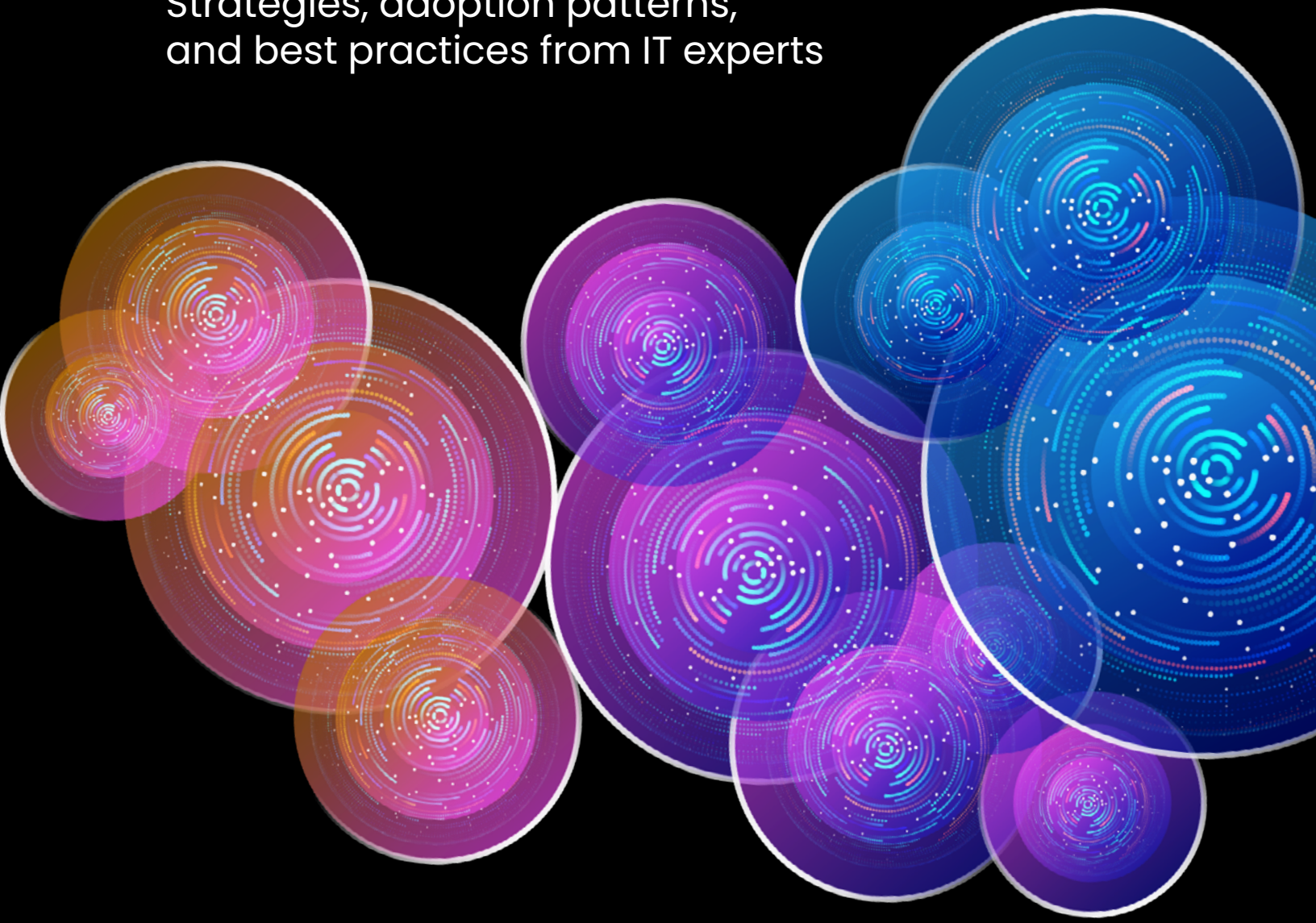
Cockroach Labs

The State of Multi-Cloud 2024

Strategies, adoption patterns, and best practices from IT experts



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Executive summary

"Multi-cloud is the future." You've heard that everywhere over the past few years, from boardrooms to conferences to reports like this one. **But does the hype match the reality on the ground?** And how can companies that do see multi-cloud as the future actually get there?

This report presents our opinionated answer to those questions, based on both hard data from a survey of IT decision-makers in the US and Europe and in-depth interviews with engineers and other engineering professionals who are in the trenches building multi-cloud applications.

This is a complex topic, and we suggest you dig into the full report for all of the details. But if you're pressed for time — and who isn't these days? — here are the key takeaways:

- **Multi-cloud and hybrid cloud are already the norm.** Half of all survey respondents said their companies leverage multi-cloud, and an additional 26% said they have hybrid cloud setups using a single cloud service provider (CSP) in addition to on-premises hardware.
- **Multi-cloud is generally adopted for business reasons, not technical reasons.** Regulatory constraints and concerns about cloud vendor lock-in are the top drivers of multi-cloud adoption.
- The EU's Digital Operational Resilience Act **(DORA) looks likely to drive further multi-cloud adoption.** Most respondents who said their companies are planning and preparing for DORA also said that multi-cloud is a part of those plans.
- Economic uncertainty is also likely to drive multi-cloud growth, respondents said.
- However, **industry hype about multi-cloud undersells some of its challenges.** Although multi-cloud adoption is growing, companies that adopt it for the wrong reasons are likely to find themselves wasting time and resources dealing with the complexities inherent in multi-cloud deployments.
- Many of those challenges stem from the fact that, although CSPs are mostly "squint equivalent," the devil is in the details. Even small technical differences between clouds can consume huge amounts of an engineering team's time.
- On the business side, maintaining a team with expertise across multiple clouds is expensive, and dealing with multiple clouds (for support, billing, etc.) can also be challenging.
- Intercloud and single-workload multi-cloud (SWMC) deployments are especially complex, and come with technical challenges and costs that may not be worth it for some use cases.
- Some of the **challenges associated with multi-cloud can be avoided** with thoughtful planning and by embracing cloud-agnostic tools to abstract away vendor-specific cloud idiosyncrasies.

How we produced this report

Our multi-cloud qualifications

Since this report is based in part on interviews with Cockroach Labs engineers, it's important to explain why we're experts in multi-cloud.

Cockroach Labs is the creator of CockroachDB, a cloud-native, distributed SQL database for mission-critical workloads. CockroachDB is available self-hosted, or as a managed cloud service that's available on Amazon Web Services (AWS), Google Cloud Platform (GCP), and Microsoft Azure. CockroachDB is thus itself a multi-cloud application. Our engineers work with all three clouds, navigating their differences to ensure a consistent product experience across all of them.

Additionally, because CockroachDB is generally used for critical workloads, our Field Engineering team is deeply familiar with the infrastructure needs and challenges encountered by our customers, many of whom have already embraced multi-cloud themselves. Quite a few of the insights in this report come from our experiences helping those customers — across financial services, technology, gaming, and retail sectors — build multi-cloud products and services.

Methodology

The quantitative data presented in this report comes from a research study sponsored by Cockroach Labs and conducted by Wakefield Research among 300 cloud architects and engineers between July 18th and July 24th, 2023, using an email invitation and an online survey. Respondents were selected against the profiling criteria for this study: cloud architects and engineers working at companies with $50 million or more in annual revenue in the following qualifying industries: SaaS, Media & Streaming, Telecommunications, Financial Services & Fintech, Retail/eCommerce, Gaming (Gambling, Sports betting), and Logistics & Transportation. Quotas for key firmographics (revenue, company size, seniority, etc.) were used to ensure that the sample with the expectations for each market included in this study (US, UK, and Germany).
It is standard practice to offer an incentive to participants in market research. All respondents were compensated for participating in the survey.

Results of any sample are subject to sampling variation. The magnitude of the variation is measurable and is affected by the number of interviews and the level of the percentages expressing the results. For the interviews conducted in this particular study, the chances are 95 in 100 that a survey result does not vary, plus or minus, by more than 5.7% at the total level, and 9.8% at the market level, from the result that would be obtained if interviews had been conducted with all persons in the universe represented by the sample.

The qualitative data comes from interviews conducted with Cockroach Labs employees, primarily engineers and sales engineers, between June and August of 2023. The opinions presented in this report are based on their experiences building CockroachDB as a multi-cloud product and their experiences working with CockroachDB customers and prospects to operationalize their multi-cloud deployments.

Definitions

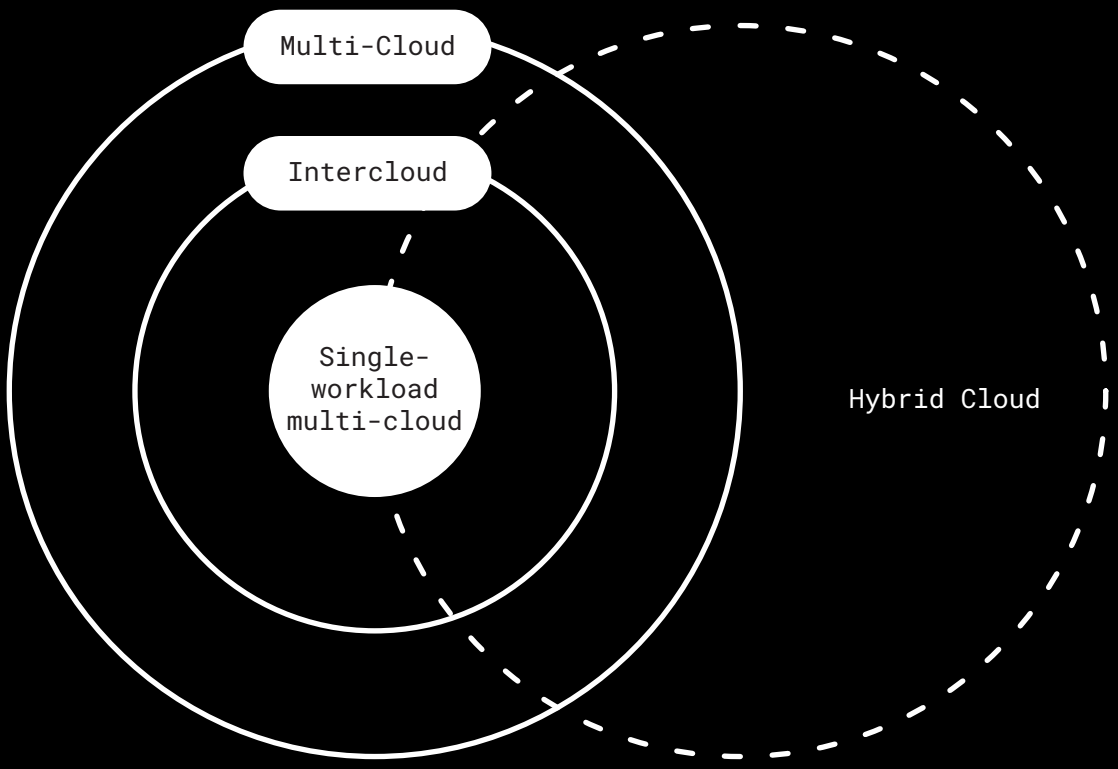
The term **"multi-cloud"** can mean different things to different people. For the purposes of this report, we'll use the following definitions:

Multi-cloud refers to using at least two different public cloud computing environments (e.g., using AWS and GCP). These clouds may be used within the same application, or for different applications. Any company that has in-use accounts with multiple public cloud providers may be considered multi-cloud.

