprise respondents

- Up to $600K — 6%
- $600K to $1.2M — 11%
- $1.2M to $2.4M — 15%
- $2.4M to $12M — 32%
- More than $12M — 36%

N=637

Source: Flexera 2021 State of the Cloud Report
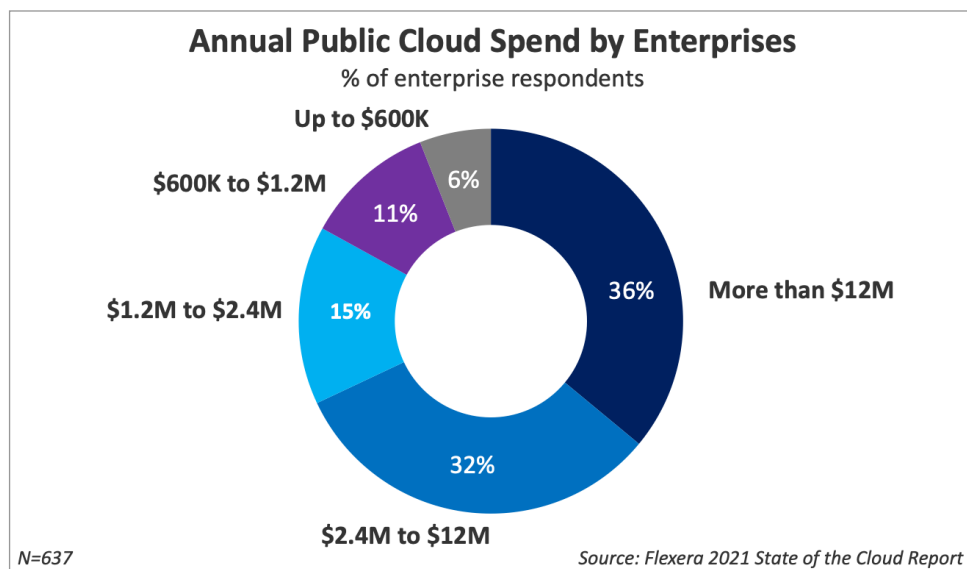
Figure 13. Annual public cloud spend for enterprises

SMB spend is less than enterprise spend

SMBs generally have substantially lower cloud bills because they run fewer workloads in the cloud than enterprises. As **Figure 14** indicates, 37 percent of SMBs are spending less than $600,000 annually, compared with only six percent of enterprises. However, 38 percent of SMBs spend more than $1.2 million—up from 32 percent reported last year.
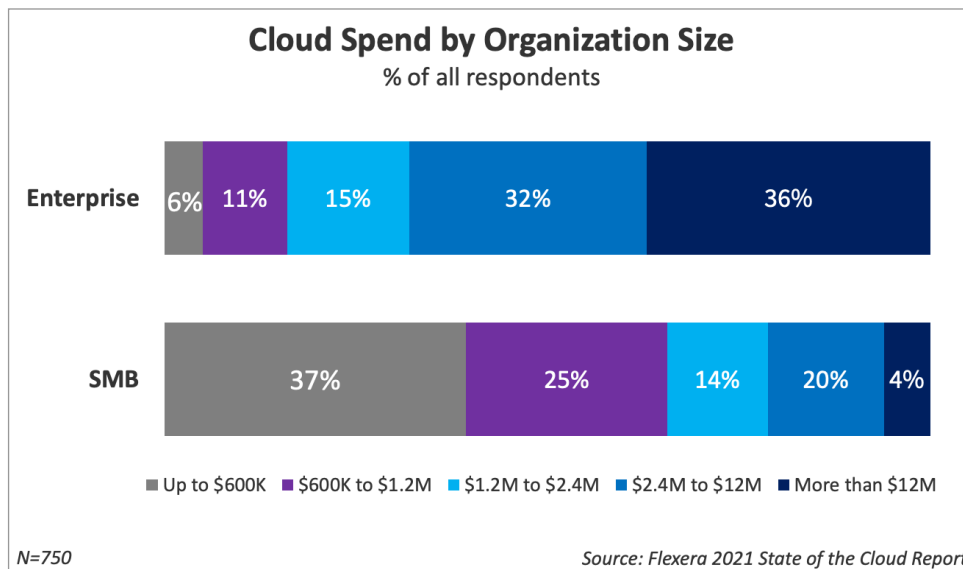
Figure 14. Comparison of enterprise and SMB cloud spend

Half of workloads and data are in a public cloud

Figure 15 shows that respondents are running 50 percent of their workloads in public cloud and they expect to increase that number to 57 percent in the next 12 months. With respect to data, 46 percent of organizations' data is in public cloud today and respondents expect to add another eight percent over the next 12 months.
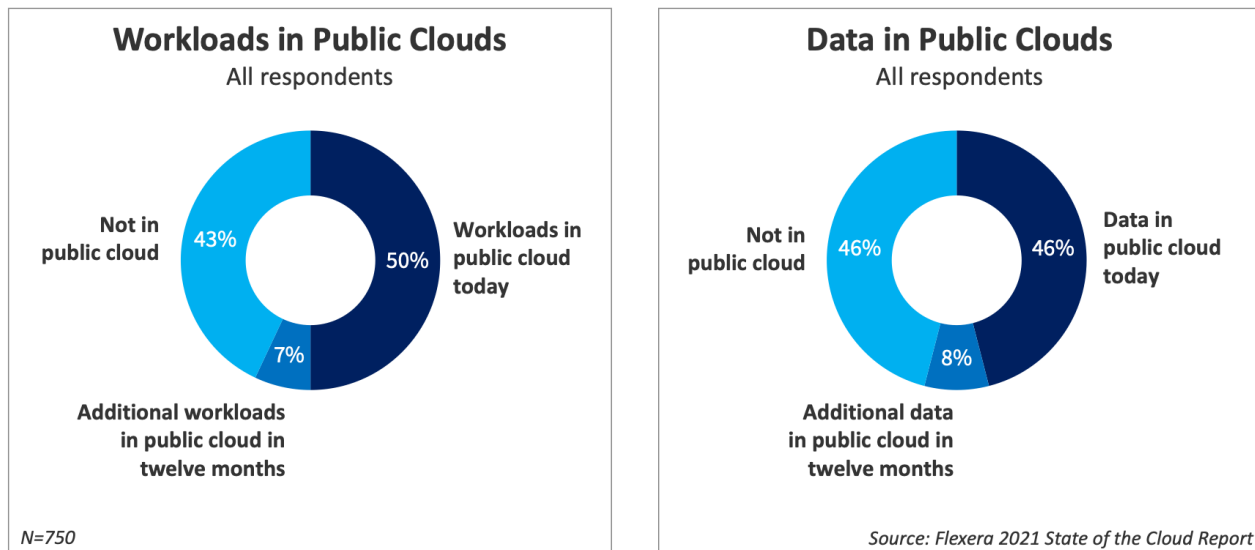
Figure 15. Workloads and data in a public cloud for all organizations

Nearly half of enterprise workloads and data are in a public cloud

As **Figure 16** indicates, enterprises are running 47 percent of workloads and storing 44 percent of data in a public cloud. Enterprise respondents plan to increase workloads and data in public cloud over the next 12 months by eight percent and seven percent, respectively.

Workloads in Public Cloud
Enterprise respondents

- Not in public cloud: 45%
- Workloads in public cloud today: 47%
- Additional workloads in public cloud in 12 months: 8%

N=637

Data in Public Cloud
Enterprise respondents

- Not in public cloud: 49%
- Data in public cloud today: 44%
- Additional data in public cloud in 12 months: 7%

Source: Flexera 2021 State of the Cloud Report
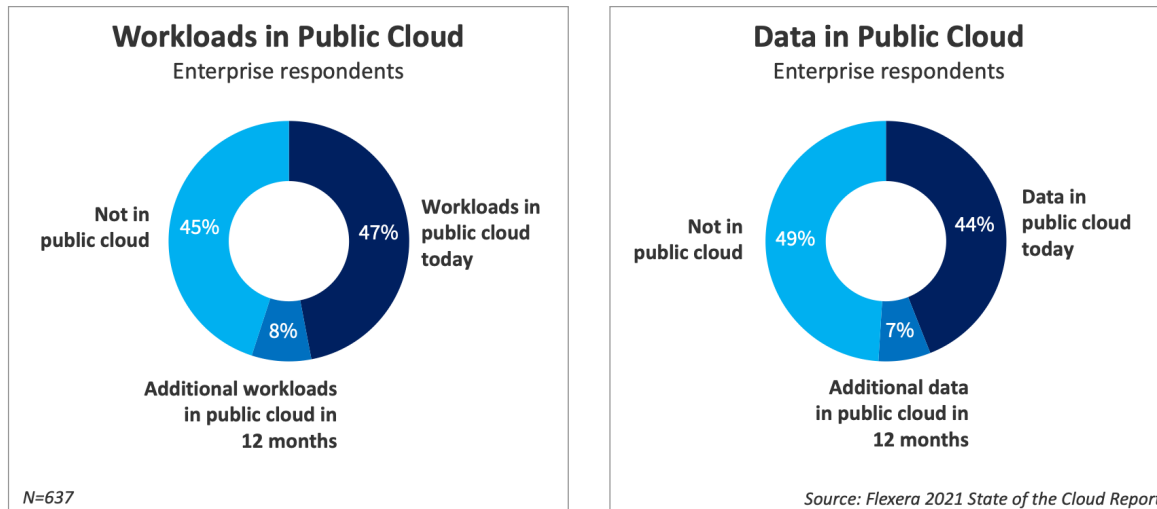
Figure 16. Enterprise workloads and data in a public cloud

Nearly two-thirds of SMB workloads will be in cloud

SMBs are moving quickly to the public cloud. As **Figure 17** indicates, 69 percent of SMB workloads and 67 percent of data will reside in a public cloud within the next 12 months.

Workloads in Public Cloud
SMB respondents

- Not in public cloud: 30%
- Workloads in public cloud today: 64%
- Additional workloads in public cloud in 12 months: 5%

N=113

Data in Public Cloud
SMB respondents

- Not in public cloud: 33%
- Data in public cloud today: 59%
- Additional data in public cloud in 12 months: 8%

Source: Flexera 2021 State of the Cloud Report
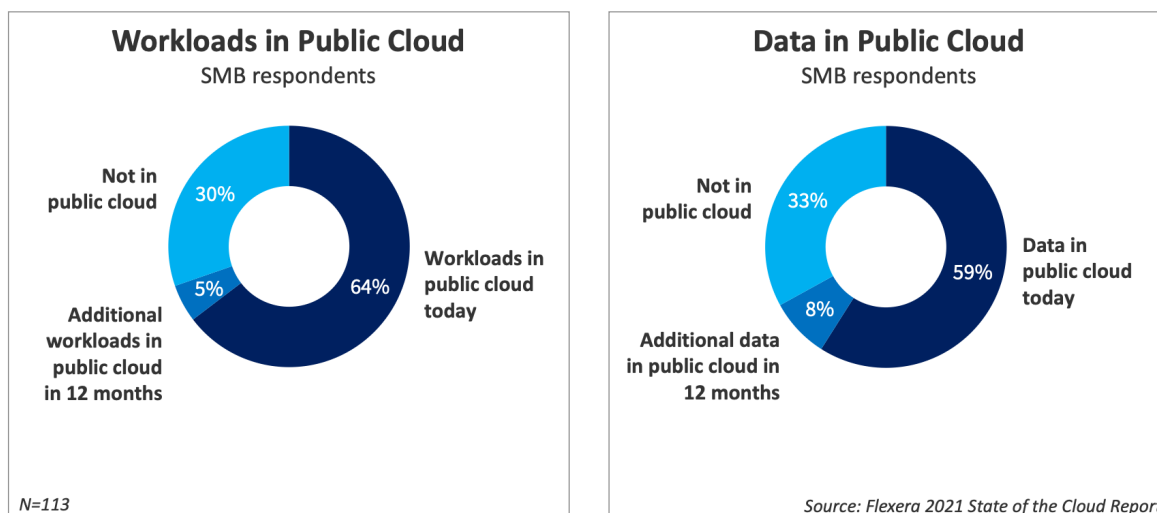
Figure 17. SMB workloads and data in a public cloud

Most believe COVID-19 increased their cloud usage

The emergence of COVID-19 prompted Flexera to add a question to the survey in 2020 that gauges how the pandemic might impact cloud strategy. Cloud plans and adoption have clearly shifted as a result of the pandemic.

Responses to the present survey indicate how organizations expect COVID-19 to affect their cloud plans. As **Figure 18** indicates, 90 percent said cloud usage is higher than initially planned. Some of the increase is a result of the extra capacity needed for current cloud-based applications to meet increased demand as online usage grows. Other organizations may accelerate migration from data centers to cloud in response to reduced headcount, difficulties in accessing data center facilities and delays in hardware supply chains.

As the pandemic runs its course, some organizations may also find that public cloud providers offer a more reliable option for business continuity.

Change from Planned Cloud Usage Due to COVID-19
% of respondents

	Slightly lower than planned	Significantly lower than planned	Slightly higher than planned	Significantly higher than planned
Total	1%	9%	61%	29%
Enterprise	1%	8%	62%	29%
SMB	3%	11%	52%	34%

N=750
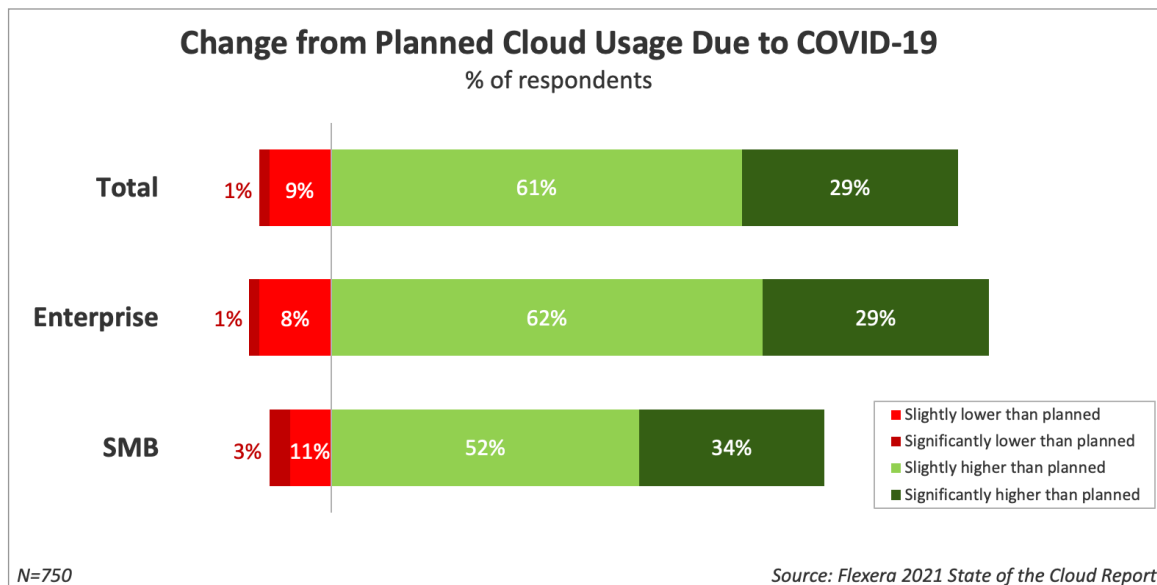
Figure 18. COVID-19 impact on planned cloud usage for all organizations

Organizations are open to moving sensitive data to the cloud

In the past, some organizations hesitated to put certain types of data in public clouds. This year's survey found many respondents are reconsidering. As **Figure 19** shows, more than half of respondents said they'll consider moving at least some of their sensitive consumer data or corporate financial data to the cloud, which reflects increasing confidence in the security practices of cloud providers.

Data in the Cloud
% of respondents

TYPE OF DATA THAT WILL MOVE TO THE CLOUD	Consumer data (PII/PHI, etc.)	Corporate financial data	Order/ Sales data	IoT/Edge data	Non-sensitive data for analytics	Other non-sensitive data
	N=625	N=625	N=623	N=582	N=625	N=596
All stays on-prem	16%	23%	12%	8%	6%	7%
Mostly stays on-prem	24%	28%	20%	15%	13%	12%
Mix of on-prem and in cloud/SaaS	34%	24%	33%	31%	23%	25%
Mostly will move to cloud/SaaS	15%	15%	18%	26%	28%	26%
All will move to cloud/SaaS	11%	11%	17%	20%	30%	29%

N=750

Source: Flexera 2021 State of the Cloud Report

Figure 19. Type of data that will move to public clouds for all organizations

Dependency mapping is top cloud migration challenge

Mapping all the relationships across apps, hardware and networking devices for each IT-delivered service is notoriously difficult to do, especially in a rapidly evolving environment. It's therefore no surprise that 51 percent of respondents reported *understanding app dependencies* as the top cloud migration challenge, as **Figure 20** indicates.

Other critical challenges include assessing the *technical feasibility* (of migrating on-premises apps), *assessing on-prem versus cloud costs* and *rightsizing/selecting the best instance*. Organizations need to address these challenges so they can make informed decisions as to which apps to migrate and optimize the cost of running on-premises apps that were in the cloud.

