OpenLogic by Perforce + open source initiative®

State of Open Source Report

Open Source Usage, Market Trends, & Analysis

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Foreword

Dear colleagues,

Welcome to the 2023 State of Open Source Report! As you will see in the pages that follow, 2022 was another fantastic year for open source software. In collaboration with the Open Source Initiative (OSI), we created a vendor-neutral, unbiased survey that is representative of the current open source trends and usage. Once again, our survey attracted respondents from every region in the world, representing organizations of all sizes, from more than 20 major industries.

What's new this year? We updated the survey with additional questions and expanded the answer choices for every technology category. The goal: to identify more up-and-coming and trending open source technologies, and provide greater insight into what OSS organizations are using, as well as the challenges they are encountering. Some of the new questions focus on where open source investments are occurring and the level of maturity for organizations that are consuming, contributing to, and leading the open source space. As a result, I think you'll find this year's report is even more comprehensive, insightful, and forward-looking than ever before.

The foundation of this report is, of course, the survey data, and it paints a clear and compelling picture. Open source continues to be thriving space, with more people and organizations adopting open source technologies for cloud-native development, DevOps, AI, and more. When we asked, "Has your organization increased its use of open source software in the last 12 months?" the response was an emphatic "yes" from 4 out of 5 respondents, or 80% of those surveyed.

The report also delves into the reasons driving OSS adoption, the most popular technologies, and the most common support challenges. In many cases, responses varied by organization size, region, or industry, revealing some interesting trends. As you read through the report, I think you'll find much to be excited about — the future of open source is unquestionably bright, and as organizations become more sophisticated with their open source strategy, they will be better able to advance all their technology investments.

I want to thank Stefano Maffulli, OSI's Executive Director, for his wonderful support and collaboration. I'm also proud of Perforce Software for helping raise money for the United Nations World Food Program USA (WFPUSA), a global humanitarian organization that provides food assistance in areas of need, conflict, or disaster. For each valid survey response we received, we donated $1 to the WFPUSA, which is currently supplying food to people in Ukraine, Haiti, and other countries.

On behalf of OpenLogic by Perforce and OSI, I invite you to read and enjoy this report, to continue to enrich your open source knowledge, and to give back to open source projects and organizations.

Happy reading,

Javier Perez

Chief Open Source Evangelist & Sr. Director of Product Management, OpenLogic by Perforce