Hybrid cloud refers to using at least two different computing environments: one or more public cloud service providers (e.g., AWS) and one or more private clouds (e.g., on-premises data centers). A company that is hybrid cloud may also be multi-cloud if it uses more than one public cloud service provider.

Intercloud refers to using multiple public cloud providers within the context of the same application. These clouds may be used for different workloads within the application, or a single workload may be running across multiple public clouds. Intercloud is therefore a specific subtype of multi-cloud.

Single-workload multi-cloud (SWMC) refers to deploying a single workload across multiple clouds — for example, operating a single distributed database cluster that has nodes on both AWS and Azure.

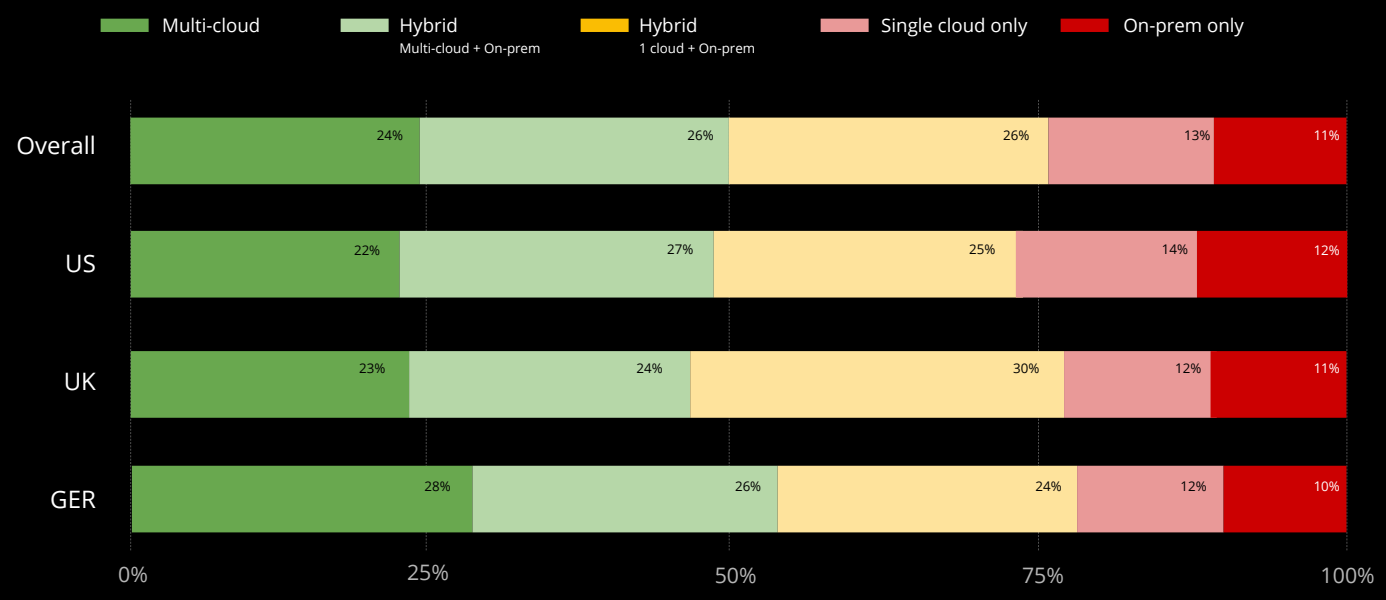


Multi-cloud and intercloud today

To understand where multi-cloud adoption is likely headed and how companies should approach multi-cloud, we must begin with a clear picture of multi-cloud as it exists now.

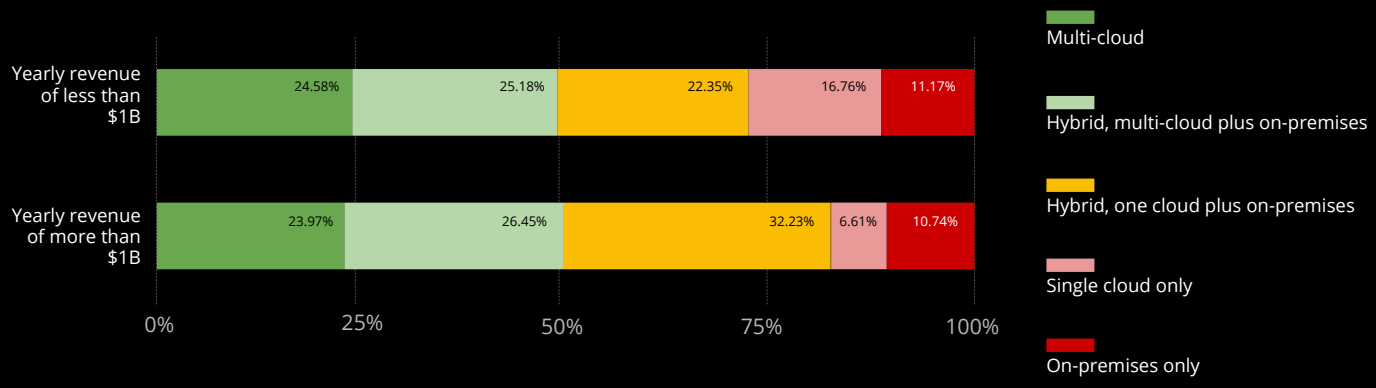
Multi-cloud is already widespread

Multi-cloud and hybrid cloud adoption by country

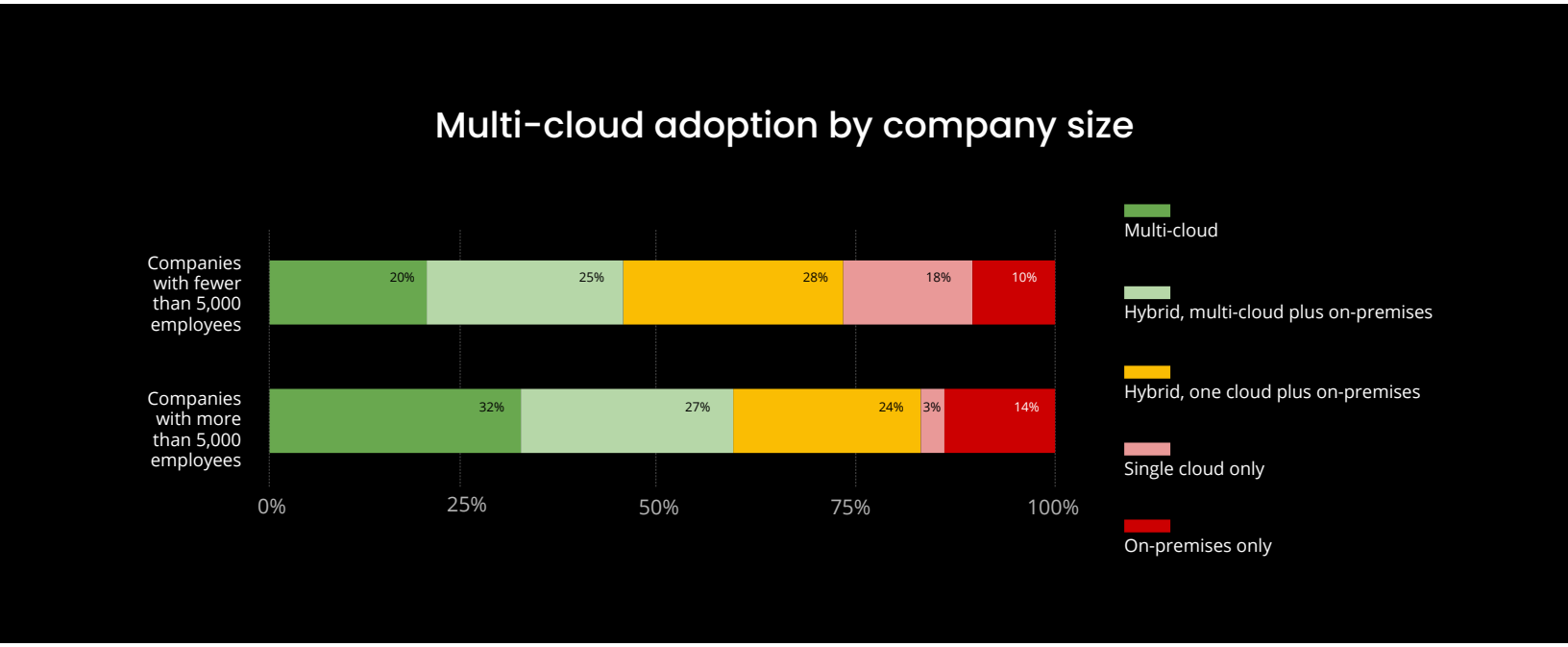


Hybrid cloud and multi-cloud are common across both the US and Europe. Of the countries surveyed, German companies were most likely to be using more than one cloud provider, but nearly half of US and UK companies were also multi-cloud. Hybrid setups are most common; more than half of companies in each country surveyed employ hybrid cloud infrastructure.

Multi-cloud and hybrid cloud adoption by company revenue



When the data are broken down by revenue, companies with revenue of more than $1 billion per year were less likely to be reliant on a single infrastructure solution (one CSP or on-premises hardware). However, companies both above and below the $1 billion revenue mark seem to be adopting multi-cloud at roughly the same rate.

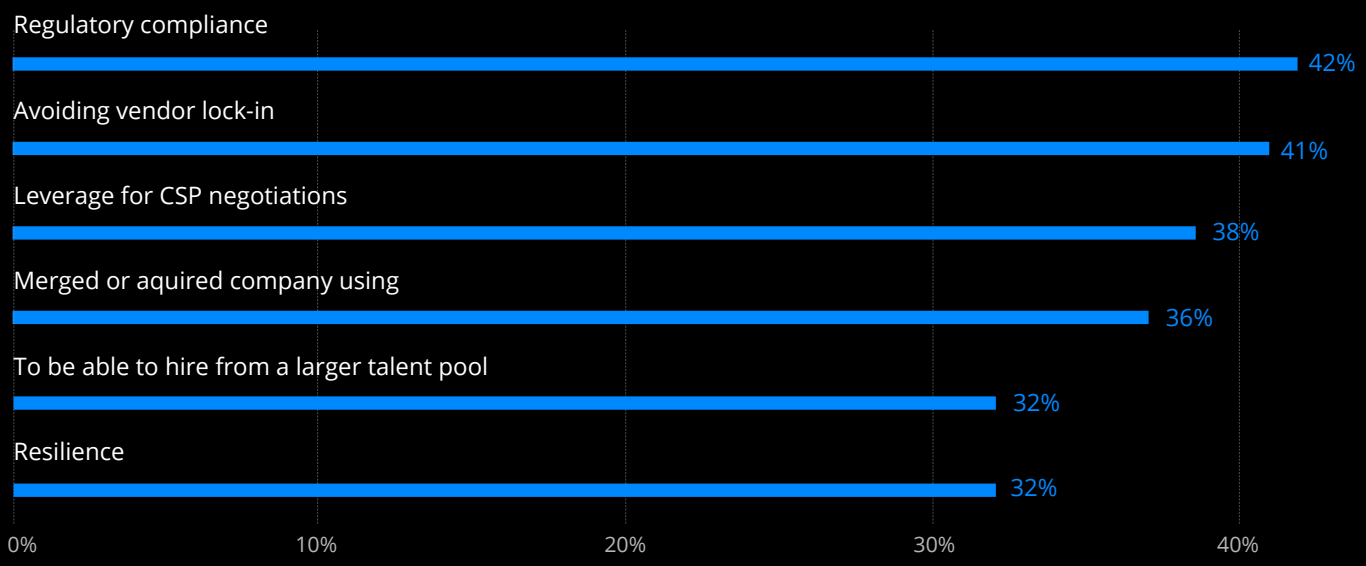


Using employee count as a proxy for company size, larger companies were 31% more likely to be multi-cloud (using multiple CSPs, with or without an on-premises component). Overall, 83% of companies with more than 5,000 employees are running hybrid or multi-cloud infrastructure, compared to 72% of companies with fewer than 5,000 employees.