Cloud Migration Challenges
% of all respondents

Challenge	%
Understanding app dependencies	51%
Assessing technical feasibility	48%
Assessing on-prem vs. cloud costs	44%
Rightsizing/selecting best instance	44%
Knowing implications of BYOL	40%
Optimizing costs post-migration	39%
Prioritizing apps to migrate	36%
Migrating the app and data	36%
Selecting the right cloud provider	36%
Managing the app post-migration	26%

N=750   Source: Flexera 2021 State of the Cloud Report

Figure 20. Cloud migration challenges for all organizations

Migration challenges are greater for enterprises

While enterprises are improving their understanding of app dependencies (66% cited it as a challenge last year, down to 51% this year in **Figure 21**), their ability to assess technical feasibility is still a weak point (48% last year going up to 49% this year), as is the ability to assess on-premises vs cloud costs (44% last year, 45% this year).

As **Figure 21** indicates, both enterprises and SMBs rank *understanding app dependencies* and *assessing technical feasibility* as their top challenges. However, these obstacles are tougher for larger organizations, which have more on-premises applications and more complex environments. Enterprises also face significantly larger challenges than SMBs in assessing the cost implications of cloud migrations.

Top Cloud Migration Challenges
% of respondents

Challenge	Enterprise	SMB
Understanding app dependencies	51%	52%
Assessing technical feasibility	49%	41%
Assessing on-prem vs. cloud costs	45%	35%
Rightsizing/selecting best instance	44%	43%
Knowing implications of BYOL	42%	32%
Optimizing costs post-migration	39%	44%
Prioritizing apps to migrate	37%	26%
Selecting the right cloud provider	36%	35%
Migrating the app and data	36%	39%
Managing the app post-migration	26%	28%

N=750

Source: Flexera 2021 State of the Cloud Report

Figure 21. Comparison of cloud challenges for enterprises and SMBs

Understanding cloud initiatives and metrics

Optimizing spend is top cloud initiative for the fifth year running

For the fifth year in a row, *optimizing the existing use of cloud (cost savings)* is the top initiative for the year ahead, followed by *migrating more workloads to cloud* and *better financial reporting on cloud costs*. **Figure 22** shows the rankings for this year.

Optimizing usage is a cost-control measure. Migrating workloads can save money and drive agility. As organizations move more workloads to the cloud, they can retire the technical debt associated with maintaining and operating traditional data centers. Better financial reporting on cloud costs gives more stakeholders within an organization actionable insight into cloud usage.

Top Cloud Initiatives for 2021
% of all respondents

Initiative	%
Optimize existing use of cloud (cost savings)	61%
Migrating more workloads to cloud	59%
Better financial reporting on cloud costs	45%
Progressing on a cloud-first strategy	43%
Expand use of containers	42%
Automated policies for governance	42%
Move on-prem software to SaaS	39%
Expand public clouds we use	39%
Manage software licenses in the cloud	32%
Implement CI/CD in the cloud	30%
Enable IT to broker cloud services	22%
Expand use of cloud MSPs	17%
Expand use of cloud marketplaces	11%

N=750   Source: Flexera 2021 State of the Cloud Report

Figure 22. Ranking of 2021 cloud initiatives for all organizations

Figure 23 divides the respondents by cloud maturity: beginner, intermediate and advanced. Beginners, intermediate and advanced users rank *optimizing existing use of cloud* as their top initiative, and each followed with *migrating more workloads to cloud*. This cost savings initiative was named by 61 percent of beginner organizations, 71 percent of intermediate-level organizations and 69 percent of advanced organizations.

Cloud Initiatives by Maturity

BEGINNER	INTERMEDIATE	ADVANCED
1. Optimizing existing use of cloud (61%)	1. Optimizing existing use of cloud (71%)	1. Optimizing existing use of cloud (69%)
2. Migrating more workloads to cloud (55%)	2. Migrating more workloads to cloud (69%)	2. Migrating more workloads to cloud (59%)
3. Expanding public clouds we use (43%)	3. Cloud-first strategy (44%)	3. Better financial reporting (50%)
4. Cloud-first strategy (39%)	4. Better financial reporting (40%)	4. Expanding container use (49%)
5. Moving from on-prem to SaaS (39%)	5. Moving from on-prem to SaaS (39%)	5. Cloud-first strategy (46%)

N=750   Source: Flexera 2021 State of the Cloud Report

Figure 23. Top cloud initiatives by cloud maturity for all organizations

Organizations measure cloud progress by savings, agility and value

Figure 24 lists the ranking of metrics that organizations are using to measure cloud progress. The top three are *cost efficiency/savings, delivery speed of product/services* and *cost avoidance*. To achieve cost benefits, organizations must optimize as they migrate by rightsizing and using automation to monitor and optimize spend continually.

Metrics Used to Measure Cloud Progress
% of all respondents

Metric	%
Cost efficiency/savings	76%
Delivery speed of products/services	66%
Cost avoidance	53%
Number of workloads migrated	50%
Increase in competitive advantage	50%
Value delivered to business units	47%
Increased speed of innovation	45%
Customer adoption of cloud offerings	42%
Decreased data center footprint	39%
Retirement/decrease of technical debt	29%

N=750   Source: Flexera 2021 State of the Cloud Report

Figure 24. Top metrics for assessing progress against cloud goals for all organizations

Organizations are taking a centralized approach to cloud

As organizations adopt cloud-first strategies, many are creating a central cloud team or a cloud center of excellence (CoE) tasked with providing centralized controls, tools and best practices. The purpose of these teams is to accelerate cloud adoption by centralizing expertise while reducing costs and risk. As **Figure 25** shows, 75 percent of organizations have a central cloud team or cloud CoE.
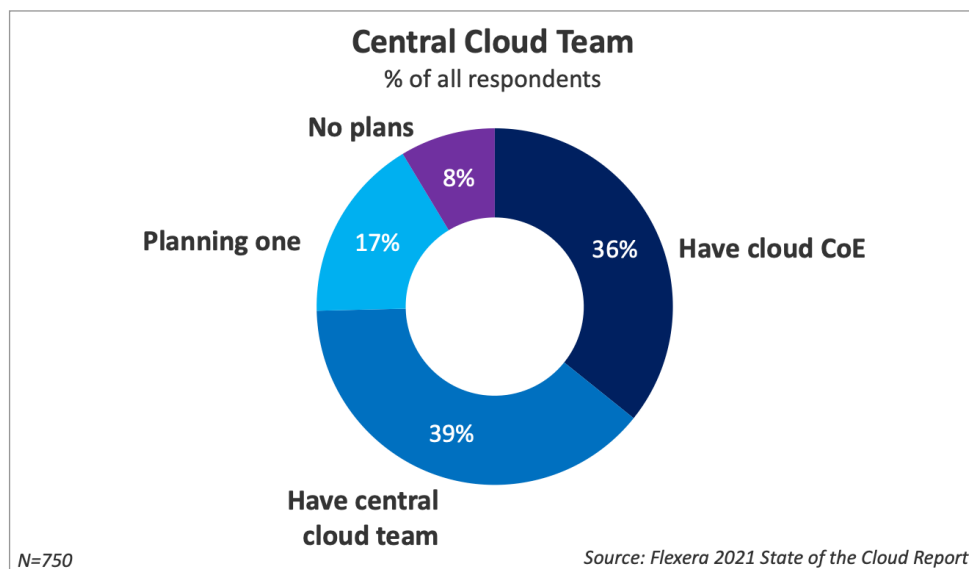
Figure 25. Adoption of central cloud team/CoE for all organizations

Enterprises lean heavily on central teams

Enterprises have a greater need for centralization than SMBs. Spend, governance and security within larger organizations are much more complex, and teams overseeing those areas must coordinate across multiple business units and functional areas. As **Figure 26** indicates, 77 percent of enterprises already have a central cloud team or cloud CoE, compared with 55 percent of SMBs. Only eight percent of enterprises and 23 percent of SMBs have no plans for a central cloud team.

Central Cloud Team by Organization Size
% of all respondents

	No plans	Planning central team	Have cloud team	Have cloud CoE
Enterprise	8%	16%	39%	38%
SMB	23%	21%	35%	20%

N=750

Source: Flexera 2021 State of the Cloud Report
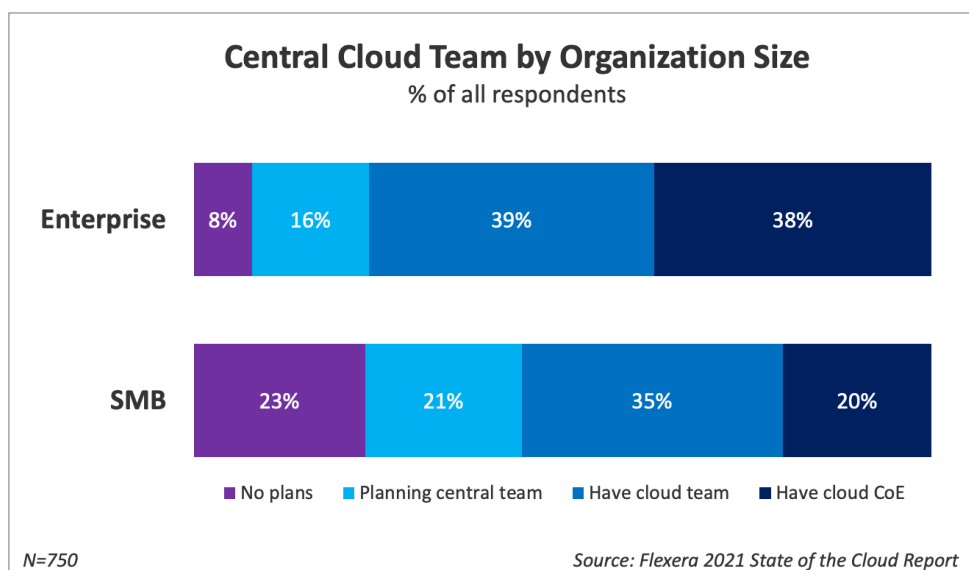
Figure 26. Central cloud team/CoE by organization size

Enterprise central teams optimize cloud costs and govern use

Figure 27 shows the role enterprise central IT teams play in providing guardrails for cloud use. These cloud teams shoulder most of the responsibility for cloud cost optimization, migration planning and governance. They also serve in an advisory capacity to help stakeholders make informed decisions and ensure the apps selected comply with the enterprise governance framework and security policies.

Role of Central IT in Cloud Use
% of enterprise respondents

Responsibility	%
Decide/advise on apps appropriate for cloud	65%
Manage/optimize costs of cloud services	62%
Plan for cloud migrations	62%
Set policies for cloud use	58%
Select public cloud providers	55%
Automate policies to govern cloud use	52%
Act as a cloud broker	46%
Select private clouds	43%
Provide/manage a private cloud	38%
Manage all cloud deployments	32%

N=637

Source: Flexera 2021 State of the Cloud Report

Figure 27. Central IT responsibilities in enterprises

SAM and vendor management can lend expertise

As **Figure 28** indicates, the cloud team and infrastructure and operations team are actively involved in enterprise cloud cost management. Their top responsibilities include *governing IaaS and PaaS usage and costs, optimizing cloud spend* and *report/analyze cloud costs*.

These are responsibilities that software asset management (SAM) and vendor management teams have traditionally handled for on-premises software. Consequently, SAM and vendor management professionals have extensive experience in optimizing license consumption. This expertise ensures compliance with contract terms, negotiating and managing favorable contracts, reclaiming unused licenses, optimizing renewals, and automating license management for on-premises and enterprise SaaS agreements. Organizations could benefit significantly from increased involvement by these teams in cloud cost management.

Cloud Cost Management Responsibilities for Teams

CLOUD COST MANAGEMENT RESPONSIBILITIES	CLOUD TEAM	INFRASTRUCTURE AND OPS	BUSINESS UNITS	FINANCE	APPLICATION TEAMS	SAM AND VENDOR MGMT
Govern IaaS/PaaS usage/costs	54%	39%	18%	16%	15%	6%
Optimize cloud spend	45%	35%	17%	15%	19%	7%
Report/analyze cloud costs	45%	33%	21%	21%	14%	7%
Govern SaaS usage/costs	44%	37%	18%	14%	18%	8%
Forecast cloud costs post migration	44%	33%	19%	18%	17%	6%
Define cost management policies	43%	33%	19%	19%	12%	8%
Govern software licenses in IaaS/PaaS	42%	37%	17%	12%	17%	9%
Own cloud budgets	39%	31%	28%	18%	14%	6%
Charge back cloud costs	36%	29%	17%	26%	12%	6%

N=750   *Source: Flexera 2021 State of the Cloud Report*

Figure 28. Cloud cost management responsibilities by IT team for all organizations

MSPs help with cloud work

As **Figure 29** shows, 61 percent are outsourcing at least some cloud work, with 29 percent engaging cloud managed service providers (MSPs) for most of their public cloud use.

Use of Cloud MSP
% of all respondents

No plans 21%
Are used for most public cloud usage 29%
Plan to decrease use 7%
Plan to use 11%
Are used for some public cloud usage 32%

N=750   *Source: Flexera 2021 State of the Cloud Report*
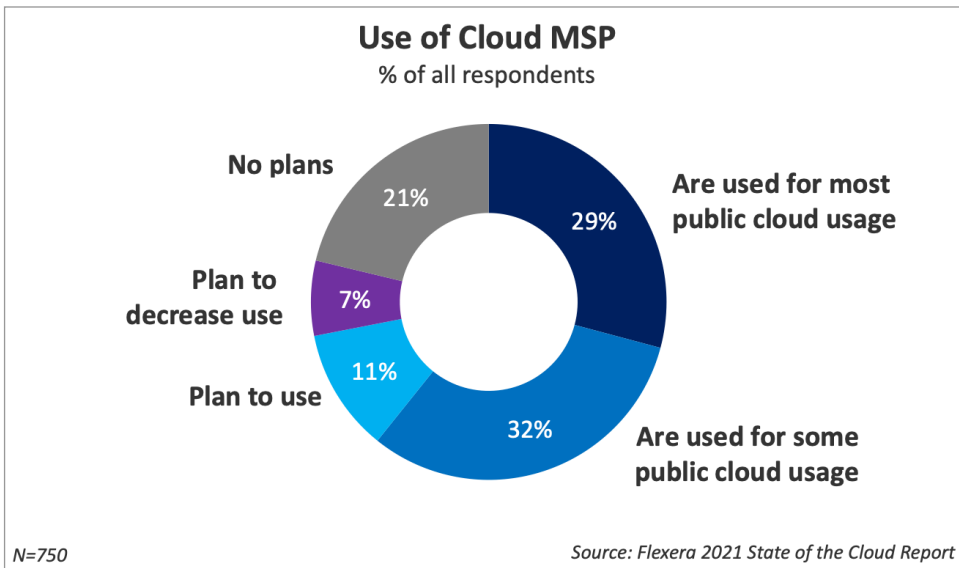
Figure 29. Leveraging MSPs to manage public cloud resources for all organizations

Figure 30 indicates that enterprises are more likely to use MSPs than are SMBs.

Use of Cloud MSPs
% of SMB respondents

No plans 33%
Use MSP 49%
Plan to use less 3%
Plan to use 15%

N=113   *Source: Flexera 2021 State of the Cloud Report*

Use of Cloud MSPs
% of enterprise respondents

No plans 19%
Plan to use less 7%
Plan to use 11%
Use MSP 63%

N=637   *Source: Flexera 2021 State of the Cloud Report*
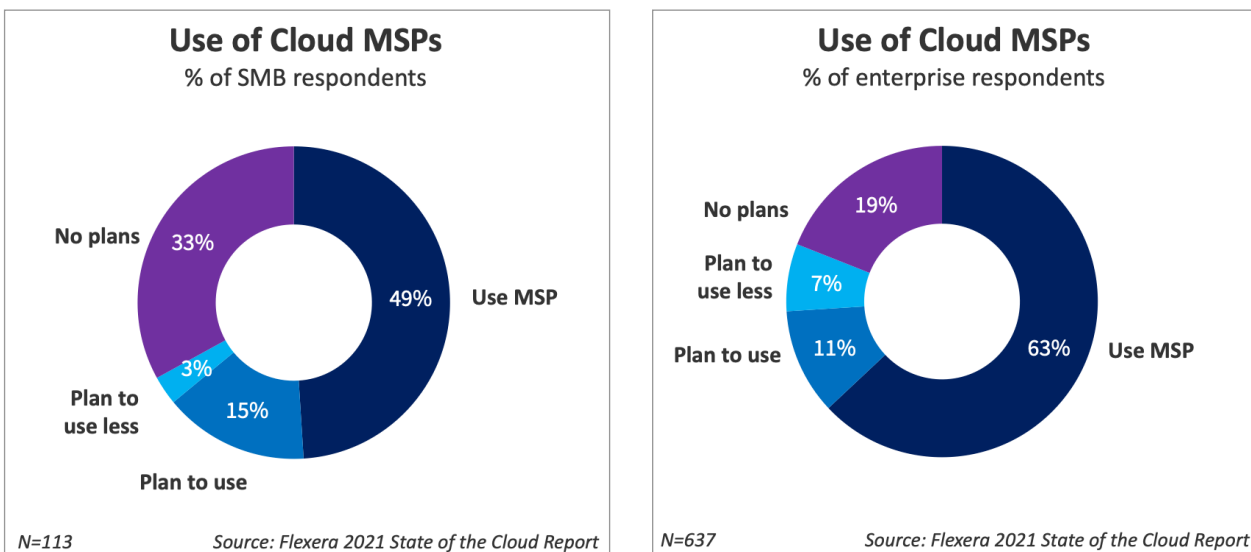
Figure 30. MSP usage by enterprises versus SMBs

Top challenges are security, spend, governance and expertise

The top cloud challenges in 2021 are all quite close in how often respondents cite them. As **Figure 31** shows, the top five are *security, managing cloud spend, governance, lack of resources/expertise* and *compliance*.