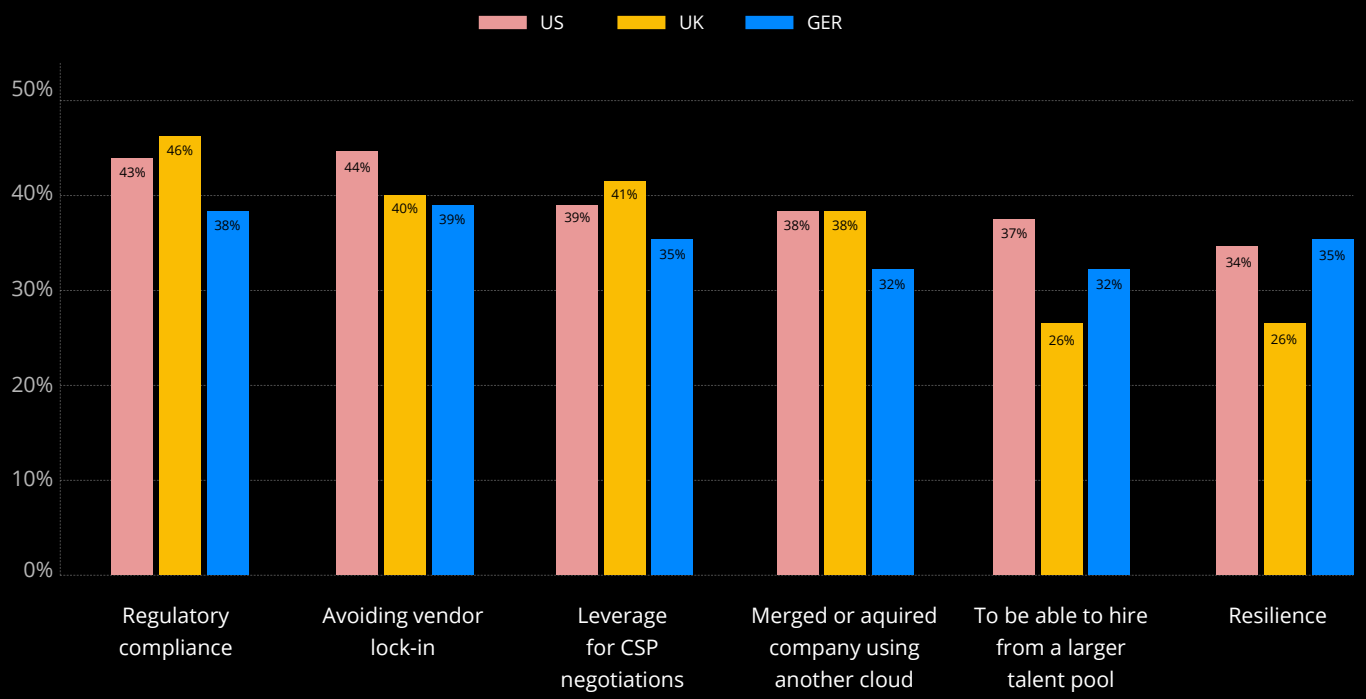
Multi-cloud adoption is driven by business concerns, not technical concerns

The largest drivers of multi-cloud adoption, according to both the survey data and our interviews, are business concerns such as complying with current and future regulations, avoiding vendor lock-in, and gaining leverage in cloud contract negotiations.

Overall: for which reasons might your company choose to adopt multi-cloud?



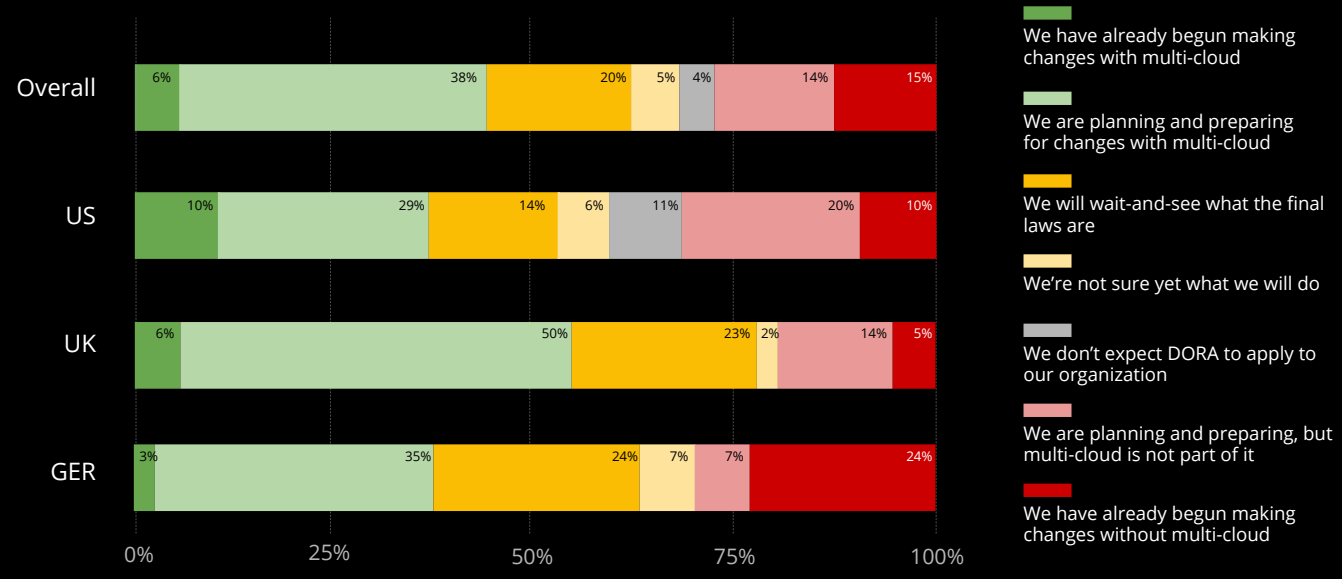
By country: for which reasons might your company choose to adopt multicloud?



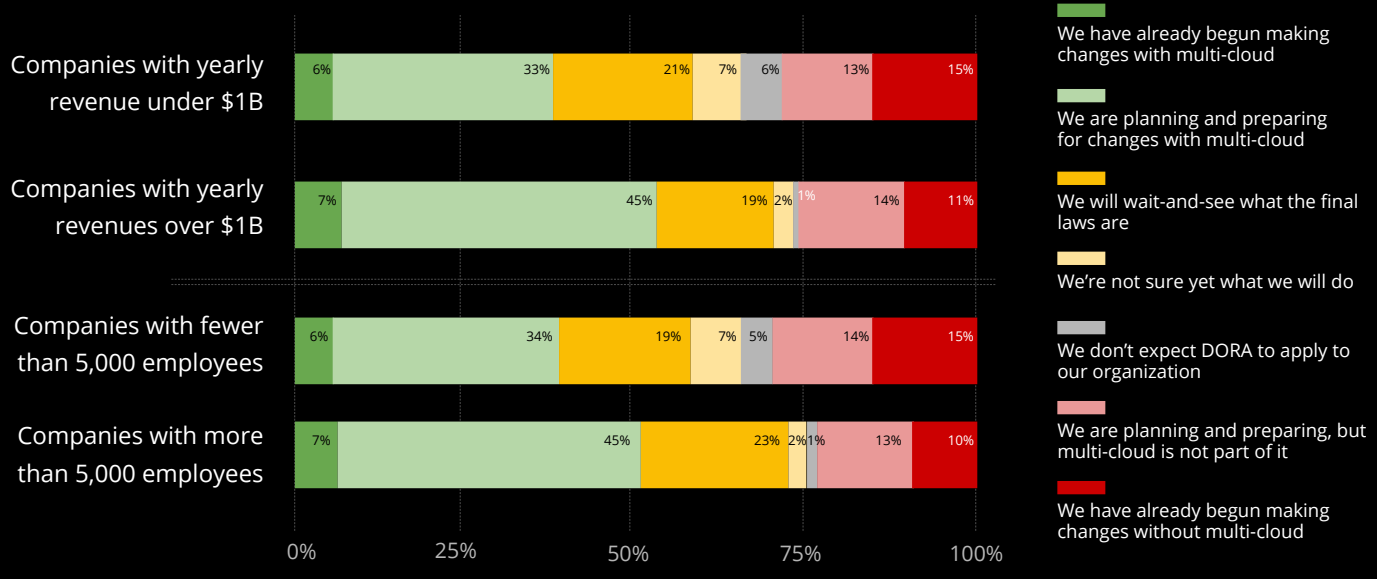
Regulatory compliance, avoiding vendor lock-in, and gaining leverage for contract negotiations with the CSPs were the top three reasons cited for adopting multi-cloud across all three countries surveyed.

Regulatory compliance was the most cited reason overall. For example, companies that operate in Europe are expected to comply with the EU's new Digital Operational Resilience Act (DORA), which will require companies operating in the financial sector to take steps to mitigate risks to their operational resilience, potentially including cloud concentration risk, by January 2025. Across all three countries we surveyed, most companies that are planning or preparing for DORA already are making multi-cloud a part of their plans.

How companies are responding to DORA

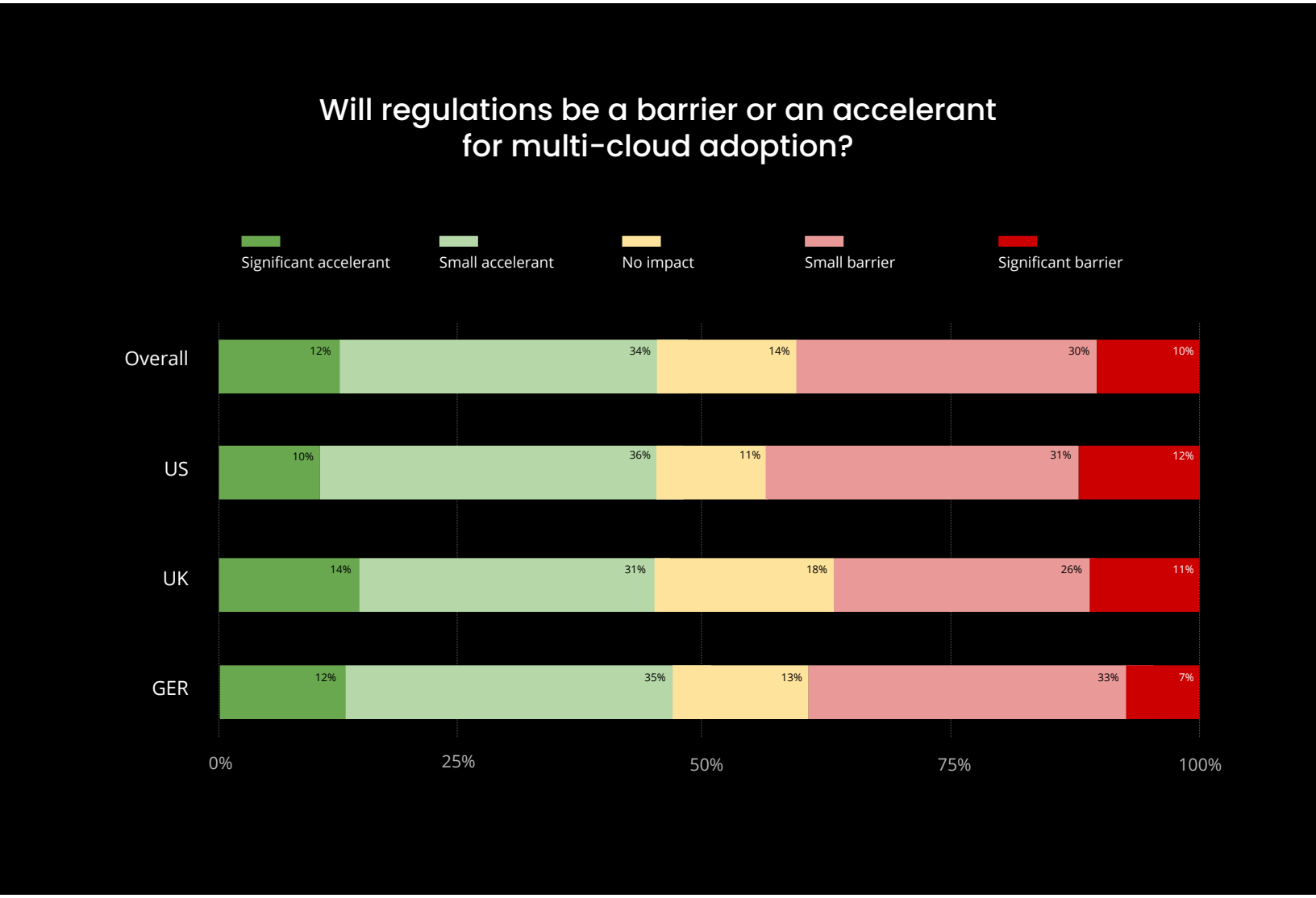


How companies are responding to DORA, by revenue and company size



Other research about attitudes towards multi-cloud echoes these findings. A 2023 Finextra report[1], for example, asked 150 senior financial services professionals to rank the benefits that drive multi-cloud adoption from 1 (biggest benefit) to 5 (smallest benefit). More than 65% of respondents ranked "regulatory demands" as either the primary or secondary benefit driving multi-cloud adoption.

It's worth noting, however, that a significant proportion (although still a minority) of respondents also said that regulations could be a barrier to multi-cloud adoption:



Respondents from smaller companies — by both revenue and employee count — were more likely to see regulations as either a barrier or an accelerant. Respondents from larger companies were more likely to discount the possibility of regulations impacting their multi-cloud adoption either way.

[1] From Cloud to Multicloud, Pathway to Resilience. Finextra Research in association with Form3. https://www.finextra.com/researcharticle/276/from-cloud-to-multicloud-pathway-to-resilience

Small vs large companies: will regulations be a barrier or an accelerant for multi-cloud adoption?

Avoiding vendor lock-in was another top reason respondents said their companies might look to multi-cloud. This was a particularly large concern for US respondents, who ranked it above all other reasons for multi-cloud adoption.

Companies that adopt multi-cloud to avoid vendor lock-in may still focus primarily on a single cloud provider, only choosing to embrace a different cloud for a few specific services. The idea behind this is that if they ever do want to switch primary clouds, they'll have developed some in-house expertise and built relationships with another CSP that will make switching somewhat easier (although still far from easy).

It's worth noting, however, that the same thing may be accomplished by choosing cloud-agnostic tools but not actually deploying across multiple clouds. For example, one large CockroachDB customer (with yearly revenues above $5 billion) made a strategic decision to avoid using AWS's proprietary databases even though they were satisfied with AWS as their primary cloud provider. They opted to embrace cloud-agnostic databases like CockroachDB not because they intended to switch clouds, but because they wanted to avoid being locked into AWS and to maintain flexibility in the future.

Negotiation leverage with cloud providers was one of the motivations for adopting multi-cloud, cited by 38% of respondents. In theory, having a multi-cloud strategy can be a cost-saving measure, as it allows you to more credibly threaten to walk during contract negotiations with cloud providers.

In our interviews, some experts expressed skepticism about the efficacy of this tactic. Cloud providers are well aware that even if a company is running some workloads on another cloud, migrating anything from

one cloud to another takes time and money. Cloud migrations are typically measured in months or years; they're not something that anyone undertakes lightly. CSPs know this, and know the savings offered by the second cloud would have to be quite significant for the threat to be credible.

However, because the clouds compete with each other, those kinds of discounts are sometimes available. For example, one field engineer told us that in his region, AWS is the most common CSP. Google wants to compete there, so GCP reps have come in and offered highly competitive discounts, credits, and more to entice companies over to Google. At least one CockroachDB customer ended up multi-cloud for this reason; they'd been an AWS shop, but GCP came in with such a compelling offer for their analytical workloads that they migrated that part of their business to GCP.

Another major driver of multi-cloud adoption is **mergers and acquisitions** — more than 30% of respondents in all three countries cited this reason for adopting multi-cloud.

In some cases, multi-cloud is an undesired side effect of the acquisition, and companies will build a long-term plan to migrate their newly acquired services over to their cloud of choice.

This is the case for one major financial services company (with a yearly revenue of more than $20 billion) that runs its legacy services on-premises, but which has acquired a number of different fintech companies and has thus inherited operations on both AWS and Azure. In the long term, they plan to consolidate and standardize. In five or ten years, they may not be multi-cloud.

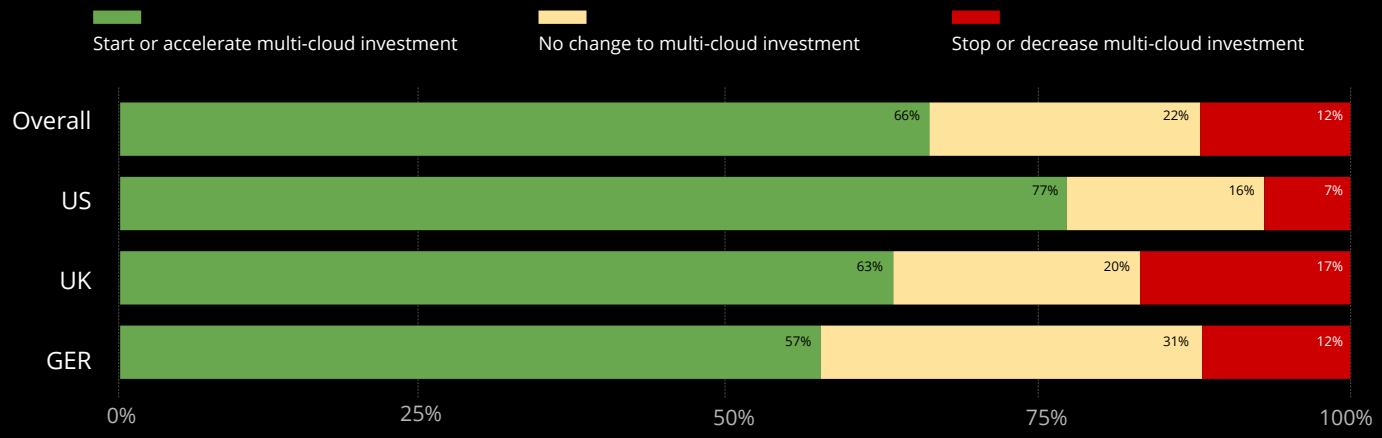
However, because cloud migrations are time consuming and expensive, it's also common for companies to simply embrace their post-acquisition multi-cloud reality. If, for example, an AWS shop acquires a company that's already running successfully on GCP, is the costly process of migrating and replacing or retraining all of that team's GCP experts so that their product can run on AWS going to generate a sufficient return on investment? Often enough, the answer is no, leading to independent workloads continuing to run with the cloud vendor on which they're implemented.

A strong technical argument for multi-cloud — **improved resilience** — was the least cited option in our survey. In interviews, engineers stressed that the technical case for multi-cloud was often difficult to make, as the improved resilience it offers comes at the cost of having to deal with all of the technical challenges involved in multi-cloud and intercloud deployments. Moreover, even companies with four- or five-nines availability SLAs can often achieve those goals by deploying across multiple regions within a single cloud.

However, there are exceptions. For example, one CockroachDB customer — a major global finance company — is building a fintech app in the UK that requires multi-region resilience. For regulatory reasons, its data also has to remain in-country. AWS only offers a single region within the UK, so to achieve multi-region resilience while keeping their data in the UK, they deploy on multiple clouds.

The current **economic uncertainty may also help to drive multi-cloud adoption**. Although it's not something we heard often in our interviews, survey respondents largely said they expected economic uncertainty to drive more multi-cloud adoption in their industries.

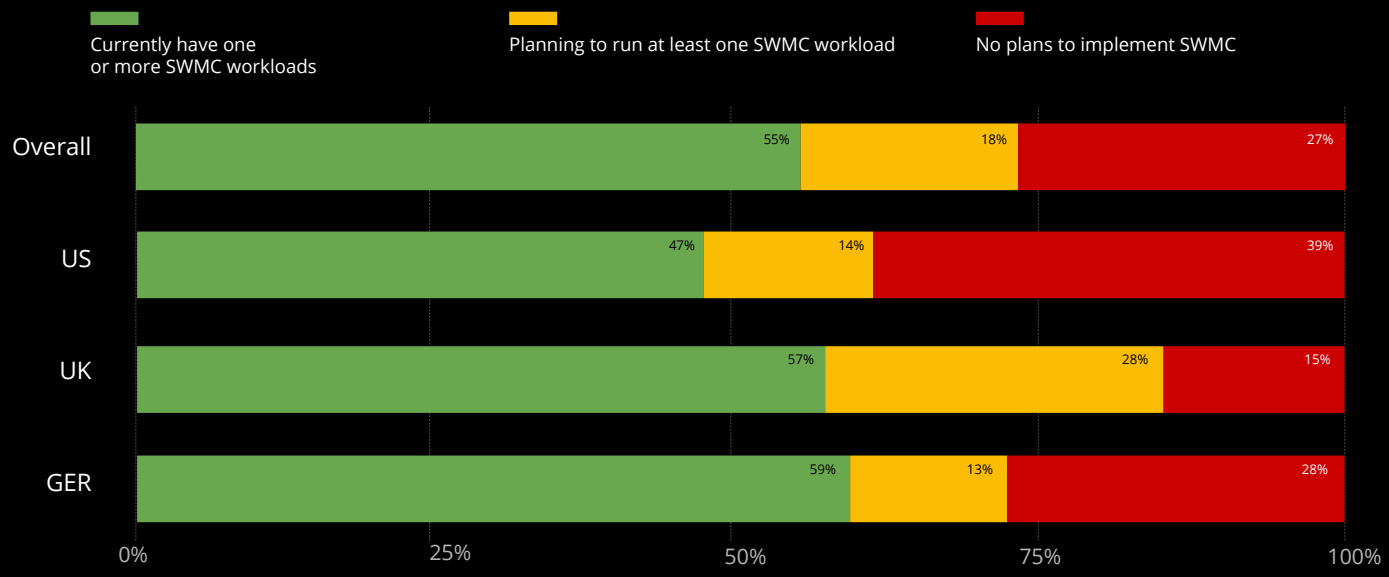
In your industry, which is most likely to happen as a result of budgets tightening due to economic volatility?