Top Cloud Challenges
% of all respondents

Challenge	%
Security	81%
Managing cloud spend	79%
Governance	75%
Lack of resources/expertise	75%
Compliance	75%
Managing BYOL	73%
Managing multi-cloud	72%
Cloud migration	71%

N=750

Source: Flexera 2021 State of the Cloud Report
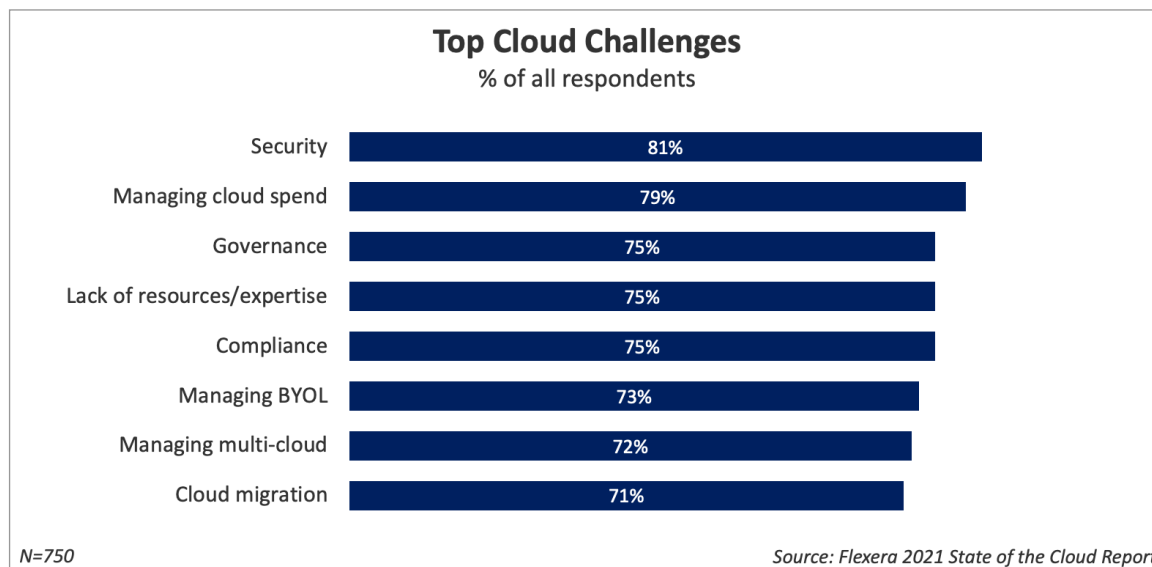
Figure 31. Top cloud challenges for all organizations

Enterprises and SMBs diverged in their ranking of the top challenges

Figure 32 indicates enterprises followed the overall trend with *security* and *managing cloud spend* at the top. But SMBs ranked *lack of resources/expertise* as their third challenge, followed by *governance*.

Top Cloud Challenges
% of respondents

Challenge	Enterprise	SMB
Security	81%	78%
Managing cloud spend	79%	76%
Governance	77%	69%
Compliance	77%	64%
Lack of resources/expertise	76%	72%
Managing BYOL	75%	58%
Managing multi-cloud	74%	60%
Cloud migration	73%	56%

N=750

Source: Flexera 2021 State of the Cloud Report
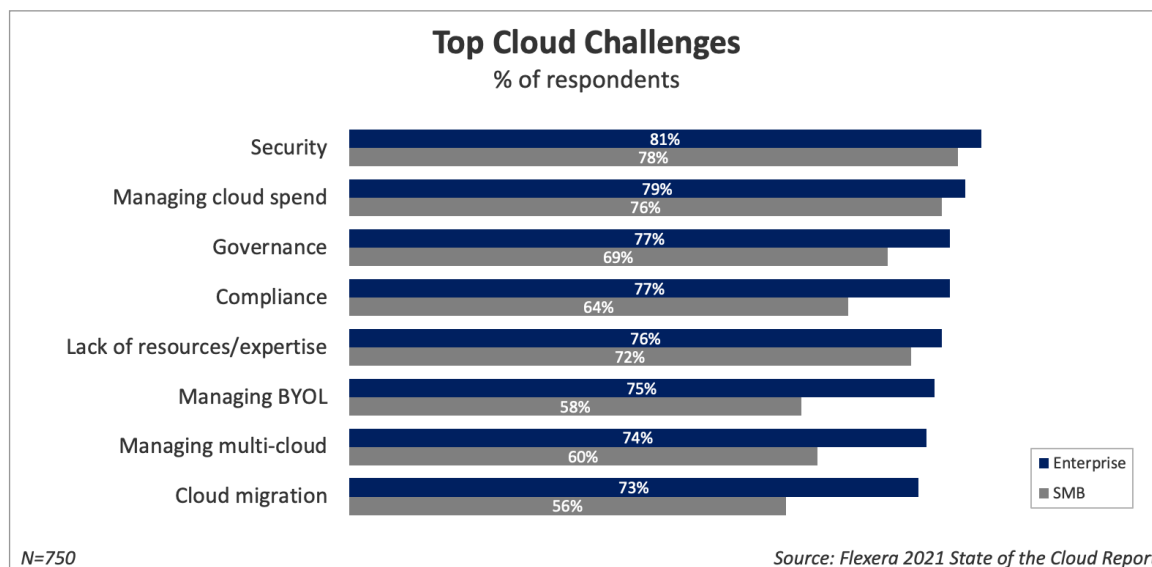
Figure 32. Comparison of top challenges for enterprises versus SMBs

Enterprise challenges decline, except for security

Enterprises are gaining experience with cloud, which has led to slight decreases in perceived cloud challenges. However, due to the growing number of workloads in the cloud and the development of hybrid and multi-cloud strategies, enterprises still face severe challenges around *security, managing cloud spend* and *governance*. **Figure 33** shows the top enterprise cloud challenges for 2021 compared with 2020.

Top Enterprise Cloud Challenges YoY
% of enterprise respondents

Challenge	2021	2020
Security	81%	83%
Managing cloud spend	79%	82%
Governance	77%	79%
Lack of resources/expertise	76%	78%
Compliance	77%	76%
BYOL	75%	76%
Cloud migration	73%	70%
Managing multi-cloud	71%	69%

N=637

Source: Flexera 2021 State of the Cloud Report
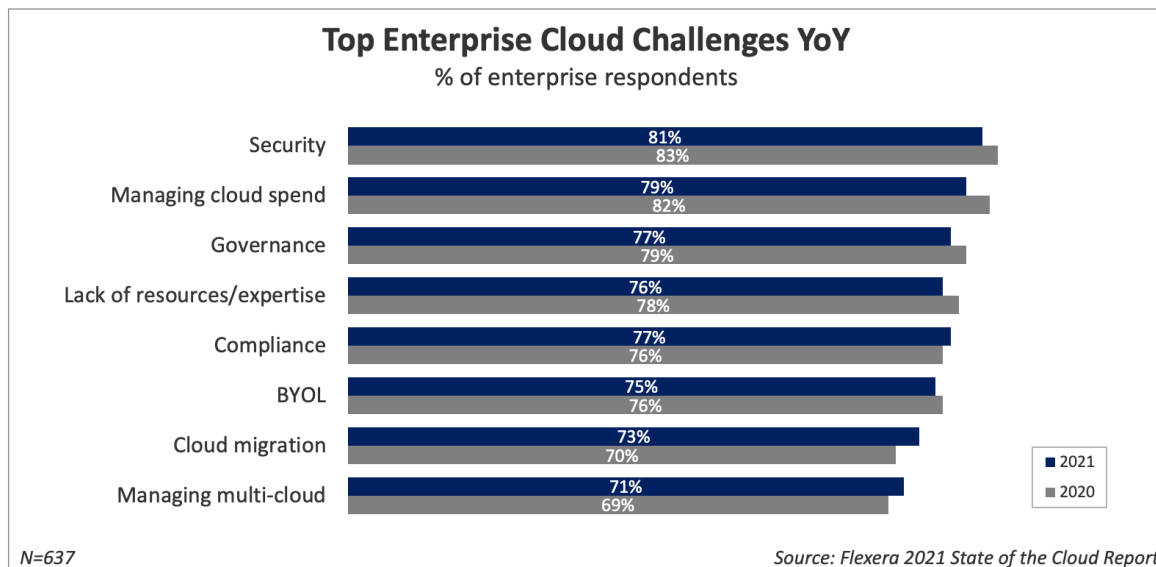
Figure 33. YoY comparison of top cloud challenges for enterprises

Cost, governance and security remain challenges

Some types of challenges, such as *managing multi-cloud* environments, become more manageable as the organization matures and gains experience. But others remain significant, even in organizations at the advanced cloud maturity level. As **Figure 34** indicate, these include *security, managing cloud spend, governance* and *compliance*.

One possible reason for this phenomenon is that the factors driving these challenges present moving targets. Hackers continue to increase their sophistication, necessitating constant attention to cloud security. Also, new legislation and regulations continue to emerge, particularly in industries such as financial services and healthcare, as legislators attempt to catch up with technology.

Cloud Challenges by Maturity
% of all respondents

Legend:
- Lack of resources/expertise
- Security
- Managing BYOL
- Managing cloud spend
- Cloud migration
- Governance
- Managing multi-cloud
- Compliance

Beginner   Intermediate   Advanced

N=750

Source: Flexera 2021 State of the Cloud Report
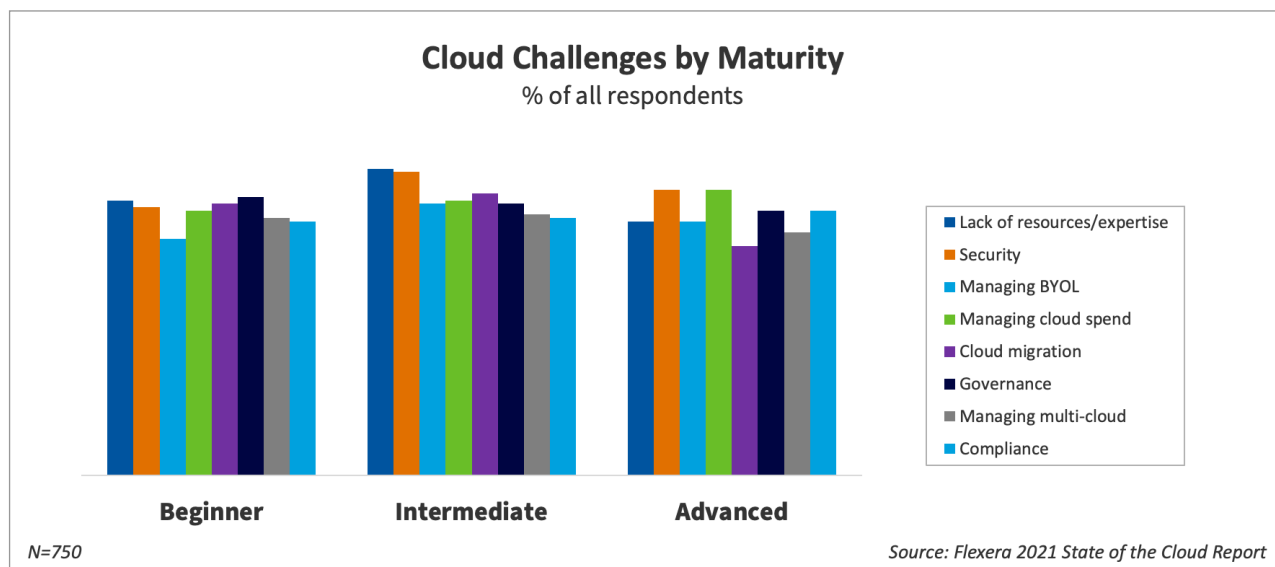
Figure 34. Cloud maturity doesn't lessen the severity of every challenge for all organizations

As **Figure 35** indicates, *governance* is the top challenge for beginners but diminishes for intermediate and advanced cloud users. The top challenge for intermediate users is *lack of resources/expertise*. For advanced users, *managing cloud spend* and *security* are the top challenges.

Cloud Challenges by Maturity

BEGINNER	INTERMEDIATE	ADVANCED
1. Governance (79%)	1. Lack of resources/expertise (87%)	1. Managing cloud spend (81%)
2. Lack of resources/expertise (78%)	2. Security (86%)	2. Security (81%)
3. Cloud migration (77%)	3. Managing cloud spend (78%)	3. Governance (75%)
4. Security (76%)	4. Governance (77%)	4. Compliance (75%)
5. Managing cloud spend (75%)	5. Managing BYOL (77%)	5. Lack of resources/expertise (72%)

N=750

Source: Flexera 2021 State of the Cloud Report

Figure 35. The ranking of cloud challenges by maturity level for all organizations

Managing software costs is challenging in the cloud

As **Figure 36** shows, the top software-related challenge in the cloud is *understanding cost implications of software licenses*, followed by challenges related to license compliance.

As stated earlier, software asset management and vendor management teams have considerable expertise in these areas. Organizations would be well advised to leverage their skills to address software challenges in the cloud.

Top Challenges of Software in the Cloud
% of all respondents

Challenge	%
Understanding cost implications of software licenses	55%
Ensuring we follow license rules	48%
Complexity of license rules in public cloud	46%
Ensuring we don't use too many licenses	45%
Knowing when licenses are no longer used in cloud	39%
Discovering what software is used in cloud	35%

N=750

Source: Flexera 2021 State of the Cloud Report
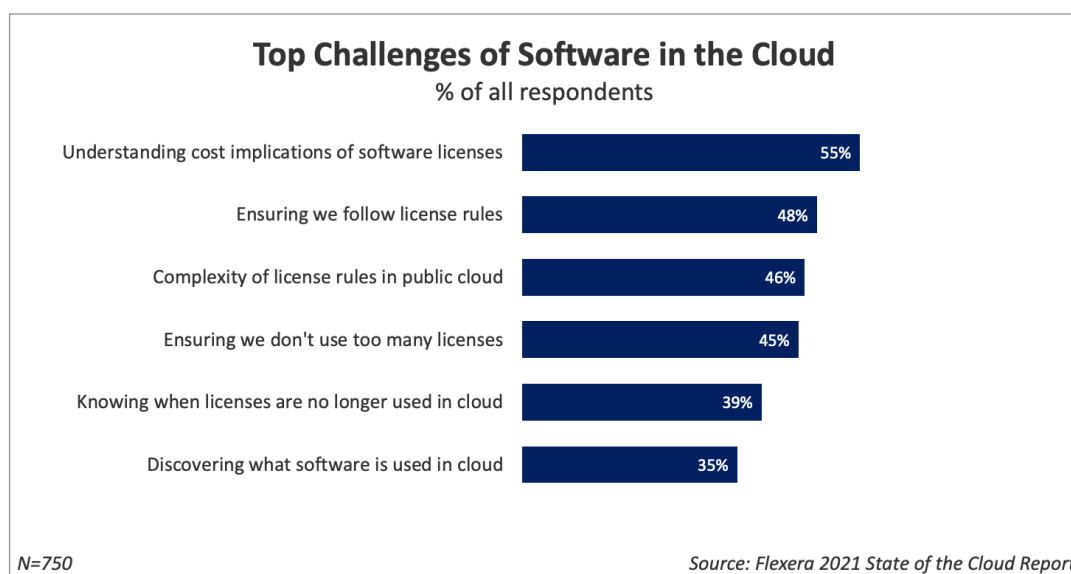
Figure 36. Top software challenges for all organizations

Organizations struggle to handle growing cloud spend

Organizations are continuing to rapidly increase their cloud spend. In so doing, they struggle to accurately forecast their fast-growing cloud costs. As **Figure 37** indicates, respondents reported their public cloud spend was over budget by an average of 24 percent. Moreover, respondents expect their cloud spend to further increase by 39 percent in the next twelve months. This trend means it's more critical than ever to get a handle on forecasting and cost optimization.
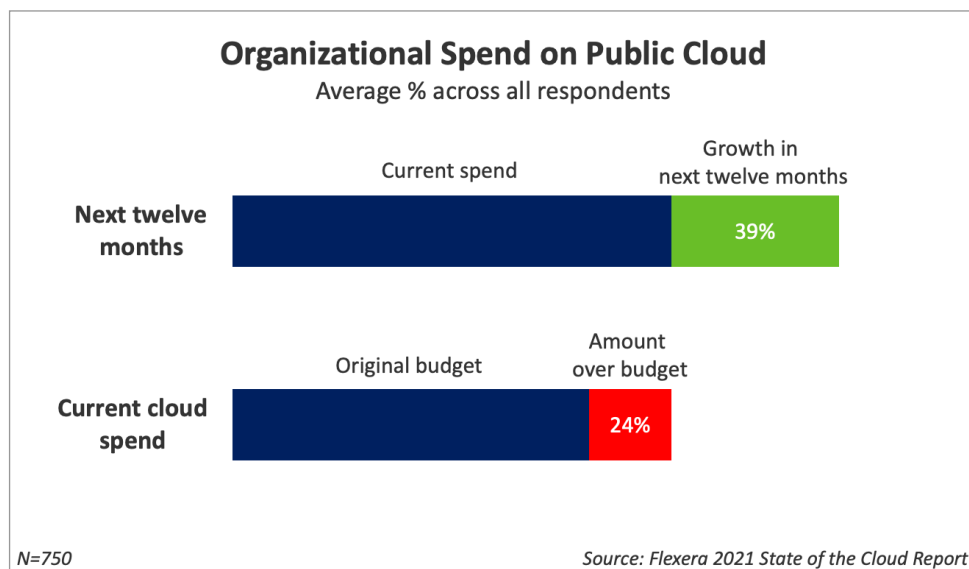
Figure 37. Overspending on public cloud for all organizations

Organizations waste significant cloud spend

Wasted cloud spend is a major issue and becomes more critical as cloud costs continue to rise. As **Figure 38** shows, respondents self-estimate that their organizations waste 30 percent of cloud spend. However, spend is likely less efficient as many organizations tend to underestimate the amount of waste. In working with customers to identify waste, Flexera has found that, on average, actual waste is 35 percent or even higher.