More than half of multi-cloud companies have single-workload multi-cloud (SWMC) services

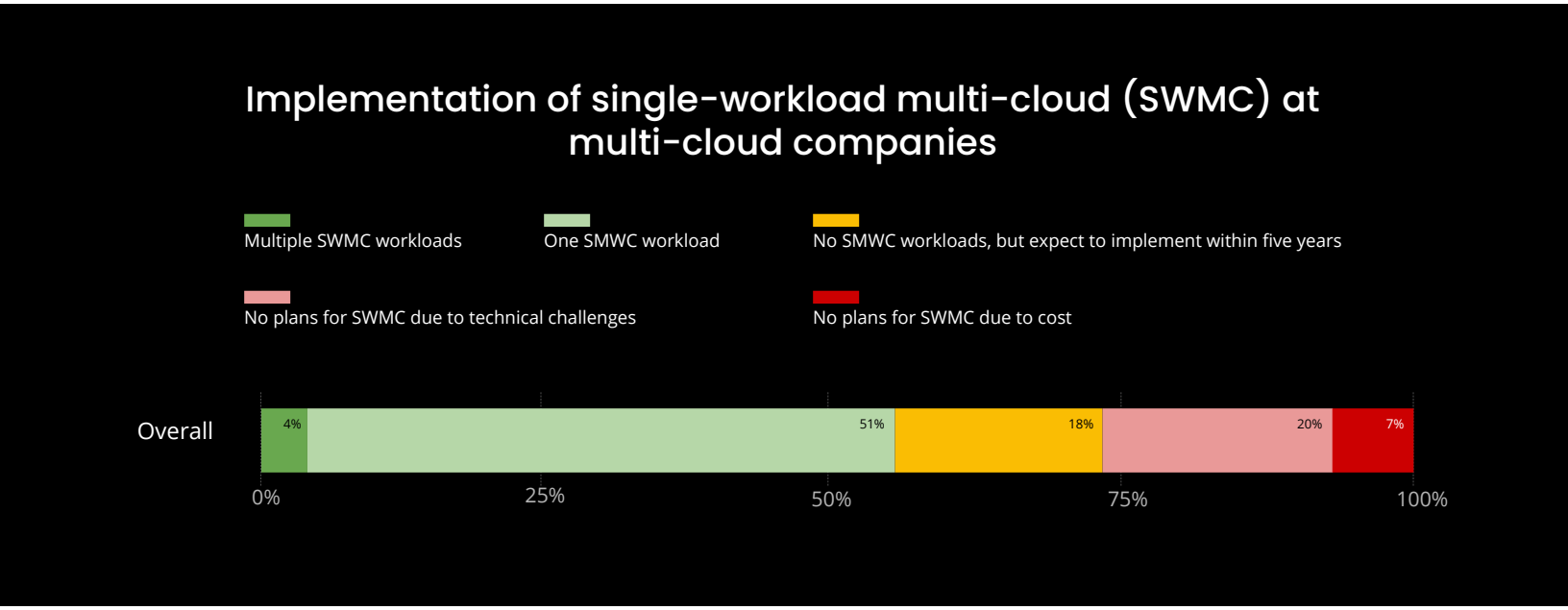
One rather surprising result of the survey was that, among respondents who said their companies were already multi-cloud, 55% said they were running at least one workload across multiple clouds:

Single workload multi-cloud (SWMC) adoption at multi-cloud companies



This type of complex intercloud deployment appears to be most common in Germany (59%). US multi-cloud companies were the most likely to say they weren't running any workloads across multiple clouds and have no plans to (39%).

However, the data suggest that most companies are still in the early phases of implementing SWMC deployments. More than half of multi-cloud companies have SWMC workloads, but just four percent of respondents – three in Germany and three in the UK — say their company has deployed more than one workload across multiple clouds. So although a surprising number of multi-cloud companies have SWMC workloads, the vast majority of workloads are still being run on a single cloud.



This makes sense given that there are additional technical challenges that come along with SWMC deployments, and the use cases for these sorts of deployments are also more limited. Most respondents who said they weren't planning SWMC cited technical challenges as the primary reason it wasn't on their roadmap.

The primary technical challenges associated with SWMC deployments relate to consistency and networking.

Data inconsistency is possible whenever any kind of data is being shared across clouds.The extent of the challenge this poses depends on the specifics of the workload being deployed. If you're storing player statistics for a video game, your system can probably tolerate some short-term inconsistency (although you'll still need to build a way to resolve those issues in the long run).

If you're storing payment transactions, on the other hand, strong consistency will be required. Building a bespoke system to maintain consistency across multiple clouds will be challenging, and maintaining and scaling such a system can be very difficult. We recommend companies requiring SWMC seriously

consider employing cloud-agnostic tools that solve this problem for you — CockroachDB, for example, will automatically maintain strong consistency in a database regardless of whether it's deployed across multiple regions, multiple clouds, etc.

Networking is likely to be a challenge in SWMC deployments. Within a single cloud, machines, AZs, and regions are connected with hard lines that are optimized for minimum latency and not exposed to the public internet. But there's currently insufficient incentive for the clouds to optimize connections between their networks and those of competing cloud providers. Companies that want to leverage SWMC must carefully consider how they'll manage communication between clouds.

The best approach to that will depend on the specifics of the workload in question. One option would be to use VPN tunnels — here's an example of a multi-cloud CockroachDB implementation that leverages this approach — but this requires careful consideration of factors such as IP and DNS.

Another option is building private lines by buying dedicated circuits from a telecom provider, just as you might to link an on-premises data center to a cloud provider for a hybrid deployment. This approach may offer more predictable throughput and lower latency, but it comes at a significant cost. It can also introduce a new type of vendor lock-in, as contracts must be negotiated with the telecom providers. Additionally, expanding your network to improve bandwidth may be slow, as you'll have to wait on the telecom provider to install any new equipment that may be required.

Many of the top clouds also have connection partnerships with companies that provide virtual intercloud routing as a service, enabling connectivity between multiple clouds without the need for new physical infrastructure while still avoiding any contact with the public internet. However, these services can also be pricey, and they may not be available for all of your clouds and cloud regions of choice.

In our survey, some respondents also cited the **cost** of SWMC as a reason they don't plan to pursue it. Any technically challenging project carries significant labor and time costs, but additionally, SWMC deployments require sending data between clouds, which means that companies must also pay cloud data egress costs. These can be prohibitive.

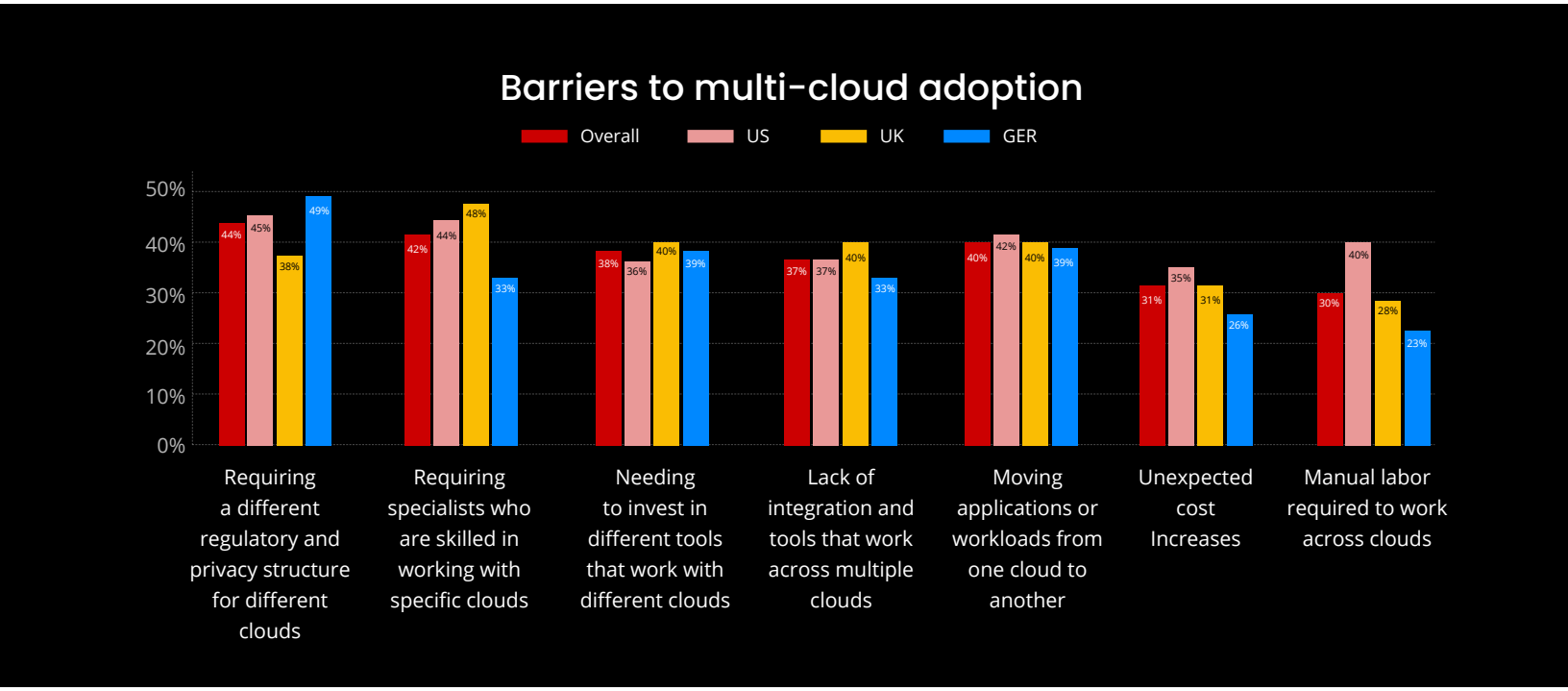
As of this writing, AWS, Azure, and GCP all charge egress fees in the general ballpark of $0.10 per GB transferred. This means that a transfer of 10 TB will cost around $1,000. (In comparison, transferring the same amount of data from one region to another

> Understanding what your costs even ***are*** can also be a challenge, as each cloud handles billing differently. This is challenging even in regular multi-cloud deployments, but figuring out what a specific application or workload costs can be even more difficult in an intercloud context because you'll have to identify and merge the billing data from each cloud associated with that workload.

within the same cloud would cost closer to $200 in many cases). In the context of small, data-light applications, this difference may not be a big deal. But for companies operating at global scale and processing millions of transactions per day across their application systems, the egress charges will add up quickly, making SWMC workloads most appropriate for high-value use cases.

Multi-cloud adoption is growing, but it isn't easy

Embracing multi-cloud can come with a host of challenges, but many of them stem from the same fundamental problem: although all of the major cloud providers offer "squint-equivalent" services, each cloud has its own idiosyncrasies. When you're working with multiple clouds, negotiating these small differences can lead to large problems.



In our survey, respondents cited the challenges that arise from **the differences between clouds** — regulatory and privacy structure, needing cloud-specific specialists, and issues with tooling and compatibility — as among the top barriers to multi-cloud adoption. Hiring specialists for multiple clouds seems to be a particular problem in the UK, where nearly half of respondents (48%) cited hiring specialists as a challenge, compared to just a third of respondents (33%) in Germany.

In line with these findings, the engineers we interviewed often raised examples where seemingly small differences between clouds led to problems or resulted in significant additional work.