Percentage of Cloud Spend Wasted
% waste of all respondents

Self-estimated
wasted spend

30%

70%

Efficient spend

N=750

Source: 2021 Flexera State of the Cloud Report
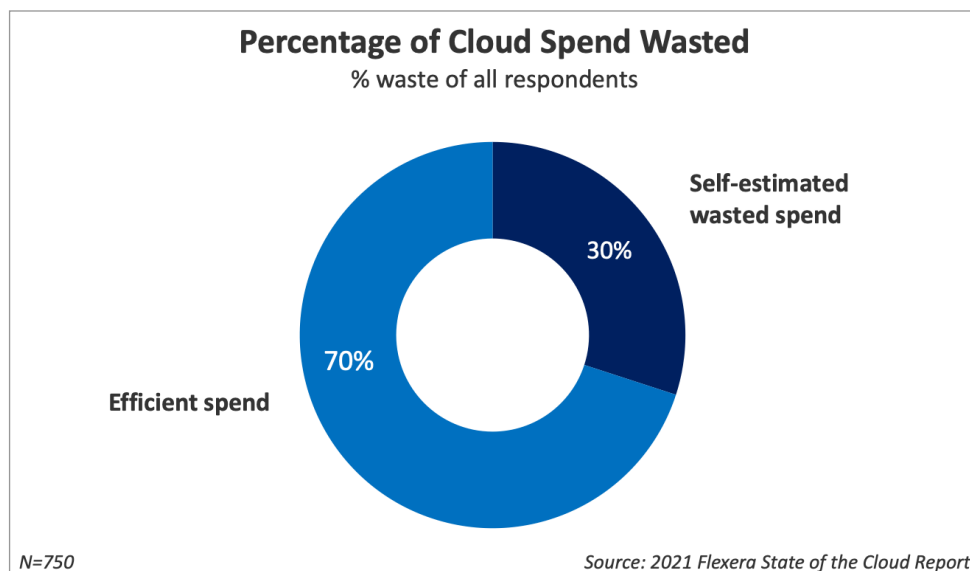
Figure 38. Respondent self-estimates of wasted cloud spend for all organizations

Cloud provider discounts offer savings opportunities

Cloud provider pricing structures are complex and tricky to decipher. However, taking a close look at provider discounts could uncover opportunities to reduce costs. **Figure 39** indicates that organizations aren't taking advantage of all the available discounts. Just over half (52 percent) of AWS users leverage *reserved instances* and only 46 percent of Azure users do so. But organizations seem to be moving quickly to adopt the AWS Savings Plan (44 percent in 2021 vs 30 percent in 2020), a new offering in 2020 that simplifies discounting.

Discount Types Used, by Cloud Provider

AWS	AZURE	GOOGLE
AWS Reserved Instances **52%**	Enterprise Agreement **49%**	Committed use discounts **61%**
AWS EDP (Enterprise Discount) **44%**	Azure Reserved Instances **46%**	Ad hoc negotiated discounts **48%**
AWS Savings Plan **44%**	Azure Hybrid Benefit **37%**	
AWS Spot Instances **37%**	Azure Low Priority VMs **28%**	
Ad hoc negotiated discounts **26%**		

N=750

Source: Flexera 2021 State of the Cloud Report

Figure 39. Discount types organizations are leveraging

Organizations use automation to optimize costs

Figure 40 indicates that policies are being leveraged by organizations to optimize costs. Automated cloud cost optimization policies can save time while ensuring that organizations monitor their environments consistently to eliminate waste.

Policies to Optimize Cloud Costs
% of all respondents

Policy	Automated policies	Manual policies
Shut down workloads after hours	49%	35%
Rightsize instances	48%	40%
Specify expiration dates	40%	42%
Allowed instance sizes/types	40%	46%
Underutilized discounts	39%	43%
Required tags	38%	43%
Eliminate inactive storage	37%	46%
Software license compliance	36%	49%
Use lowest-cost regions	31%	48%
Use lowest-cost cloud	25%	53%

N=750

Source: Flexera 2021 State of the Cloud Report

Figure 40. Types of policies to optimize cloud costs

Containers are now mainstream

The use of Docker and Kubernetes continues to be considerable. As **Figure 41** indicates, 53 percent of organizations use Docker and 21 percent plan to use it. Forty-eight percent use Kubernetes, a container orchestration tool that leverages Docker, and another 25 percent plan to use it.

Many organizations are also choosing container-as-a-service offerings from public cloud providers. The AWS container service (ECS/EKS) experienced substantial adoption, with 51 percent using it and another 23 percent planning to use it. Azure Container Service adoption reached 43 percent, and Google Kubernetes Engine (GKE) reached 31 percent.
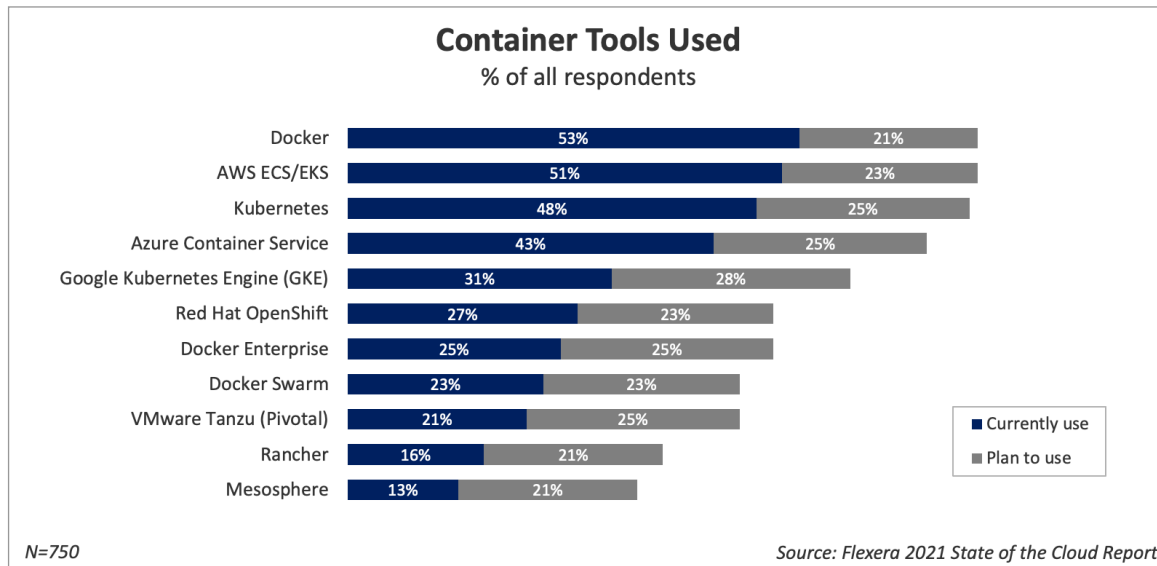
Figure 41. Current and planned container use for all organizations

As **Figure 42** and **Figure 43** illustrate, Docker is used about the same between enterprises (54 percent) and SMBs (48 percent). AWS ECS/EKS is now the most popular container tool by SMBs (52 percent) and the second most popular with enterprises (51 percent). Enterprises use Kubernetes more frequently (50 percent) than SMBs (37 percent). (Note: Respondents could select all container tools that apply to them; there is obvious overlap between some of the answers.)

Container Tools Used by Enterprises
% of enterprise respondents

Tool	Currently use	Plan to use
Docker	54%	22%
AWS ECS/EKS	51%	23%
Kubernetes	50%	25%
Azure Container Service	45%	26%
Google Kubernetes Engine (GKE)	32%	29%
Red Hat OpenShift	30%	24%
Docker Enterprise	26%	27%
VMware Tanzu (PCF)	24%	27%
Docker Swarm	24%	25%
Rancher	18%	23%
Mesosphere	15%	21%

N=637

Source: Flexera 2021 State of the Cloud Report

Figure 42. Enterprise use of container tools

Container Tools Used by SMBs
% of SMB respondents

Tool	Currently use	Plan to use
AWS ECS/EKS	52%	19%
Docker	48%	16%
Kubernetes	37%	24%
Azure Container Service	35%	21%
Google Kubernetes Engine (GKE)	23%	21%
Docker Swarm	19%	12%
Docker Enterprise	16%	15%
Red Hat OpenShift	8%	19%
Rancher	8%	11%
Mesosphere	6%	12%
VMware Tanzu (PCF)	4%	17%

N=113

Source: Flexera 2021 State of the Cloud Report
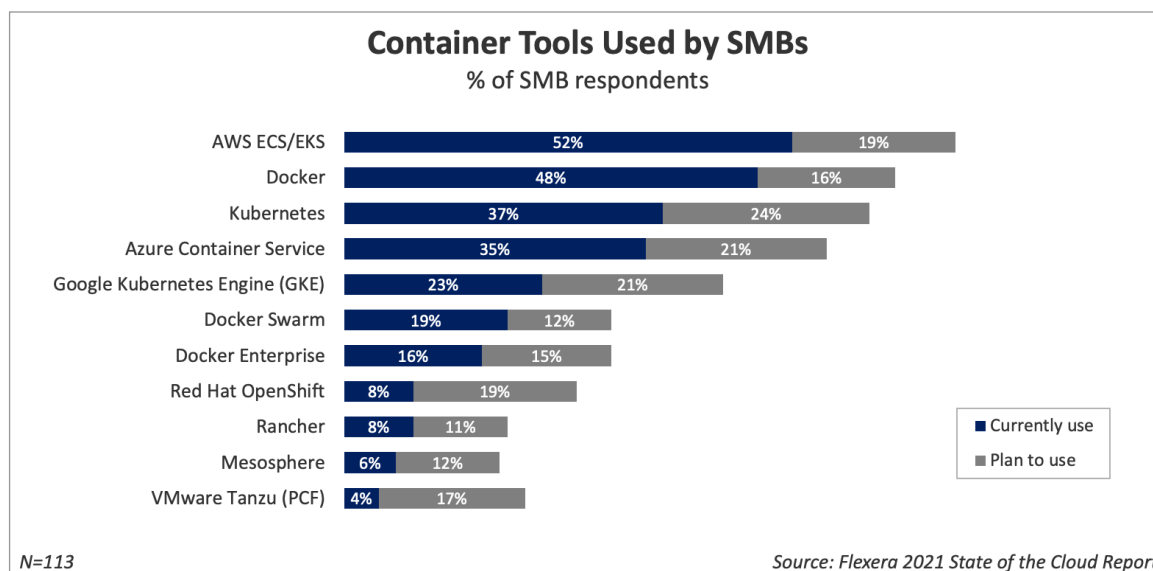
Figure 43. SMB use of container tools

Lack of expertise is the top challenge for container use

Organizations face challenges using containers. As **Figure 46** indicates, the top container challenges are the *lack of internal resources with expertise, ensuring security* and *migrating traditional applications to containers*. These resource challenges can be attributed to the relatively recent adoption of container technology. Migrating traditional applications to containers is problematic because containers are optimized for microservices, while traditional apps aren't.

Container Challenges
% of all respondents

Challenge	Very much of a challenge	Somewhat of a challenge
Lack of internal resources with expertise	30%	45%
Ensuring security	29%	48%
Migrating traditional applications to containers	29%	45%
Ensuring compliance	26%	47%
Managing containerized environments	25%	47%
Tracking software licenses use in containers	22%	46%
Lack of service providers with expertise	21%	47%
Deciding on container platform	19%	46%
Optimizing costs of containers	16%	51%

N=750

Source: Flexera 2021 State of the Cloud Report

Figure 44. Top container-related challenges for all organizations

Adoption of cloud configuration tools is shifting

Cloud use often goes hand in hand with adopting DevOps processes. Organizations will frequently choose to implement configuration management tools that allow them to standardize and automate deployment and configuration of servers and applications.

As **Figure 45** shows, Terraform, used by 36 percent of respondents, leads among all configuration tools. Ansible is close behind with 31 percent. Chef and Puppet are in a virtual tie at 29 percent and 27 percent, respectively. (Note: Many organizations use more than one tool, so the individual percentages add up to more than 100 percent.)

Configuration Tools Used
% of all respondents

Tool	Currently use	Plan to use
Terraform	36%	22%
Ansible	31%	22%
Chef	29%	19%
Puppet	27%	19%
Salt	12%	24%

N=750

Source: Flexera 2021 State of the Cloud Report
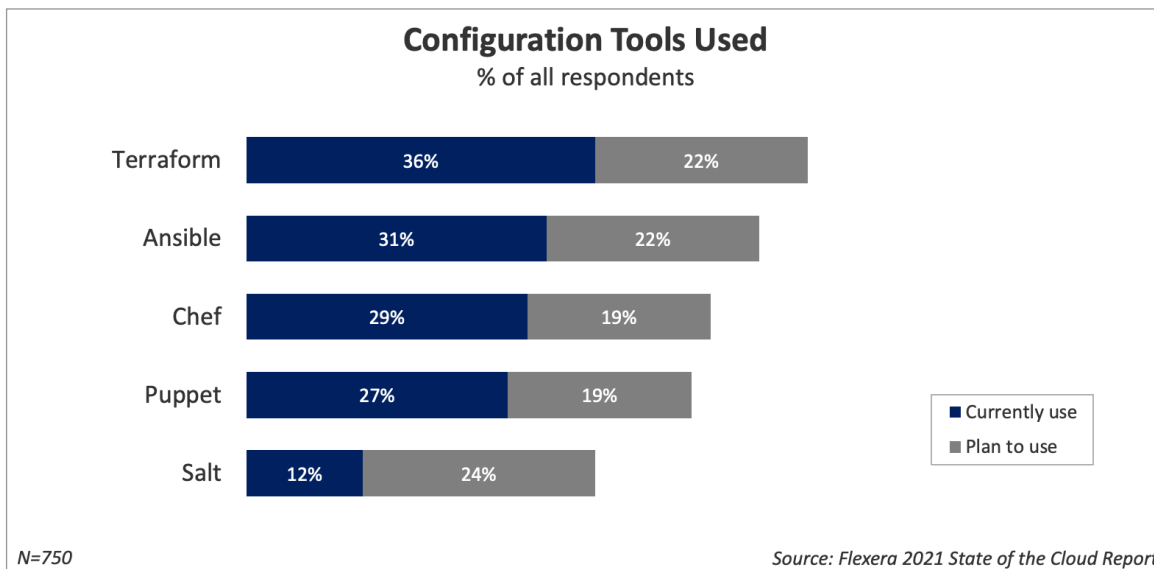
Figure 45. Current and planned configuration tools for all organizations

Figure 46 shows the configuration tools used by enterprises, and **Figure 47** indicates the tools used by SMBs. Overall, the use of configuration tools is higher among enterprises. Terraform leads for enterprises, with Ansible second at 33 percent and Chef third at 32 percent.