For example, GCP does not limit the number of accounts/subscriptions within an organization, but AWS and Azure do. Moreover, AWS and Azure handle deleting accounts differently. When building CockroachDB Cloud, we discovered these differences only after we'd built a data and isolation model that didn't account

for them. This has led to a significant amount of code refactoring, as well as lengthy negotiations with the cloud providers.

Network peering is handled differently on different clouds. So is identity management. So is scaling. So are many other things. If you're using different clouds for wholly different applications, this means that each team will have to build its own unique solution for each cloud. If you're using multiple clouds for the same application (i.e., intercloud), you'll have to build multiple solutions to each problem into a single application's infrastructure.

And though each cloud has documentation, the reality is that it's impractical for every engineer on your team to read all of the docs of every cloud provider. Even support personnel from the CSPs themselves may miss issues and sign off on designs that will lead to problems down the road. For example, support personnel from one of the CSPs with account limits vetted CockroachDB Cloud's planned design without noticing that the limits created an issue.

In any kind of multi-cloud setup, it's likely that your project will collect paper cuts from these seemingly minor differences between the clouds. Even if you're fully aware of all of the differences between your chosen CSPs ahead of time, multi-cloud can still present a major challenge to architects, who must try to design a system that employs multiple clouds without inheriting all of the deficiencies and idiosyncrasies of each cloud.

And of course, even after the system is built, there are maintenance, observability, and even billing tasks, many of which can be significantly complicated by the inclusion of more than one cloud.

A secondary but still significant group of challenges relates to the **costs in terms of both time and money** that can come with multi-cloud. In the US, the amount of manual labor that's required to work across multiple clouds was of particular concern, with 40% of respondents citing this as a barrier, compared to just 23% of respondents in Germany.

And though some of the labor costs stem from the time required to navigate the technical challenges mentioned above, working with multiple cloud providers can also increase the amount of time teams spend in meetings and managing CSP relationships. Each additional CSP you add will come with its own onboarding procedures. It will have its own products and services its reps will want to pitch. It will have its own preferred channels and styles for communication.

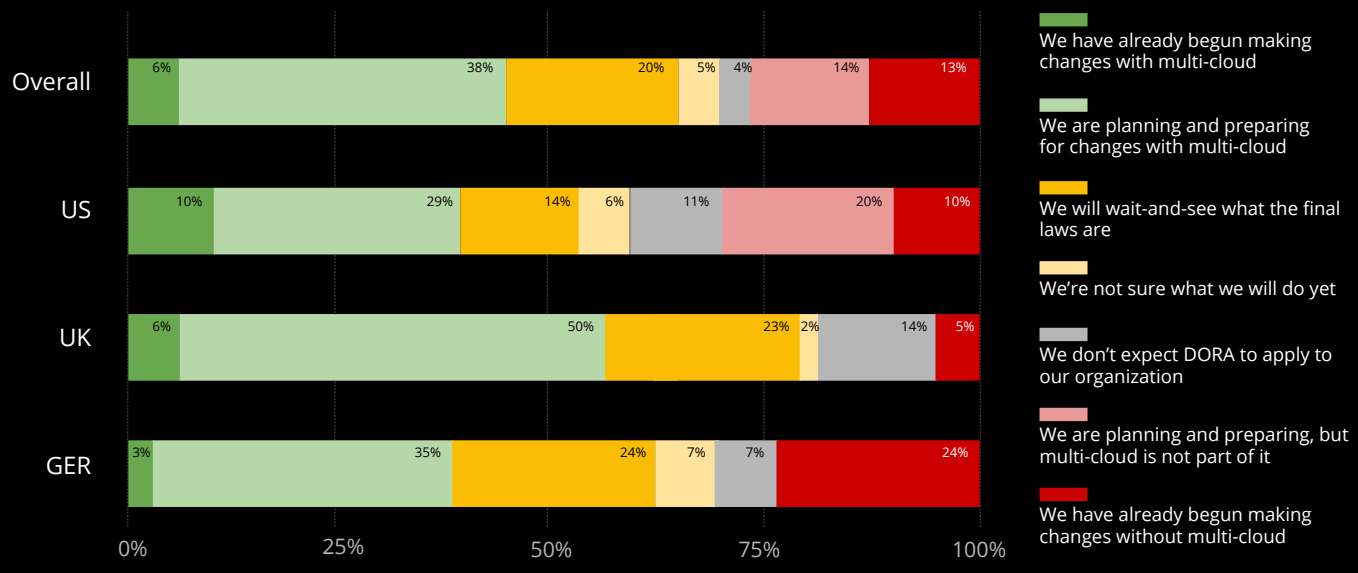
Even in a best-case scenario, moving from single cloud to multi-cloud is likely to increase the number of meetings with CSP reps your team has to make time for. And the more CSPs you're using, the higher your chances of encountering personality conflicts, communication breakdowns, intrateam disagreements about which cloud to use for what, and other very human problems that can slow your project down.

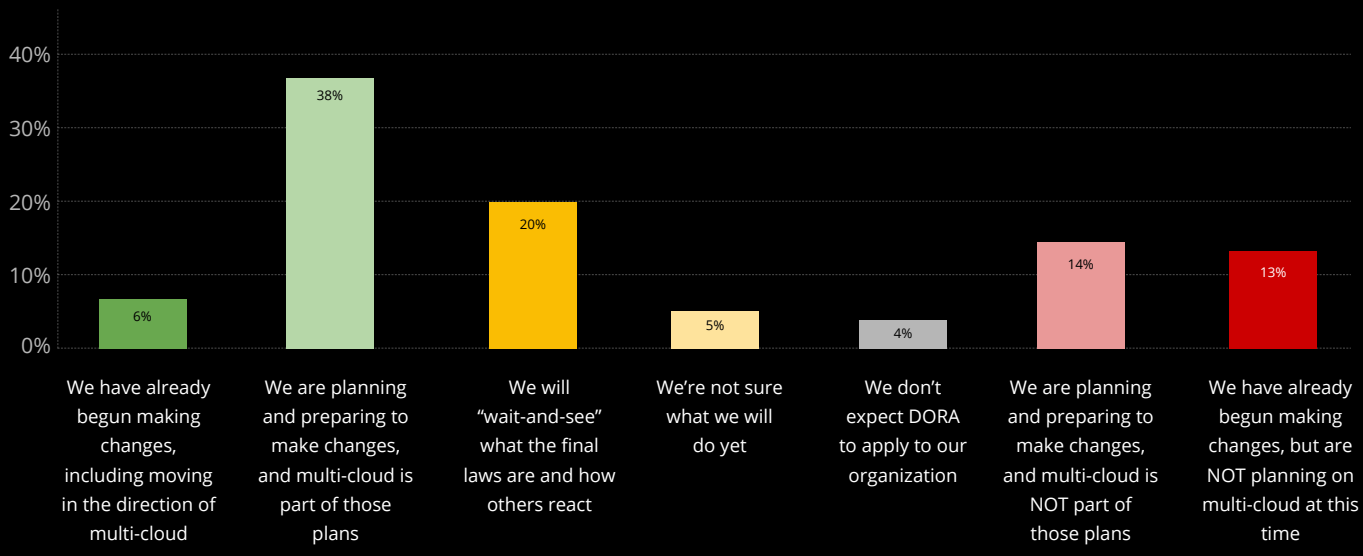
The technical and business challenges presented by multi-cloud are significant, but there are still good reasons — primarily business reasons — to adopt it. **So when is it worth it to leverage multi-cloud?**

Multi-cloud may be the right choice...

For complying with regulations

Governments across the world are moving to ensure resilience in key industries such as finance. And while many of these regulations, including DORA in the EU, are works in progress and the details are still being ironed out, the general thrust is toward requiring firms to ensure business continuity in the event of various disruptions and disasters. These regulations — particularly when combined with data sovereignty laws — have led many companies to conclude that multi-cloud is part of the path to compliance.





Among respondents who said they were either implementing changes or actively planning for changes to comply with DORA, 62% said multi-cloud was part of their plans. In the UK specifically, the number was even higher — 74% — perhaps because several of the major cloud providers only offer a single region within the UK, making multi-cloud one of the clearest paths to surviving cloud region outages without violating data sovereignty laws.

For avoiding vendor lock-in

In our survey, vendor lock-in was the most cited reason for going multi-cloud among respondents at large companies (45%). But it's worth pointing out that in many cases, these companies are still concentrated primarily on a single cloud provider. Often, going multi-cloud is about maintaining flexibility and unlocking the possibility of migration, rather than running workloads across multiple clouds.

For meeting customers' requirements

Often, companies — particularly B2B SaaS companies — embrace multi-cloud because their customers demand it. One major CockroachDB customer with yearly revenues above $25 billion prefers AWS and runs the vast majority of their services there, but they also maintain a small presence on Azure because they have customers that consider Amazon a competitor and won't use AWS-based services.

In fact, meeting customer expectations is one of the primary reasons that Cockroach Labs itself is multi-cloud. Many of our customers have a preferred cloud provider, so it was necessary for us to build CockroachDB Cloud as a multi-cloud product that works seamlessly regardless of whether a customer prefers AWS, GCP, Azure, their own on-premises hardware, or any combination of those options.

For leverage in price negotiations with CSPs

Being multi-cloud has the potential to be helpful in negotiations with CSPs, as having an established relationship and workloads running on another CSP makes the threat that you might move to a competitor more credible. However, this tactic is likely to work only when the discounts on offer from a competitor are truly significant. Both parties in the negotiation know that migrations are time consuming and costly, so simply being multi-cloud isn't necessarily enough to make the threat of switching to another CSP credible.

For empowering your teams

One reason large enterprises in particular may choose to go multi-cloud is to empower their teams to choose the best-fit cloud for the specific use case they're building. This allows them to take advantage when they see differences in performance or services between the clouds. For example, if a company feels that GCP offers the best-in-class options for analytics but that AWS is still superior for running their business logic, embracing multi-cloud allows them to build applications with best-in-class infrastructure.

For resilience (limited use cases)

One of the only technical reasons companies adopt multi-cloud is to increase their resilience and maintain availability even during cloud-specific outages and downtime.

Whole-cloud outages are rare, and in many cases companies can mitigate the risk of regional outages by embracing multi-region deployments across a single cloud without having to worry too much about downtime. But this isn't always possible. **Cloud region failures are not uncommon**, and there are circumstances under which the goal of surviving region failure points towards a multi-cloud architecture (for example, operating in a country where CSPs only offer a single region, and data must be stored in-country).

However, a hybrid cloud approach might allow for the same resilience at a lower cost, depending on the company's existing on-premises hardware infrastructure and skillset.

For cost optimization (limited use cases)

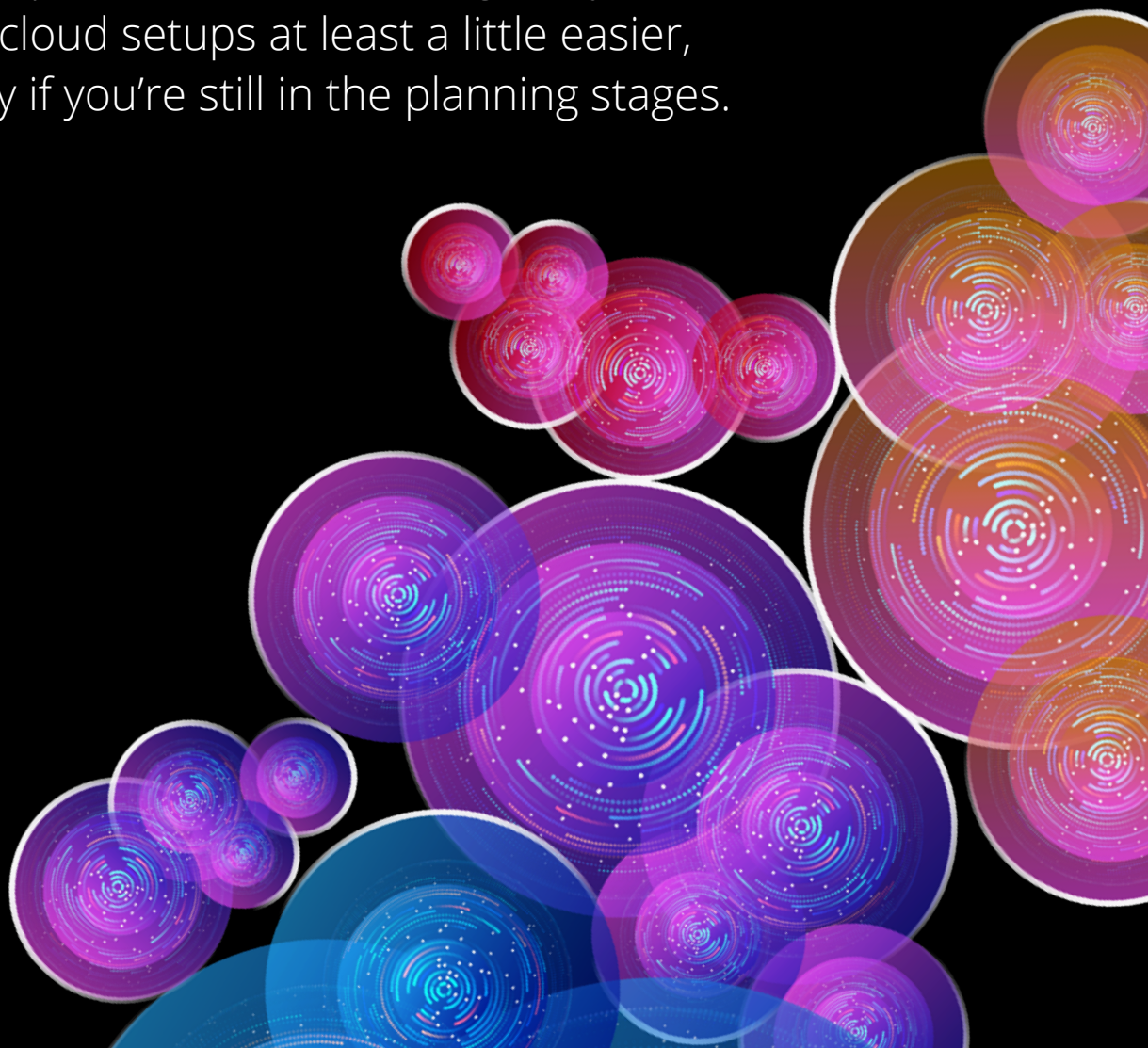
Although it's only applicable to a certain subset of use cases, there are times when companies adopt a multi-cloud approach for cost optimization, chasing the best prices across clouds in real time. This approach works best for workloads that have relatively little state, looser consistency requirements, and can tolerate latency as workloads are migrated.

For example, some game companies use this approach for operating game servers. When a match is being created, the company may spin up a spot instance on any of its cloud providers, depending on what's cheapest at the moment or what's available in the location most appropriate to minimize latency for the players. After the game is over — often in 10–20 minutes — the instance can be shut down.

However, many companies can't take advantage of this, as it doesn't work as well for heavily stateful applications or services with high-availability requirements. A game server with minimal data transfer needs can have this sort of ephemeral existence, and if a specific server crashes, players may be annoyed at the interruption but they'll likely just retry and a new server will spin up elsewhere for their next game. A banking database, on the other hand, cannot be ephemeral. Even a short outage is likely to incur dramatic costs, and the high volume of transactions a bank must process would quickly generate cloud data egress costs that eliminate any savings from the arbitrage anyway.

Best practices for multi-cloud success

Multi-cloud is probably never going to be easy. But in our interviews, some common themes emerged that can help to make transitioning to hybrid- and multi-cloud setups at least a little easier, particularly if you're still in the planning stages.



Establish cloud relationships early

Working through each cloud's onboarding process — and their sales pitches — can take time. It can also take time to find reps at each cloud who understand what you're trying to accomplish so they can guide you in the right direction. It's best to start these conversations early so that by the time you're ready to start building, you've gotten some of those sales pitches out of the way and made connections with reps that can help ensure your project is a success.

Learn from people who know the "gotchas"

Many of the problems associated with multi-cloud come from the fact that, though the clouds offer very similar products, there are a variety of minor differences and idiosyncrasies between them. If you're not aware of these differences, they can wreak havoc, and they may not rear their heads until long after you've started building.

The easiest way to identify these problems in advance is to talk to people who've built systems similar to whatever you're trying to build. If possible, hire them and bring them into your project. Admittedly, engineers who've built multi-cloud applications at scale aren't plentiful or cheap, but having some foresight from folks who've been through it before has the potential to save your team months of headaches and painful refactoring. To some extent, you can reduce your hiring costs here if you've done a good job of establishing cloud relationships early, as finding the right support rep can help mitigate some of the need for in-house, cloud-specific expertise.

Choose cloud-agnostic tools

A few years ago, building a multi-cloud application would have meant having to solve a lot of the complex problems yourself. Today, however, there are multi-cloud and cloud-agnostic solutions available for pretty much every level of your stack. In many cases, these products have already solved some of the challenges inherent in multi-cloud. Rather than reinventing the wheel, why not take advantage and use the time your team saves to focus on more meaningful work?

For example, Terraform is a cloud-agnostic Infrastructure-as-Code tool that facilitates management and orchestration of large-scale infrastructures across multiple clouds. Scalr is a cloud-agnostic tool that allows for the use of a single interface for managing resources across any cloud platform. CockroachDB is a cloud-agnostic distributed SQL database. The best tools for your use case will vary, but there are a wide variety of cloud-agnostic tools available, and implementing them into your stack will often allow you to abstract away some of the complexities of working with each specific cloud.

Of course, you'll still have networking challenges and egress costs to contend with. Cloud-agnostic tooling doesn't make multi-cloud easy. But anywhere you can abstract away some of the complexity of a multi-cloud deployment by using cloud-agnostic tools rather than having to build and manage something bespoke, it's worth considering.

Consider managed services

Managed services are another tool you can use to take some of the complexity and bespoke work associated with building and managing multi-cloud systems out of the hands of your team. This can have two advantages: your team has more bandwidth for building and shipping features, and your managed service is being operated by experts who may be able to optimize it more effectively than your internal team.

Let's say, for example, that you're primarily an AWS shop, but you have a few database workloads that must be run on GCP. Developing (or hiring) the in-house expertise needed to get up and running on that cloud could be time consuming. It may be better to simply opt for a cloud-agnostic managed DBaaS and let your vendor worry about how to optimize their database's performance on GCP.

Crawl, walk, run

One mistake we see some organizations make is trying to modernize too much at the same time. For example, if your application's persistence layer is currently a single on-premises Postgres server, taking that workload multi-cloud probably isn't the right next step.

If you're not already set up on a single cloud, do that first. If you're not already comfortable with distributed architecture for whatever layer of your application you're trying to make multi-cloud, do that next.

Build new apps rather than migrating if possible

Though it's possible to migrate an existing application to multi-cloud, it's a time-consuming process. In some cases — particularly when a complex form of multi-cloud deployment such as single-workload multi-cloud is needed — it may be both quicker and easier to build a net-new application that's designed for multi-cloud from the beginning rather than migrating your existing app.

Starting from scratch may also make it easier to implement new cloud-agnostic tools at various layers of your stack, allowing you to abstract away some or all of the complexities of multi-cloud.

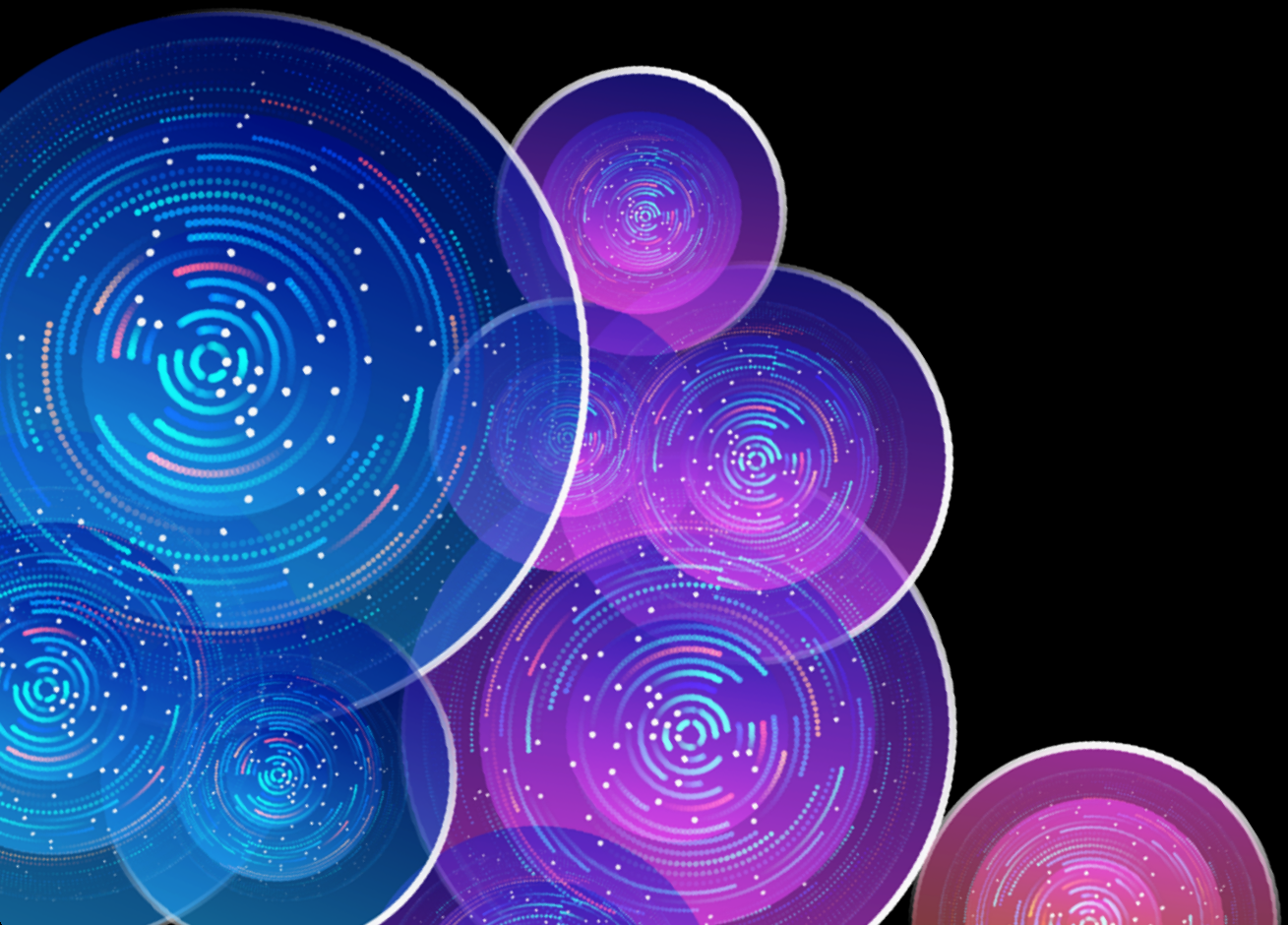
Consider communication and security between clouds

Unless you're certain that your cloud networks will never need to communicate with each other, it's best to think about potential networking issues such as overlapping IP addresses from the beginning. The specific issues you need to consider will depend on the specifics of your services and the CSPs you've chosen, but in general you'll want to think about how and what your services will need to communicate across clouds, and what issues might arise as a result of that.