Configuration Tools Used by Enterprises
% of enterprise respondents

Tool	Currently use	Plan to use
Terraform	36%	26%
Ansible	33%	25%
Chef	32%	18%
Puppet	26%	22%
Salt	14%	25%

N=637

Source: Flexera 2021 State of the Cloud Report
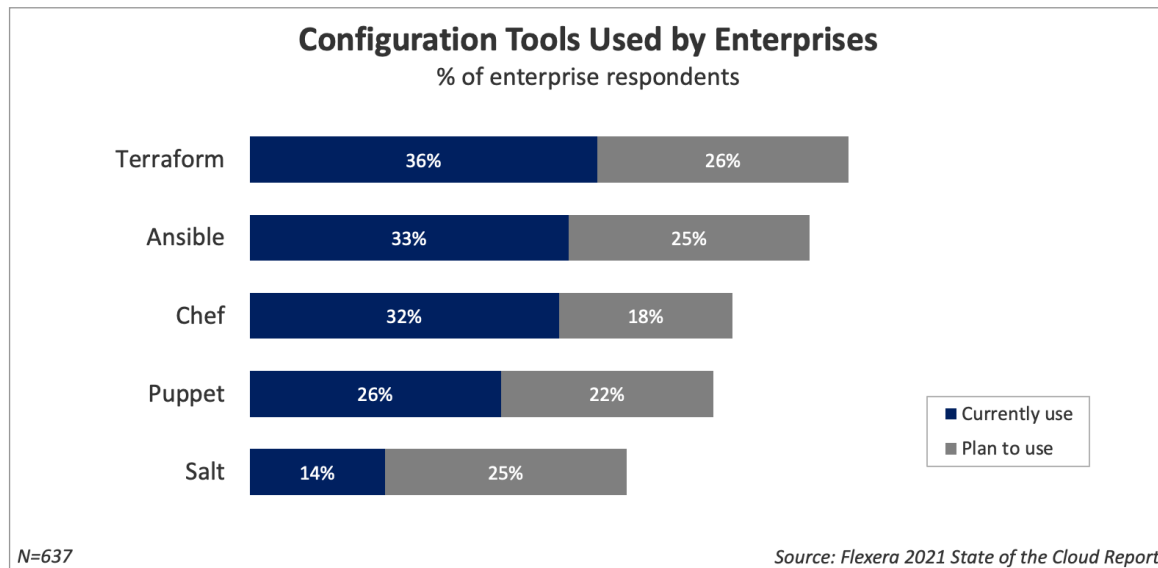
Figure 46. Enterprise container tool usage

Configuration Tools Used by SMBs
% of SMB respondents

Tool	Currently use	Plan to use
Terraform	39%	15%
Ansible	29%	15%
Chef	21%	19%
Puppet	18%	14%
Salt	10%	14%

N=113

Source: Flexera 2021 State of the Cloud Report
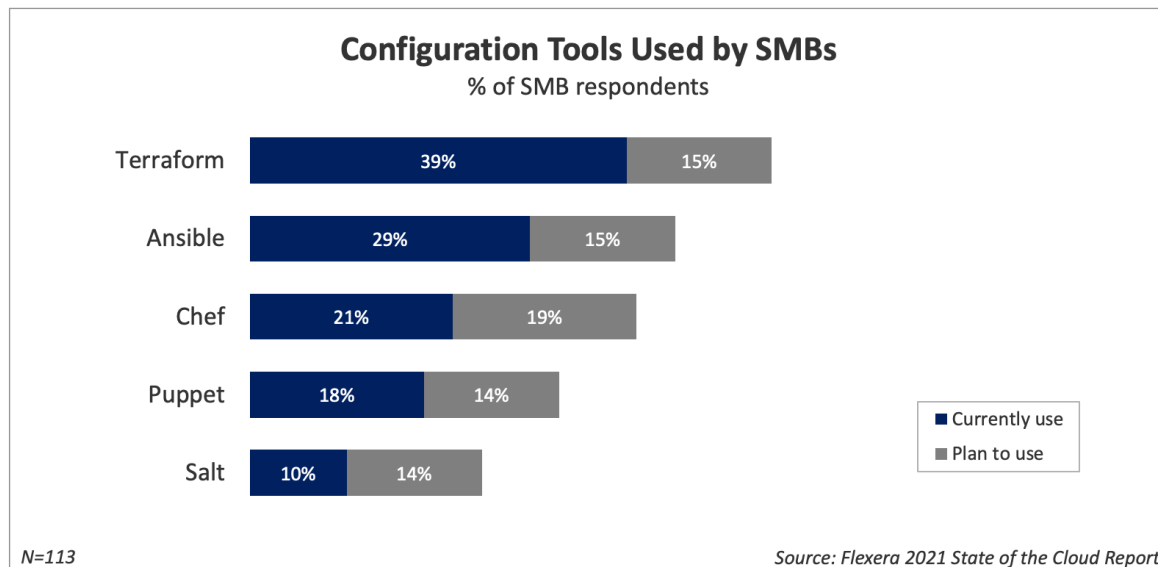
Figure 47. SMB container tool usage

Public cloud adoption is evolving

The survey delved into the private and public clouds that organizations are using. For each public cloud provider, respondents specified whether they're running applications in that cloud, experimenting with it, planning to use it or had no plans to use it. Most respondents are using more than one cloud, so individual percentages sometimes total more than 100 percent.

It's important to note that adoption—meaning an organization is using a cloud provider— is only one factor influencing revenue growth for the provider. The survey also explores other factors, including the number of VMs running and PaaS cloud services used. This year respondents were also asked about their level of cloud spend per cloud provider.

In 2021, as in previous years, AWS, Microsoft Azure and Google Cloud are the top three public cloud providers. **Figure 48** shows how the major providers stack up for adoption across all respondents in 2020. **Figure 49** compares the rankings for 2020 and 2021.

Public Cloud Adoption
% of all respondents

Provider	Running significant workloads	Running some workloads	Experimenting	Plan to use
AWS	50%	27%	10%	4%
Azure	41%	32%	12%	5%
Google Cloud	22%	25%	23%	9%
VMware Cloud on AWS	9%	15%	20%	10%
Oracle Infrastructure Cloud	10%	19%	15%	9%
IBM Public Cloud	8%	16%	19%	7%
Alibaba Cloud	3%	9%	13%	8%

N=750

Source: Flexera 2021 State of the Cloud Report
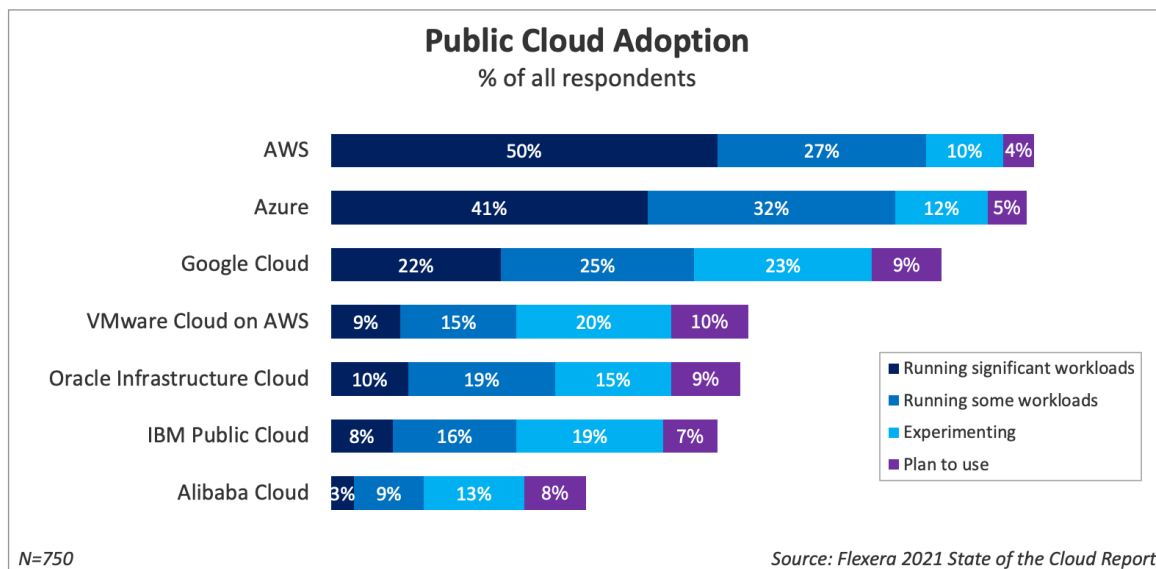
Figure 48. Public cloud provider adoption rates for current use/experimenting/planned for all organizations

Public Cloud Adoption YoY

% of all respondents

Provider	2021	2020
AWS	77%	76%
Azure	73%	63%
Google Cloud	47%	35%
VMware Cloud on AWS	24%	17%
Oracle Infrastructure Cloud	29%	17%
IBM Public Cloud	24%	13%
Alibaba Cloud	12%	7%

N=750

Source: Flexera 2021 State of the Cloud Report
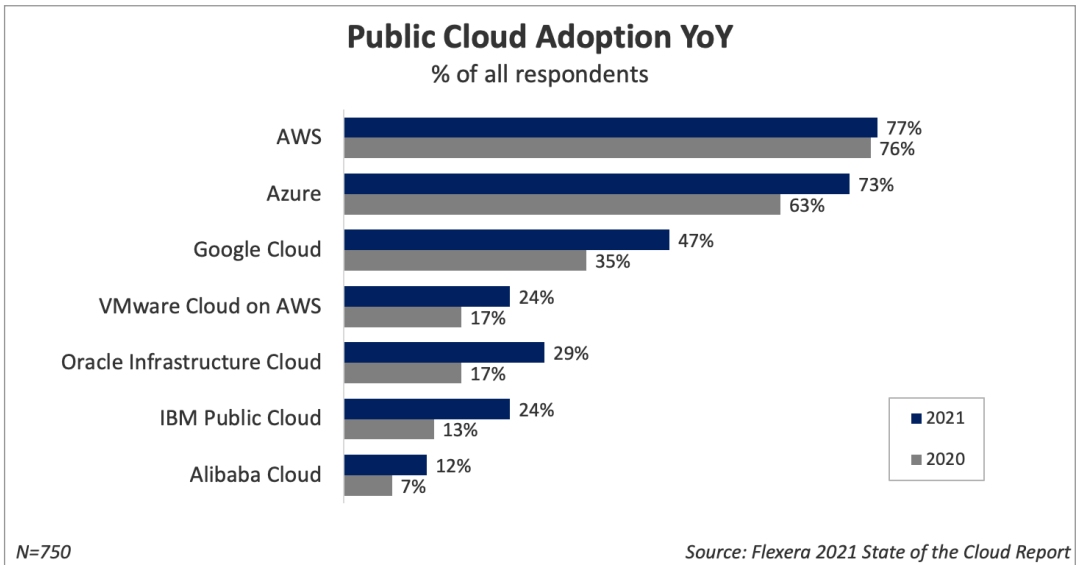
Figure 49. YoY public cloud provider adoption rates for all organizations

Major public cloud provider use shifting among enterprises

Among enterprises, Azure is tied with AWS for breadth of adoption, as **Figure 50** indicates. Google Cloud, Oracle and VMware Cloud on AWS round out the top five. Among the top three, Google (49 percent running workloads) exhibited the most growth over 2020. The highest percentages for experimentation are with VMware Cloud on AWS and Oracle, which could drive more adoption in future years.

Public Cloud Adoption for Enterprises

% of enterprise respondents

Provider	Running significant workloads	Running some workloads	Experimenting	Plan to use
AWS	50%	29%	9%	4%
Azure	44%	32%	11%	5%
Google Cloud	23%	26%	23%	8%
Oracle Infrastructure Cloud	11%	21%	16%	9%
VMware Cloud on AWS	10%	17%	21%	10%
IBM Public Cloud	9%	16%	21%	7%
Alibaba Cloud	3%	10%	15%	8%

N=637

Source: Flexera 2021 State of the Cloud Report

Figure 50. Enterprise public cloud adoption rates for current use/experimenting/planned

Figure 51 shows that AWS and Azure adoption rates rose somewhat among enterprises over the previous year. Azure is now at 96 percent of AWS adoption among enterprises. Google adoption rates rose by 44 percent.

Public Cloud Adoption for Enterprises YoY
% of enterprise respondents

	2021	2020
AWS	79%	76%
Azure	76%	69%
Google Cloud	49%	34%
Oracle Infrastructure Cloud	32%	20%
VMware Cloud on AWS	27%	19%
IBM Public Cloud	25%	15%
Alibaba Cloud	13%	7%

N=637

Source: Flexera 2021 State of the Cloud Report
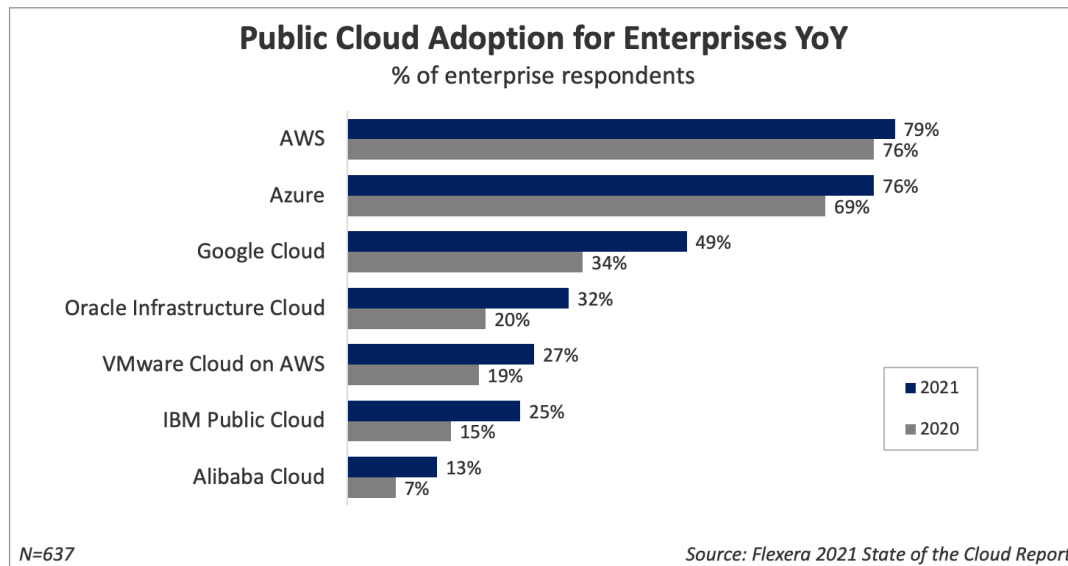
Figure 51. YoY enterprise adoption rates

Choice of public cloud provider changing for SMBs

Among SMBs, AWS continues to show a clear lead. As **Figure 52** indicates, vendors that have traditionally appealed to enterprises (VMware, IBM and Oracle) have 10 percent or less penetration in this market in terms of planning to use. Alibaba Cloud is used widely in China, but much less so globally. Thirty-six percent of SMBs are experimenting with Azure and 19 percent are trying Google.

Public Cloud Adoption for SMBs
% of SMB respondents

	Running significant workloads	Running some workloads	Experimenting	Plan to use
AWS	53%	19%	12%	4%
Azure	22%	36%	14%	6%
Google Cloud	20%	19%	21%	10%
VMware Cloud on AWS	3%	8%	10%	12%
IBM Public Cloud	4%	16%	9%	6%
Oracle Infrastructure Cloud	6%	9%	10%	9%
Alibaba Cloud	3%	4%	7%	6%

N=113   *Source: Flexera 2021 State of the Cloud Report*
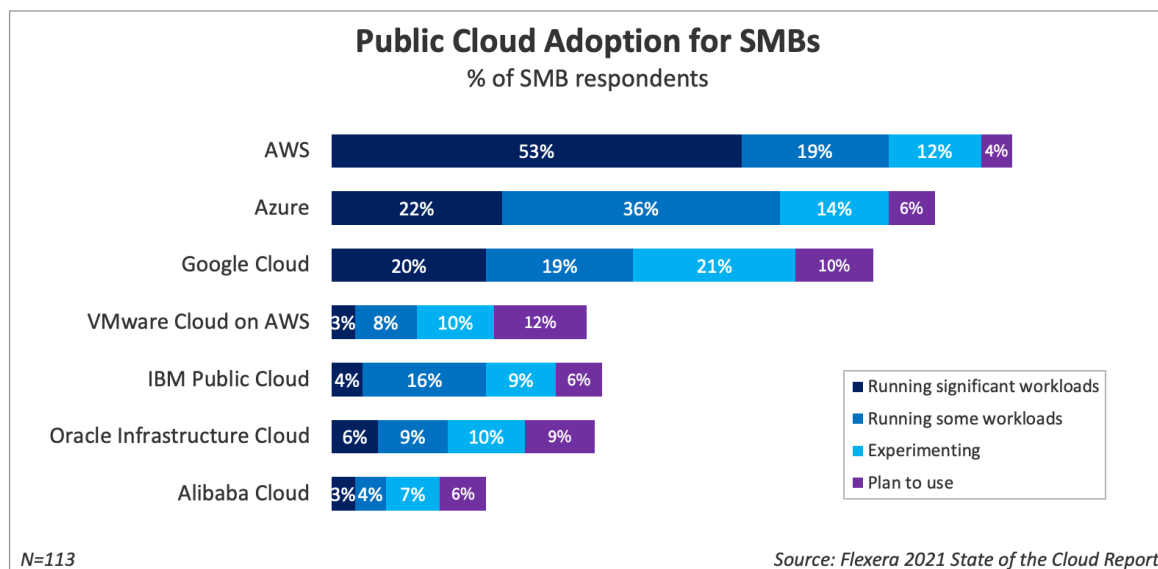
Figure 52. SMB public cloud adoption rates for current use/experimenting/planned

SMB respondents with future projects—indicated by the combination of the clouds they're experimenting with and planning to use—demonstrated the most interest in Google Cloud (31 percent), followed closely by VMware Cloud on AWS (22 percent) and Azure (20 percent).

SMB adoption rates for both Azure and Google Cloud are increasing faster than the rates for AWS, as **Figure 53** indicates. Adoption of VMware Cloud on AWS, IBM Public Cloud, Oracle Infrastructure Cloud and Alibaba Cloud rose year over year. However, only a small percentage of SMBs still chose each one.