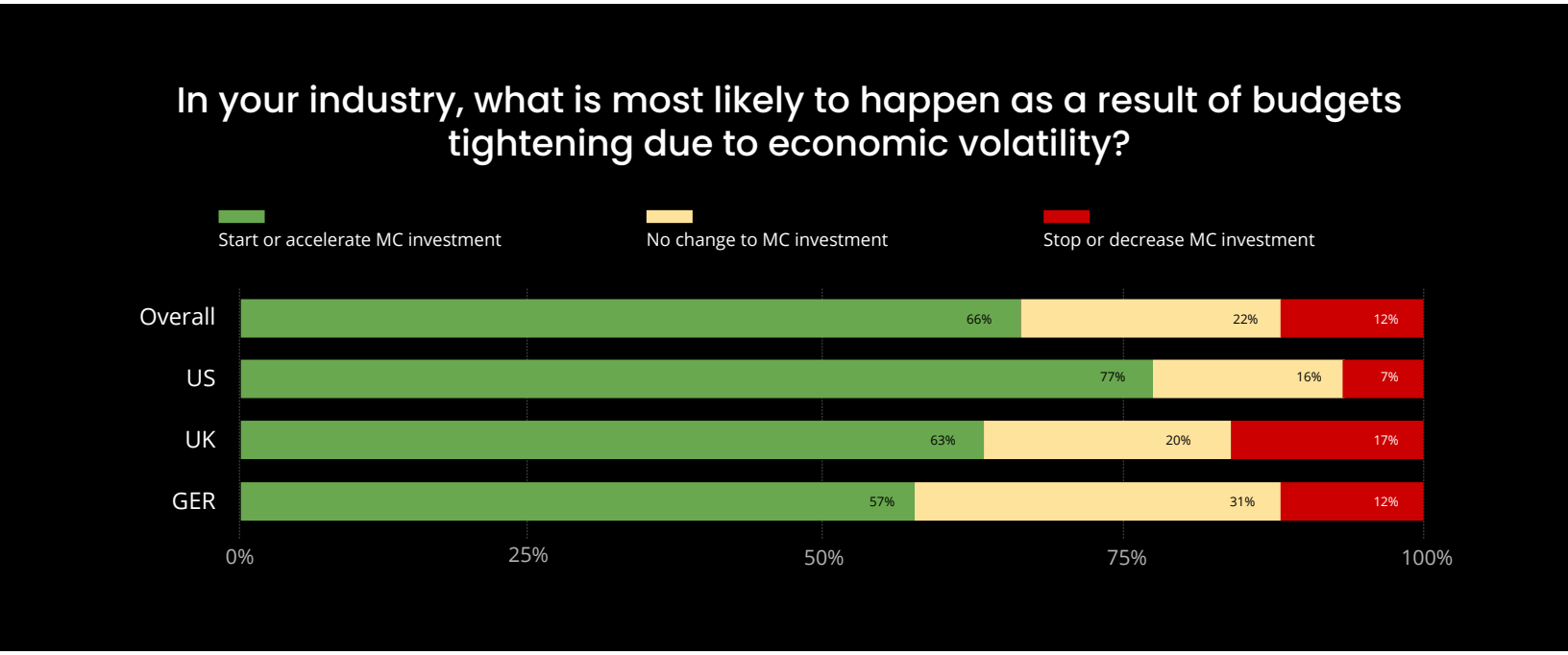
Security must also be a consideration here, as any data that's passing between clouds must either touch the public internet or additional private infrastructure (such as private lines from a telecom company), which provides an additional attack surface. Whatever your solution for connecting cloud platforms, security should be a consideration from day one.

The future of multi-cloud

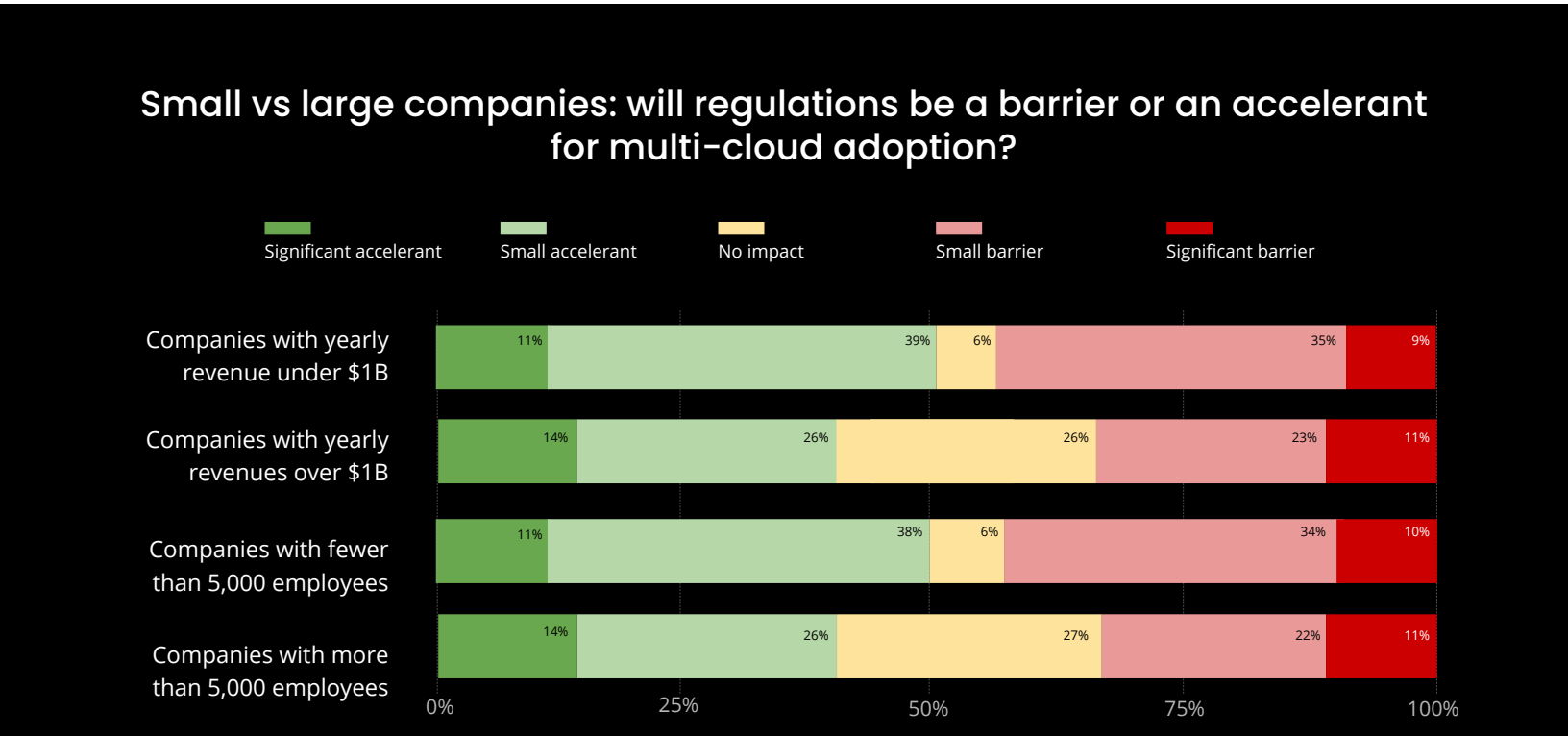
Broadly, the responses to our survey and what we're hearing on the ground point towards increasing adoption of multi-cloud, particularly at larger companies and companies in critical industries. This expansion is being driven in no small part by regulations like DORA.



But that doesn't mean that multi-cloud is the future for everyone. For example, though we mentioned earlier that most survey respondents felt economic uncertainty would drive more multi-cloud adoption, a small but still significant percentage of respondents (12% overall) said it could decrease or even stop the spread of multi-cloud in their industries:



Similarly, though more respondents saw regulations as an accelerant (46% overall) than a barrier (40% overall), the difference is quite small. Particularly among smaller companies, it seems that an increasingly complex regulatory environment could make it more difficult to adopt multi-cloud in some cases.



It's worth mentioning here that, as of this writing, regulations like DORA typically mandate companies maintain a certain level of operational resilience, but they do *not* specifically mandate that companies must adopt multi-cloud. Multi-cloud is clearly a part of the plan for compliance at many companies, but there are other valid paths to achieving operational resilience, too.

As the specific details of these regulations become clearer, and as companies get more real-world data on the performance and ROI of various compliance strategies, it's possible that — as 40% of respondents overall speculate — regulations could end up pushing them away from multi-cloud.

Additionally, some of our on-the-ground experts stressed that companies are particularly likely to encounter trouble with multi-cloud, and particularly intercloud, if they try to leapfrog to an advanced multi-cloud deployment from a relatively simple starting point.

For example, there are companies that come to Cockroach Labs with something like a single-instance on-premises database, and they're interested in moving to a multi-cloud deployment. But this means moving from on-premises to the cloud, moving from a single instance to a distributed database, and moving from working with zero clouds to multiple clouds.

Each of these steps can be complex and time consuming; trying to do them all at once is a recipe for failure, especially if that company's interest in multi-cloud isn't grounded in a solid business use case like regulatory compliance. (As mentioned earlier, our recommendation is that companies should already be comfortable with operating a distributed application and a distributed database before considering adding the additional complexity of multi-cloud.)

In short: the future of multi-cloud is as complex as multi-cloud itself. Although most of the data and what we're hearing on the ground suggest that multi-cloud adoption is likely to accelerate, companies should still evaluate their options based on their specific needs rather than falling victim to the hype cycle.

Is *your* future multi-cloud?

Whether multi-cloud adoption expands or shrinks in the future is ultimately irrelevant. Other firms adopting multi-cloud doesn't make it the right solution for you, just as other firms moving away from multi-cloud doesn't mean it isn't the right solution for you.

We expect multi-cloud adoption to expand among companies that can implement it efficiently and that have a genuine business case for needing it. Larger companies — particularly those in heavily regulated areas like finance and real-money gaming — and savvy companies that can leverage the right tools and approaches to adopt multi-cloud without introducing too much complexity will continue to profit from multi-cloud.

On the other hand, adoption may ultimately contract among companies that buy into the hype around multi-cloud without a real need for it, and among companies that aren't able to implement it efficiently, driving up its cost and reducing their ROI.

We hope this report has provided some guidance to help you assess whether multi-cloud is right for your company, and if it is, how you can do it right.

About Cockroach Labs

Cockroach Labs is the creator of CockroachDB, the cloud-native, distributed SQL database designed to enable global businesses to build and operate world-changing applications. CockroachDB is trusted to run mission-critical workloads for some of the world's largest enterprises, including Bose, Comcast, Hard Rock Digital, Fortune 50 financial institutions, as well as category leaders in retail and media.

Find out how highly available CockroachDB can help you comply with regulations and improve application performance — whether you're multi-cloud, single-cloud, hybrid, or on-prem.

Talk to us