Public Cloud Adoption for SMBs YoY
% of SMB respondents

Provider	2021	2020
AWS	72%	74%
Azure	48%	46%
Google Cloud	39%	37%
VMware Cloud on AWS	11%	10%
IBM Public Cloud	20%	8%
Oracle Infrastructure Cloud	15%	6%
Alibaba Cloud	7%	5%

N=113

Source: Flexera 2021 State of the Cloud Report
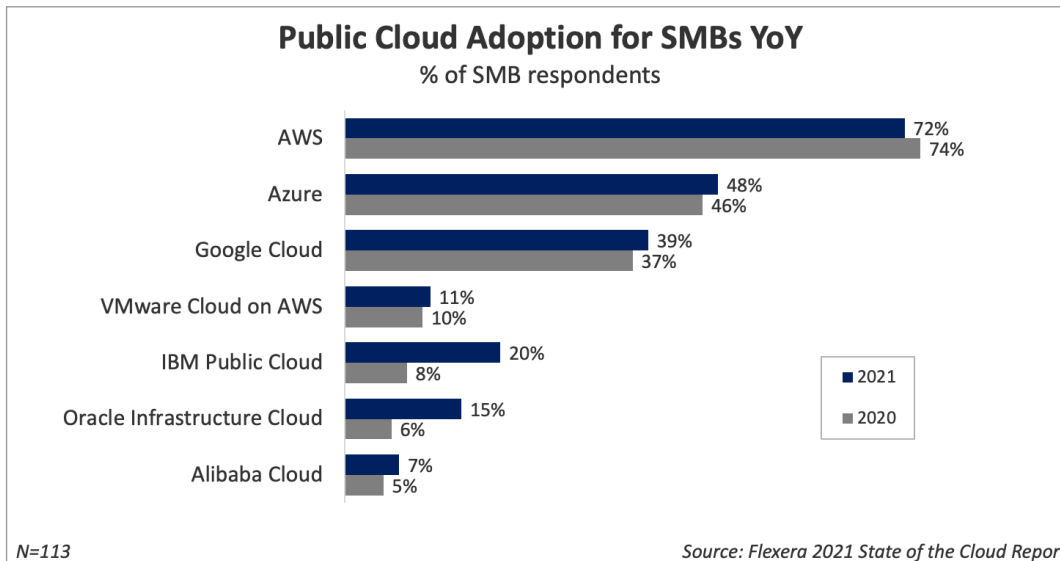
Figure 53. YoY SMB adoption rates

Maturity affects public cloud provider choice

Cloud maturity correlates to the length of time an organization has been using the cloud. That correlation is due to the time it takes to build cloud expertise and create processes and best practices across the organization. **Figure 54** indicates public cloud provider adoption based on the organization's cloud maturity level.

As the first large-scale cloud provider, AWS is used more frequently by organizations that have been using the cloud over a longer period—those at the advanced cloud maturity level. Across all respondents, 82 percent of advanced organizations use AWS compared with 74 percent using Azure. In the intermediate cloud maturity category, Azure has a slight lead.

Azure enjoys higher adoption for cloud beginners for the second time, holding a sizable lead over AWS and Google Cloud.

Google remains in third place at all three maturity levels. But its popularity is significantly higher, at 50 percent, within advanced maturity organizations.

Source: Flexera 2021 State of the Cloud Report
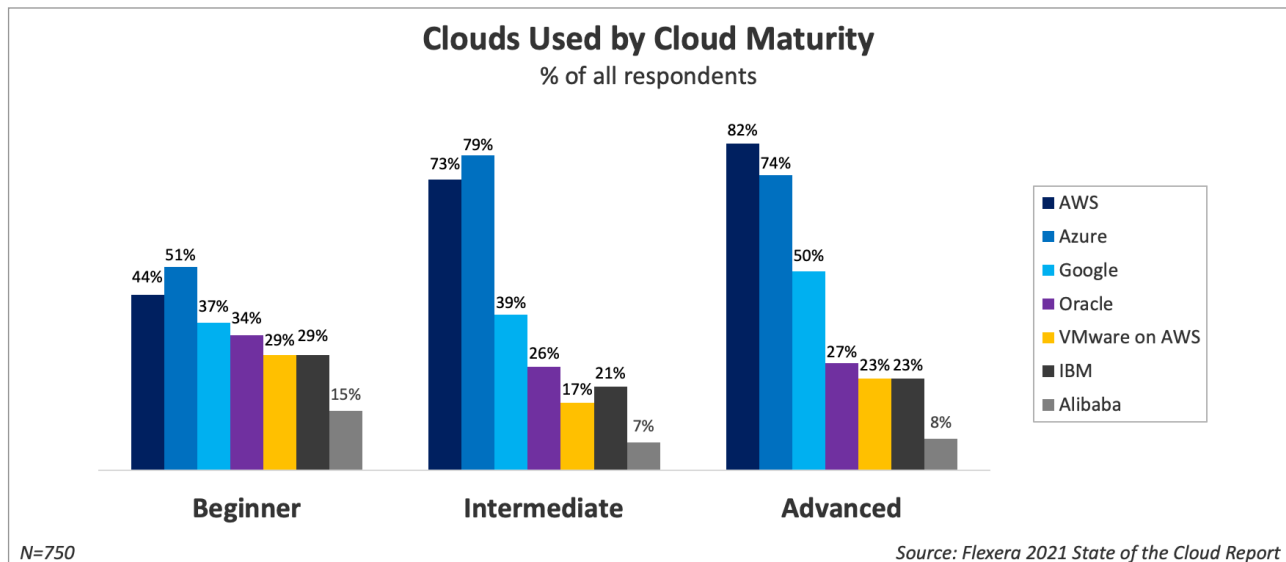
Figure 54. Public cloud provider adoption based on cloud maturity level for all organizations

Enterprises are growing their public cloud footprint

Cloud-first policies and cloud migration are top of mind for senior IT leaders, particularly in enterprise environments. As a result, enterprises are rapidly increasing public cloud spend and workload volumes.

Cloud spend is a good indicator of how much an enterprise is using a public cloud provider. As **Figure 55** indicates, 53 percent of enterprises spend $1.2 million or more annually on AWS. By comparison, 48 percent spend $1.2 million or more annually on Azure, indicating Azure's footprint is approaching that of AWS. Thirty-two percent of enterprises reported spending $1.2 million or more annually on Google.

Annual Enterprise Spend on Top 3 Clouds
% of enterprise respondents

	More than $12M	$2.4M to $12M	$1.2M to $2.4M	$600K to $1.2M	Up to $600K
AWS	16%	22%	15%	15%	15%
Azure	14%	20%	14%	18%	18%
Google Cloud	8%	13%	11%	12%	22%

N=637

Source: Flexera 2021 State of the Cloud Report
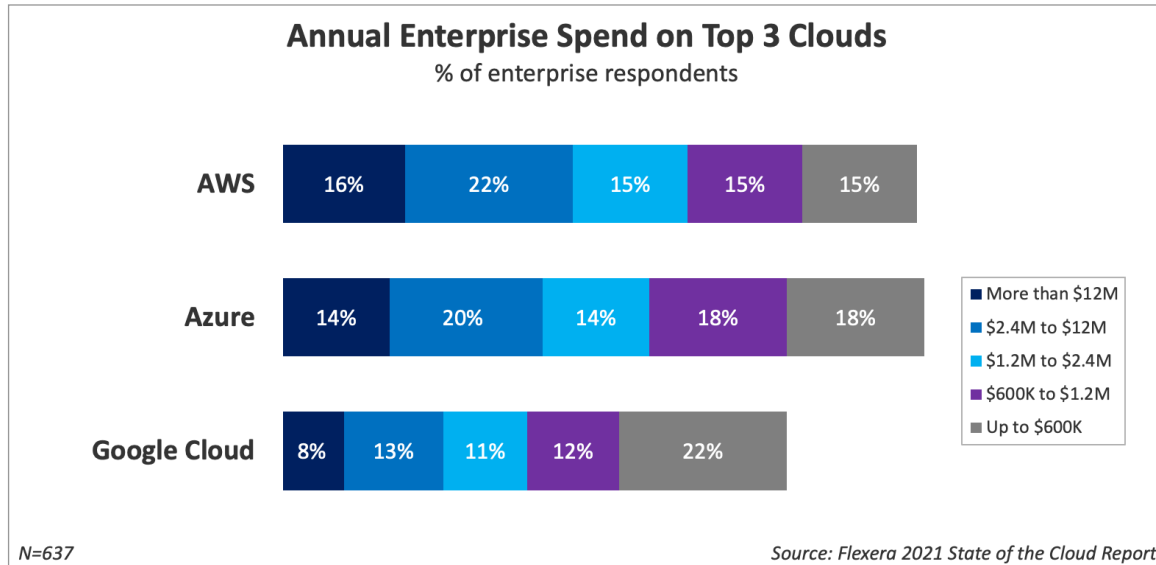
Figure 55. Enterprise spend for top three cloud providers

The number of VMs or instances currently running in each cloud provides additional insight into the size of organizations' footprints within each cloud. For example, **Figure 56** indicates that Azure is now close to AWS among the larger footprint sizes. Fourteen percent of respondents run more than 1,000 VMs in AWS compared to 12 percent in Azure.

Number of VMs by Cloud for Enterprises
% of enterprise respondents

Cloud	More than 1,000	501 to 1,000	101 to 500	51 to 100	1 to 50
AWS	14%	17%	19%	17%	21%
Azure	12%	11%	20%	20%	22%
Google Cloud	5%	5%	11%	15%	25%
Oracle Infrastructure Cloud	3%	5%	11%		20%
VMware Cloud on AWS	4%	7%	11%		19%
IBM Public Cloud	3%	5%	9%		14%
Alibaba Cloud	3%	4%	7%		

N=637
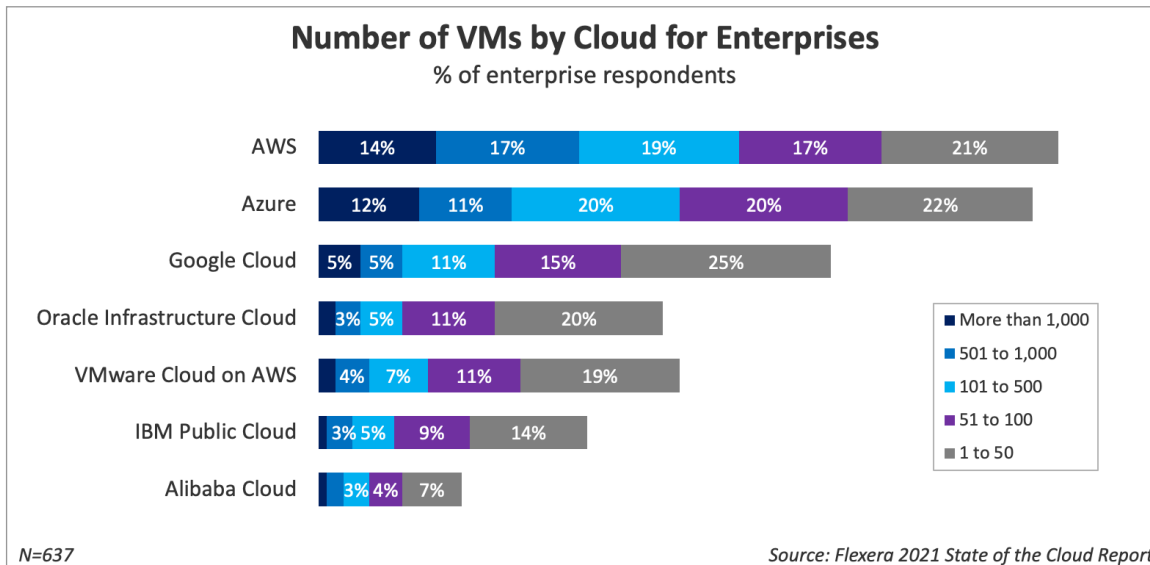
Figure 56. Number of VMs enterprises use by cloud provider

Use of public cloud PaaS services is increasing

The number of public cloud users leveraging services beyond basic compute, storage and network services continues to grow.

Most heavily used PaaS services have shifted

Organizations are increasingly leveraging the many PaaS services offered by cloud providers. **Figure 57** ranks the services that organizations are currently using, experimenting with or plan to use. The top three are *data warehouse, relational database as a service (DBaaS)* and *container-as-a-service*. Organizations are driving this shift due to their growing interest in leveraging containers to speed deployment, scale operations and increase the efficiency of workloads running in the cloud.

A look at the respondents experimenting with or planning to use a PaaS service sheds light on their strategies. Almost half are experimenting with or plan to use *machine learning/AI* (46 percent), *disaster-recovery-as-a-service (DRaaS)* (45 percent), *edge services* (43 percent), *IoT* (41 percent) and *stream processing* (42 percent).

Public Cloud Services Used
% of all respondents

Service	Currently use	Experimenting	Plan to use
Data warehouse	54%	18%	15%
DBaaS (Relational)	50%	24%	13%
Container-as-a-service	49%	24%	15%
DBaaS (NoSQL)	47%	22%	13%
Push notifications	45%	20%	15%
Serverless	44%	23%	16%
Search	43%	20%	15%
Caching	43%	21%	17%
Batch processing	42%	22%	15%
Mobile services	41%	24%	16%
Queueing	40%	23%	15%
Machine learning/AI	39%	27%	19%
Stream processing	36%	24%	18%
Hadoop	32%	24%	14%
Edge services	31%	26%	17%
IoT	30%	26%	15%
DRaaS	24%	25%	20%

N=750

Source: Flexera 2021 State of the Cloud Report

Figure 57. Public cloud services organizations are using, experimenting with or plan to use

Enterprises use more PaaS services

Enterprises use more PaaS services overall than SMBs. **Figure 58** lists the rankings for enterprise respondents. These respondents place *relational database as a service (DBaaS)*, *container-as-a-service* and *data warehouse* in the top three. While the current use of *disaster recovery-as-a-service (DRaaS)* is lower on the list, it has the highest percentage of respondents experimenting or planning to use the service. *Machine learning/AI* has the highest level of experimenting.

Public Cloud Services Used for Enterprises
% of enterprise respondents

Service	Currently use	Experimenting	Plan to use
Data warehouse	55%	19%	14%
DBaaS (Relational)	50%	26%	13%
Container-as-a-service	50%	22%	16%
DBaaS (NoSQL)	49%	22%	13%
Push notifications	45%	21%	16%
Serverless	44%	23%	17%
Search	44%	21%	16%
Caching	43%	21%	19%
Mobile services	43%	25%	16%
Machine learning/AI	42%	28%	17%
Batch processing	41%	22%	15%
Queueing	40%	24%	16%
Stream processing	37%	24%	18%
Hadoop	35%	25%	14%
Edge services	33%	27%	17%
IoT	32%	27%	15%
DRaaS	25%	26%	21%

N=637

Source: Flexera 2021 State of the Cloud Report

Figure 58. Public cloud services enterprises are using or plan to use

PaaS services use increases with maturity

Organizations increase their use of PaaS services as they mature, as **Figure 59** indicates. For example, advanced organizations use *DBaaS (relational), container-as-a-service* and *data warehouse* significantly more than cloud beginners.

Services Used by Cloud Maturity
% of all respondents

Legend:
- DBaaS (Relational)
- Container-as-a-service
- Data warehouse
- DBaaS (NoSQL)
- Serverless
- IoT

Beginner: 28%, 35%, 47%, 20%, 24%, 24%
Intermediate: 41%, 45%, 45%, 42%, 36%, 20%
Advanced: 60%, 56%, 61%, 54%, 51%, 37%

N=750

Source: Flexera 2021 State of the Cloud Report
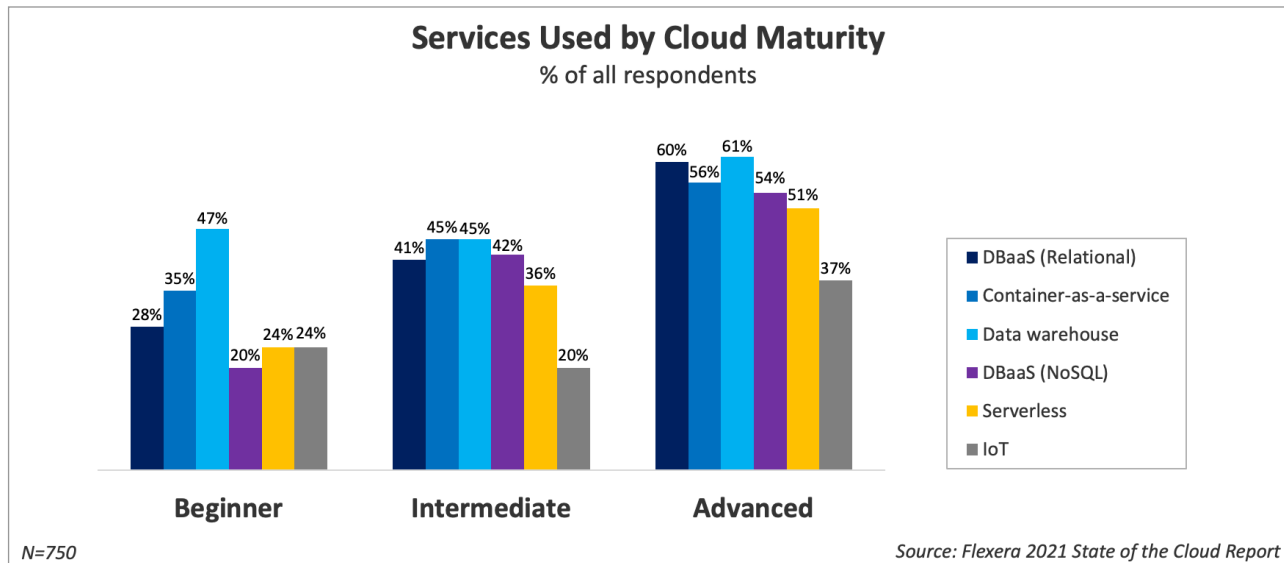
Figure 59. Services used based on cloud maturity for all organizations

Private cloud plays important role

Most organizations are taking a multi-cloud, hybrid approach in which private cloud plays an important role. As mentioned earlier in this report, about 80 percent of survey respondents are running at least one private cloud (see **Figure 10**).

As in previous years, respondents reported on the technologies their organizations are using to run private clouds. **Figure 60** lists the technologies organizations are currently using, experimenting with or planning to use. Respondents could choose more than one, as there can be overlap with some of these technologies.

Private Cloud Adoption
% of all respondents

Technology	Currently use	Experimenting	Plan to use
VMware vSphere	36%	18%	13%
Microsoft Azure Stack	35%	20%	11%
OpenStack	28%	26%	11%
AWS Outpost	28%	21%	15%
VMware vCloud Director	23%	21%	13%
Red Hat OpenShift	20%	20%	12%
Google Anthos	20%	20%	15%
Bare-metal Cloud	19%	17%	13%
Pivotal CloudFoundry	15%	19%	15%
CloudStack	12%	20%	13%

N=750

Source: Flexera 2021 State of the Cloud Report

Figure 60. Private cloud technologies organizations are using, experimenting with or plan to use

SMBs use private clouds less than enterprises

Figure 61 shows the ranking of the private cloud technologies enterprise respondents are currently using, experimenting with or plan to use.

Private Cloud Adoption for Enterprises
% of enterprise respondents

	Currently use	Experimenting	Plan to use
VMware vSphere	38%	19%	13%
Microsoft Azure Stack	36%	21%	12%
OpenStack	31%	27%	12%
AWS Outpost	30%	23%	15%
VMware vCloud Director	25%	23%	14%
Red Hat OpenShift	23%	22%	13%
Bare-metal Cloud	21%	18%	14%
Google Anthos	21%	22%	16%
Pivotal CloudFoundry	18%	20%	16%
CloudStack	14%	22%	14%

N=637

Source: Flexera 2021 State of the Cloud Report

Figure 61. Private cloud providers enterprises are currently using, experimenting with or planning to use

Private cloud adoption by SMBs is lower overall than for enterprises. **Figure 62** shows SMB rankings for the technologies they're currently using, experimenting with or plan to use. Microsoft Azure Stack is the top choice, with 27 percent of SMB respondents currently using it. VMware vSphere is in second place, cited by 20 percent of SMB respondents.

Private Cloud Adoption for SMBs
% of SMB respondents

	Currently use	Experimenting	Plan to use
Microsoft Azure Stack	27%	17%	6%
VMware vSphere	20%	13%	12%
AWS Outpost	16%	14%	13%
OpenStack	13%	23%	6%
Bare-metal Cloud	13%	12%	9%
VMware vCloud Director	12%	15%	8%
Google Anthos	12%	11%	13%
Red Hat OpenShift	7%	12%	9%
CloudStack	6%	12%	9%
Pivotal CloudFoundry		14%	10%

N=113

Source: Flexera 2021 State of the Cloud Report

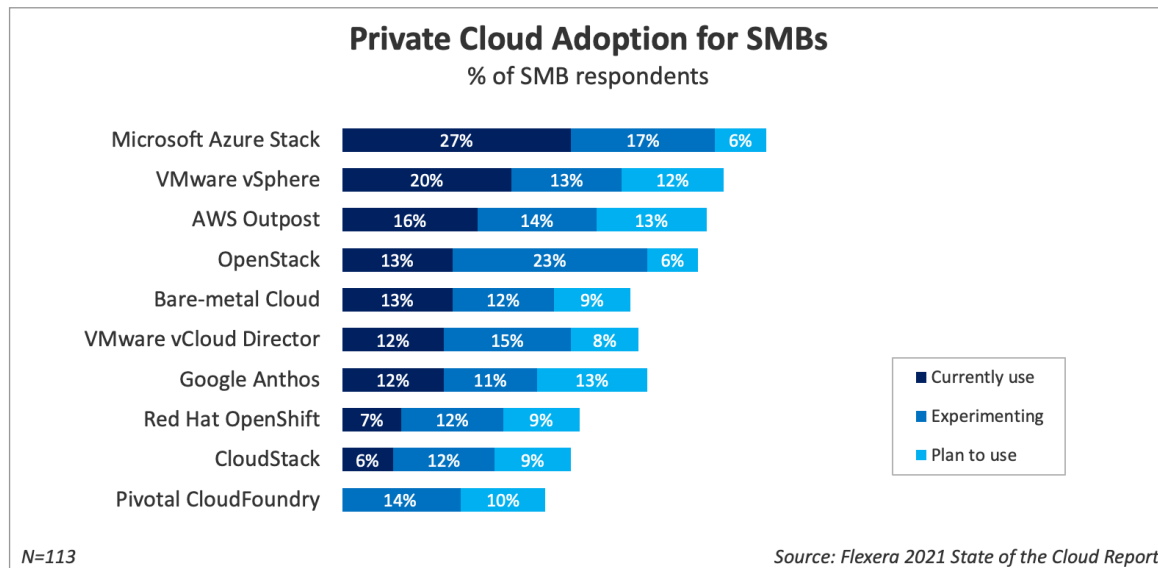*Figure 62. Private cloud providers SMBs are currently using, experimenting with or planning to use*

Summary

The *2021 Flexera State of the Cloud Report* reveals that COVID-19 had a significant impact on cloud adoption in 2020. Multi-cloud continues to be the dominant strategy, adopted by nearly all surveyed enterprises. The most common multi-cloud approach among enterprises is a mix of multiple public and multiple private clouds. The report also indicates that organizations are becoming increasingly comfortable with putting even sensitive data in the cloud.

Due to its complexity and dynamic nature, the multi-cloud environment brings many challenges, such as assessing the suitability of on-premises apps for migrating to the cloud.

The use of public clouds continues to grow dramatically in all organizations. This growth has driven a significant increase in public cloud spend, and the COVID-19 outbreak may have driven that spend even higher. As a result of continually increasing cloud spend, optimizing the existing use of cloud (cost savings) continues to be the top cloud initiative for all organizations for the fifth year in a row. Organizations are leveraging automated policies to continually scan and optimize their cloud costs.

The quest to reduce cost and the increasing adoption of DevOps are driving up the use of containers. Docker and Kubernetes use remains strong, and many users are also adopting container-as-a-service offerings from AWS, Azure and Google.

The growing migration to the cloud continues to affect organizational structure. Organizations are increasingly establishing central cloud teams and centers of excellence to best leverage in-house expertise, especially in managing and optimizing cloud costs.

Organizations are moving to the cloud because of its scalability, economy and reach, and are using a variety of metrics to measure the resulting business value of cloud. The many advantages delivered by the cloud have proven to be especially valuable as organizations adapted over the past year to meet the rapidly evolving needs presented by the COVID-19 pandemic's impact on business.

FLEXERA™ 2021 STATE OF THE CLOUD REPORT: Europe Spotlight

Despite a few differences, European organizations face similar challenges and cite the same tech initiative priorities as their global counterparts.

Europe spotlight: introduction

The 155 European participants in the *Flexera 2021 State of the Cloud Report* survey represent about one-fifth of the total survey audience. They're executives and high-level managers in IT with significant knowledge of their organizations' overall IT budgets. This Europe spotlight provides insight into their perspectives on the technology and spend issues they face as they develop tech strategies and make technology choices. It includes comparisons between European organizations and their counterparts in other parts of the world.

Europe spotlight: highlights

- European companies are moving toward the cloud significantly more aggressively due to COVID-19 than companies in the Americas. Eighty-nine percent of European respondents have increased cloud usage due to COVID-19 compared to 61 percent of respondents from the Americas

- European respondents of the *Flexera 2021 State of the Cloud Report* survey were slightly more advanced in their cloud maturity than respondents from the Americas. Sixty-two percent of European respondents were advanced, compared to 58 percent of those from Americas

- Top cloud migration challenges for European respondents are assessing technical feasibility (52 percent), understanding app dependencies (49 percent) and rightsizing/selecting best instance (41 percent)

- Top challenges of software in the cloud for European respondents were understanding cost implications of software licenses (57 percent), ensuring we don't use too many licenses (49 percent) and complexity of license rules in public cloud (46 percent)

- Top European cloud initiatives are migrating more workloads to the cloud (70 percent), optimizing existing use of cloud (cost savings) (59 percent) and progressing on a cloud-first strategy (50 percent)

- Ninety-five percent of European respondents use multi-cloud

European respondent demographics

As **Figure 63** shows, 56 percent of European participants work in organizations with 5,000 or more employees, compared with 50 percent globally. Representation by European organizations with 1,001 to 5,000 employees is 28 percent, compared to 35 percent globally.

European Respondents by Organization Size

N=155

Source: Flexera 2021 State of the Cloud Report
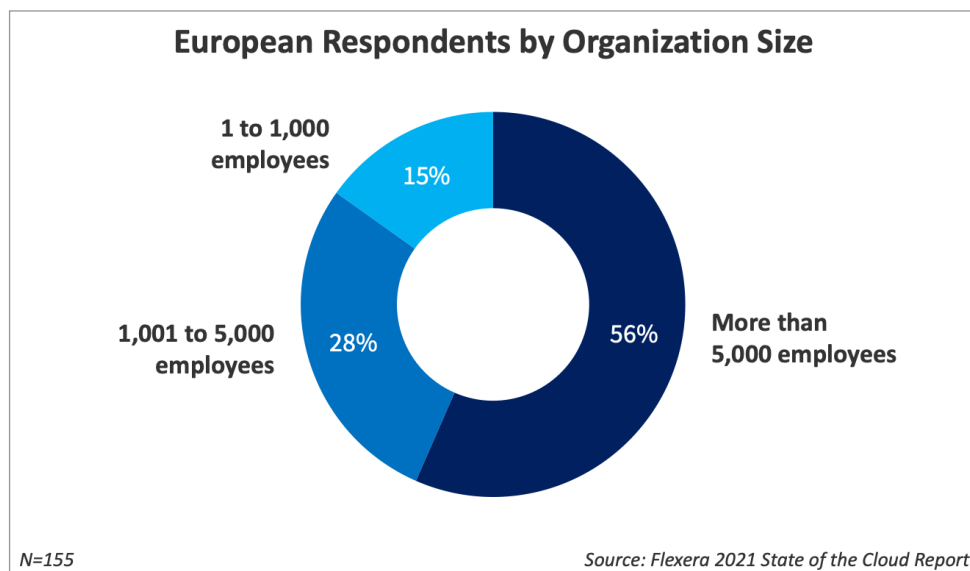
Figure 63. European respondents by organization size

Figure 64 summarizes participation by industry. While the survey encompasses a cross section of industries, three have double-digit representation: financial services, technology services and software. The *Other* category represents a variety of industries, with each representing less than three percent of respondents.

European Respondents by Industry

- Other 19%
- Tech services 19%
- Financial services 19%
- Software 15%
- Retail and ecommerce 8%
- Industrial products 5%
- Telecom 4%
- Education/Government 4%
- Healthcare 4%

N=155

Source: Flexera 2021 State of the Cloud Report
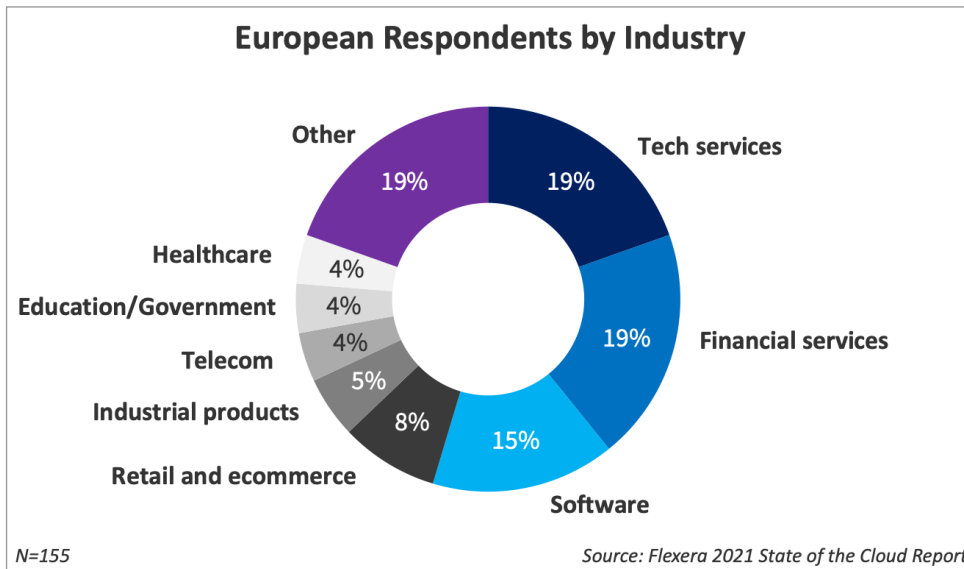
Figure 64. European respondents by industry

Figure 65 summarizes European respondents by region. More than half (51 percent) are from the UK, 17 percent are from Germany and 13 percent are from France.

Respondents by Region

N=155
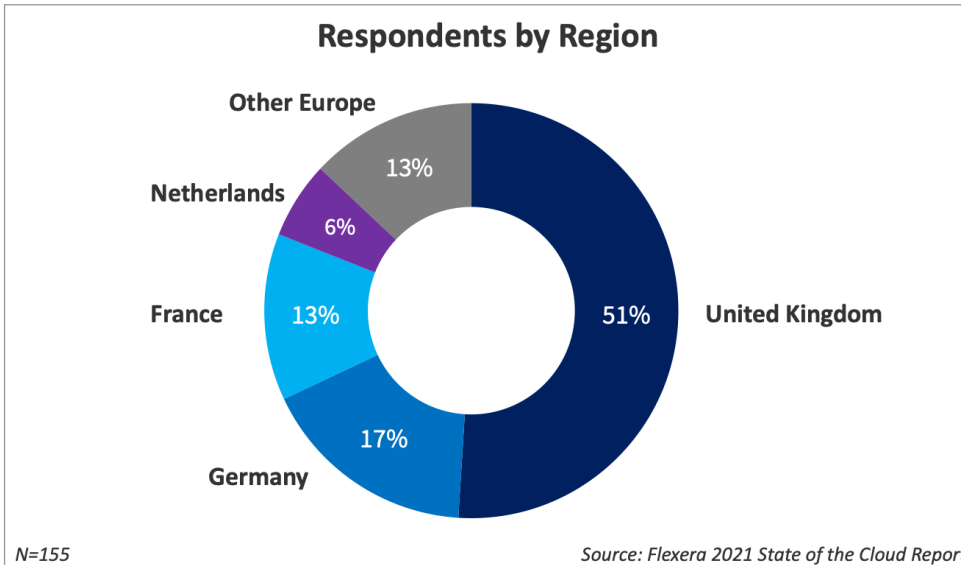
Figure 65. European respondents by region

Figure 66 indicates the breakdown of European respondents by level within the organization and by business role.

European Respondents by Level

N=155

European Respondents by Role
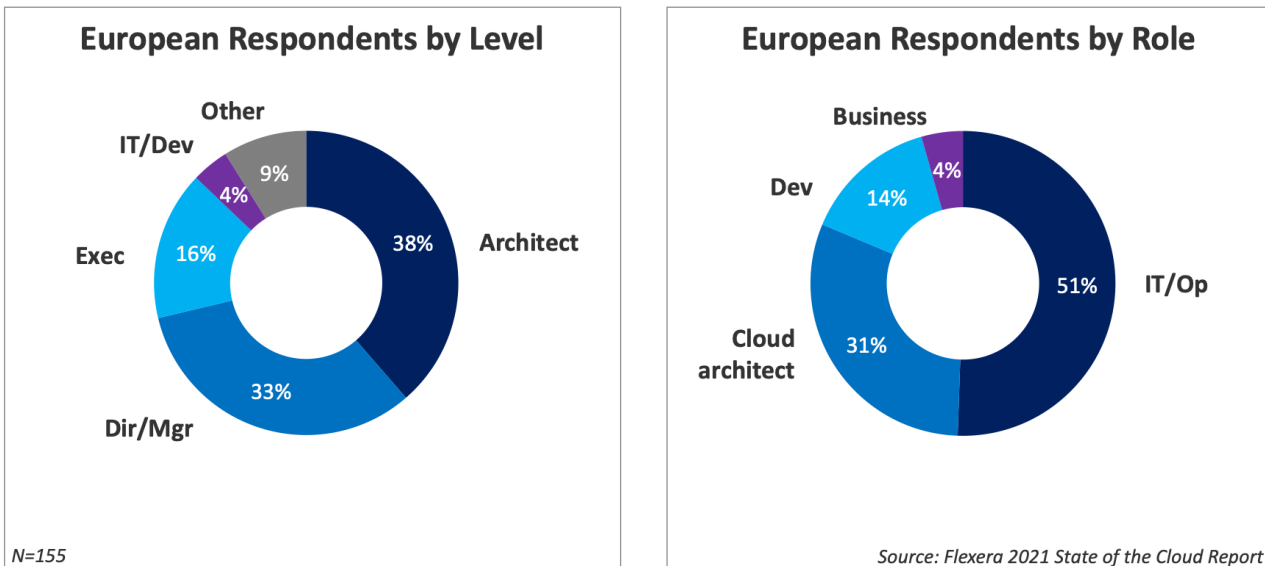
Figure 66. European respondents by level and by role

Cloud has now become mainstream. As **Figure 67** shows, more than half (62 percent) of European respondents use cloud heavily and have reached the advanced cloud maturity level, compared to 59 percent globally; four percent are beginners. **Figure 68** provides a comparison of organizational cloud maturity in Europe and in America.

Cloud Maturity of Respondents
% of all European respondents

Beginner	Intermediate	Advanced
17%	22%	62%
Beginner First projects	**Intermediate** Apps running	**Advanced** Heavy use

N=155

Source: Flexera 2021 State of the Cloud Report
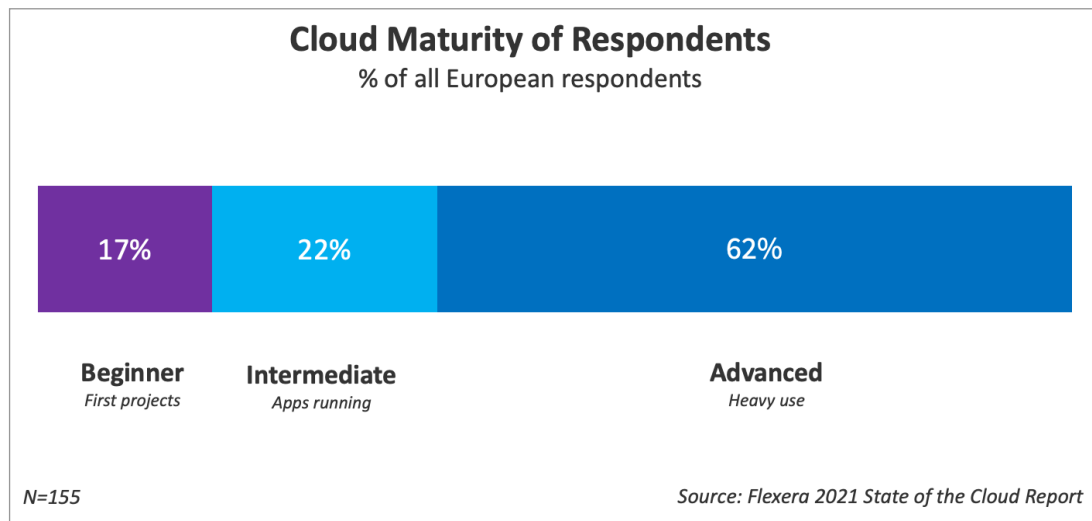
Figure 67. European respondents by cloud maturity level

Cloud Maturity of Respondents
% of all respondents

	Beginner	Intermediate	Advanced
AMERICAS	26%	15%	58%
EUROPE	17%	22%	62%
	Beginner First projects	**Intermediate** Apps running	**Advanced** Heavy use

N=155

Source: Flexera 2021 State of the Cloud Report
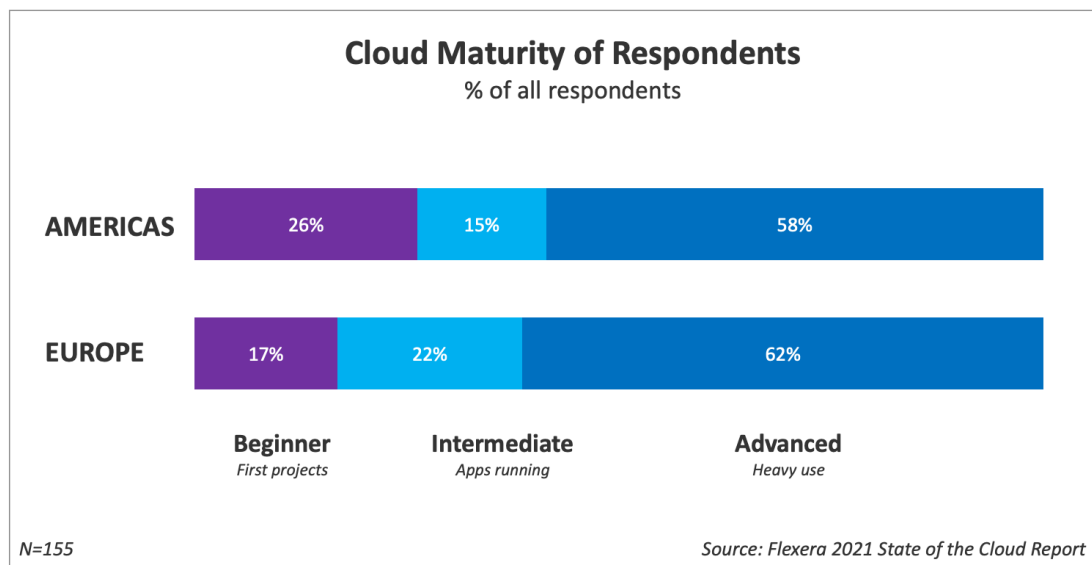
Figure 68. European respondents compared to Americas respondents by maturity level

European cloud usage accelerates faster due to COVID-19

As **Figure 69** shows, slightly higher than normal cloud usage in Europe due to COVID-19 is more prevalent (by 24 percentage points) than it is in the Americas; the highest level of acceleration in Europe is four percentage points higher than in the Americas.

Change from Planned Cloud Usage Due to COVID-19
% of respondents

	Slightly lower than planned	Significantly lower than planned	Slightly higher than planned	Significantly higher than planned
Total America	1%	5%	42%	17%
Total Europe	1%	6%	44%	18%

- Slightly lower than planned
- Significantly lower than planned
- Slightly higher than planned
- Significantly higher than planned

N=750   Source: Flexera 2021 State of the Cloud Report

Figure 69. Accelerating cloud plans in Europe due to COVID-19

Seven in ten European respondents have cloud teams or centers of excellence

European organizations allocate a lower percentage of revenue to IT spend than their counterparts worldwide. In addition, as **Figure 70** indicates, 70 percent of European organizations have a central cloud team or a cloud center of excellence (CoE), compared to 75 percent globally.

Central Cloud Team
% of all European respondents

No plans — 10%
Have cloud CoE — 31%
Planning one — 20%
Have central cloud team — 39%

N=155
Source: Flexera 2021 State of the Cloud Report

Figure 70. Adoption of central cloud team/CoE for European organizations

Assessing technical feasibility is top cloud migration challenge

Without the best tools, assessing technical feasibility of migrating on-premises apps is difficult. More than half (52 percent) of respondents reported *assessing technical feasibility* as the top cloud migration challenge in Europe, as **Figure 71** indicates.
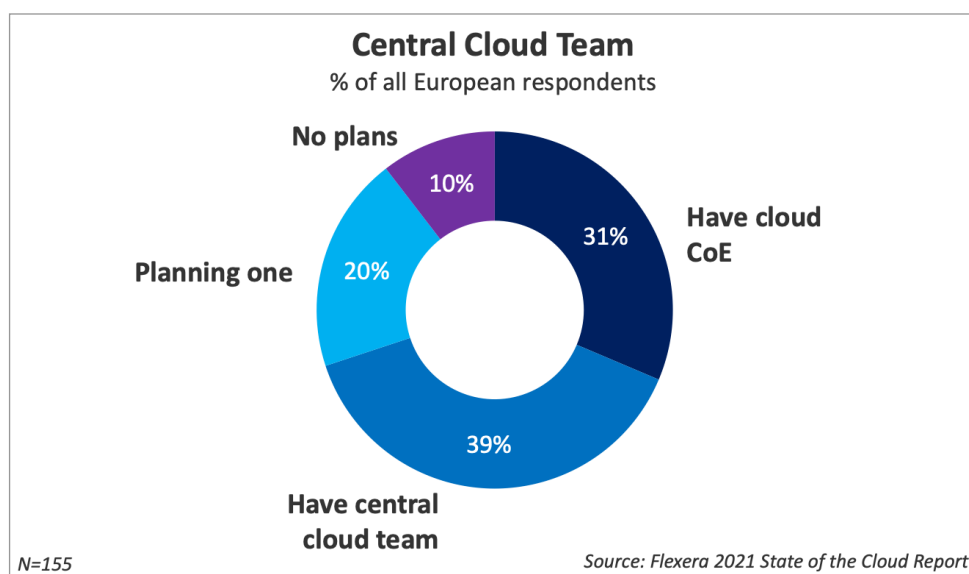
Other critical challenges include *understanding app dependencies, rightsizing/selecting the best instance* and *prioritizing apps to migrate.*

Cloud Migration Challenges
% of European respondents

Challenge	%
Assessing technical feasibility	52%
Understanding app dependencies	49%
Rightsizing/selecting best instance	41%
Prioritizing apps to migrate	39%
Migrating the app and data	39%
Selecting the right cloud provider	39%
Optimizing costs post-migration	38%
Assessing on-prem vs. cloud costs	35%
Knowing implications of BYOL	35%
Managing the app post-migration	27%

N=155

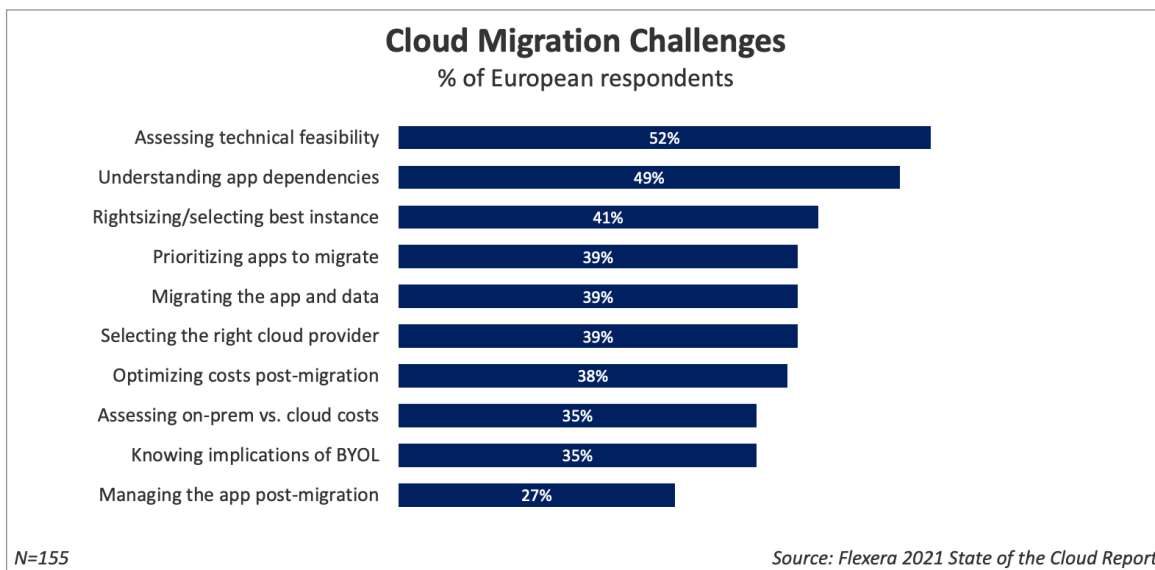Source: Flexera 2021 State of the Cloud Report

Figure 71. Cloud migration challenges for European organizations

Managing software costs is challenging in the cloud

As **Figure 72** shows, the top software-related challenge in the cloud is *understanding the cost implications of software licenses*. As stated earlier, software asset management and vendor management teams have considerable expertise in these areas; organizations would be well advised to leverage their skills to address software challenges in the cloud.

Top Challenges of Software in the Cloud
% of all European respondents

Challenge	%
Understanding cost implications of software licenses	57%
Ensuring we don't use too many licenses	49%
Complexity of license rules in public cloud	46%
Ensuring we follow license rules	45%
Knowing when licenses are no longer used in cloud	40%
Discovering what software is used in cloud	31%

N=155

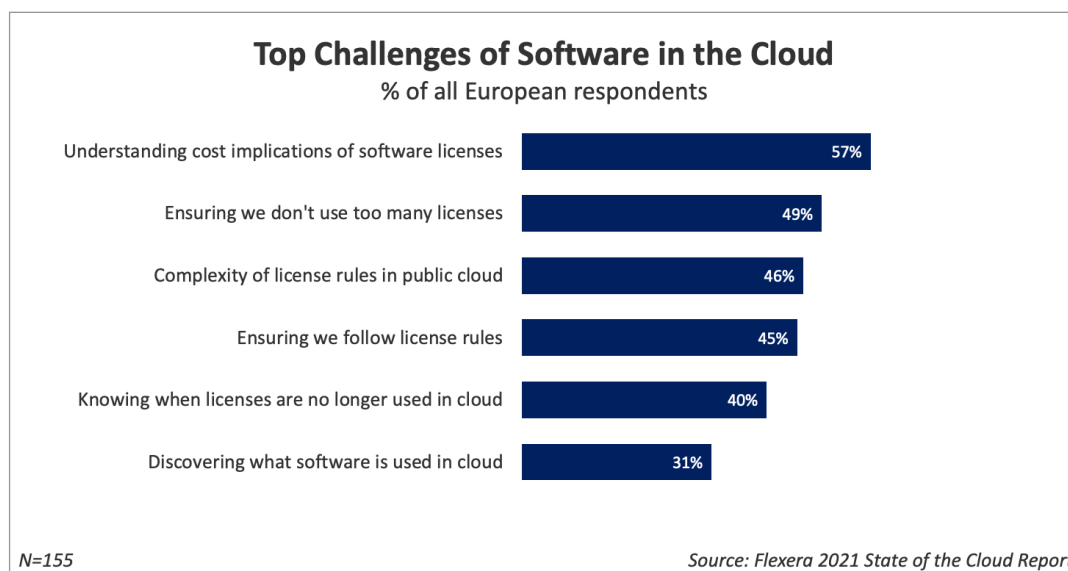*Source: Flexera 2021 State of the Cloud Report*

Figure 72. Top software challenges for European organizations

Migrating to cloud is top initiative

Migrating more workloads to cloud is the top European cloud initiative for 2021 (see **Figure 73**), followed by *optimize existing use of cloud (cost savings)* and *progressing on a cloud-first strategy*.

Top Cloud Initiatives for 2021
% of all European respondents

Initiative	%
Migrating more workloads to cloud	70%
Optimize existing use of cloud (cost savings)	59%
Progressing on a cloud-first strategy	50%
Better financial reporting on cloud costs	48%
Automated policies for governance	44%
Expand use of containers	43%
Expand public clouds we use	39%
Move on-prem software to SaaS	36%
Manage software licenses in the cloud	30%
Implement CI/CD in the cloud	29%
Enable IT to broker cloud services	23%
Expand use of cloud MSPs	17%
Expand use of cloud marketplaces	11%

N=155   Source: Flexera 2021 State of the Cloud Report

Figure 73. Cloud initiatives for European organizations

Enterprises embrace multi-cloud

European enterprises have almost entirely embraced multi-cloud. As **Figure 74** indicates, 95 percent of respondents reported having a multi-cloud strategy. Eighty-four percent are taking a hybrid approach, combining the use of both public and private clouds.
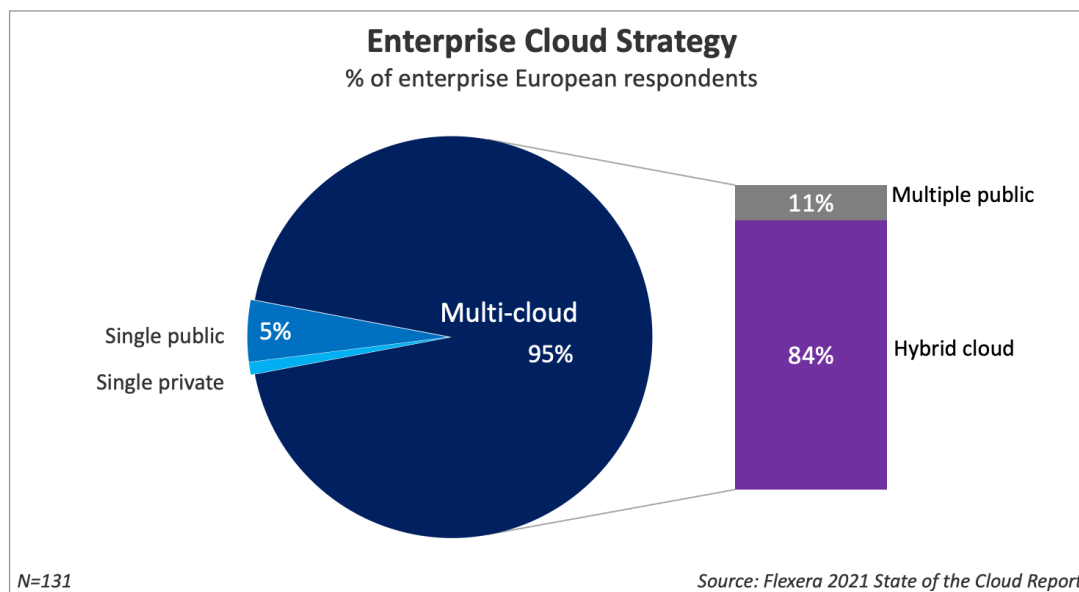
Enterprise Cloud Strategy
% of enterprise European respondents

Single public — 5%

Single private

Multi-cloud 95%

11% — Multiple public

84% — Hybrid cloud

N=131

Source: Flexera 2021 State of the Cloud Report

Figure 74. European enterprises with a multi-cloud strategy

About Flexera

Flexera delivers IT management solutions that enable enterprises to accelerate the return on their technology investments. We help organizations ***inform their IT*** with total visibility into complex hybrid ecosystems, so they can ***transform their IT*** by rightsizing across all platforms, reallocating spend, reducing risk and charting the most effective path to the cloud. Our technology value optimization solutions are delivered by 1,300+ team members helping more than 50,000 customers achieve their business outcomes. To learn more, visit **flexera.com**

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