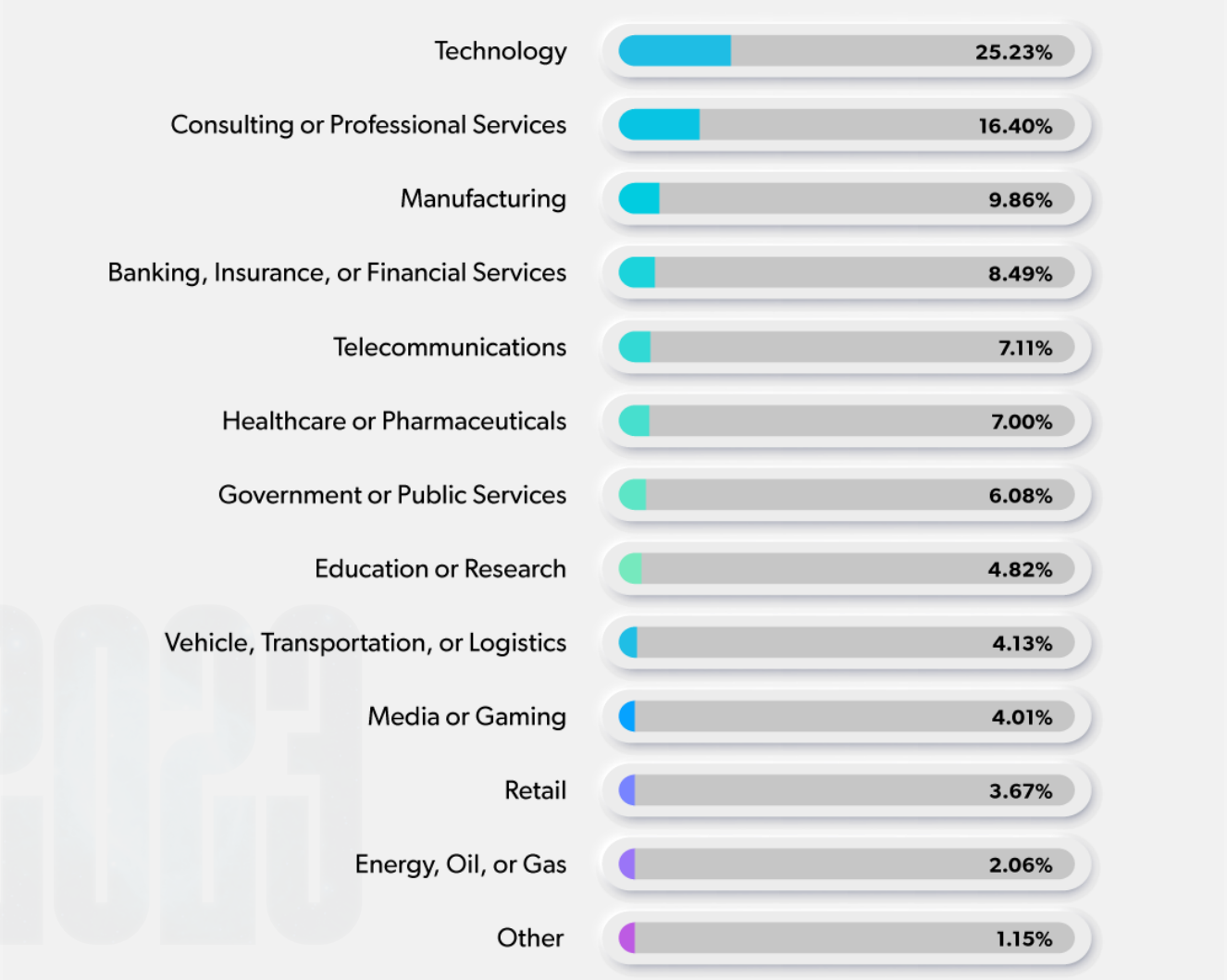
About the Survey

The 2023 State of Open Source Report is based on an anonymous survey conducted between September 27 and November 15, 2022. It targeted professionals around the world working with open source software in their organizations. The survey received a total of 872 qualified responses.

To help segment and analyze the survey results, we first asked respondents some basic demographic and firmographic questions about their industry, organization size, region, and job title.

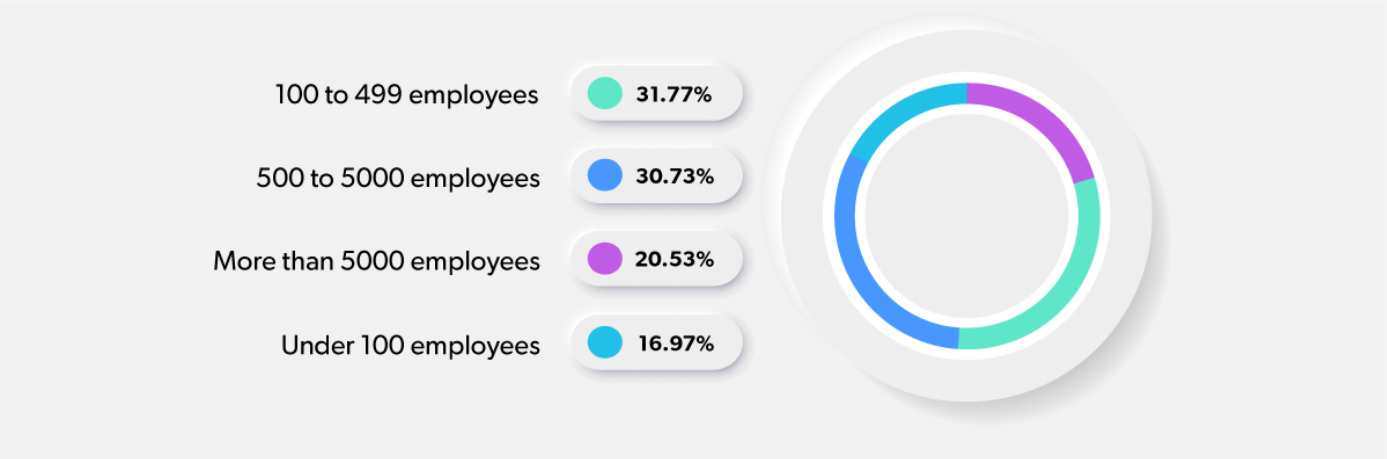
INDUSTRY

Unsurprisingly, the largest block of this year's survey respondents — about a quarter — work for technology companies. Consulting or professional services was the next most common sector, followed by manufacturing (including hardware and microprocessors), banking, and telecommunications.



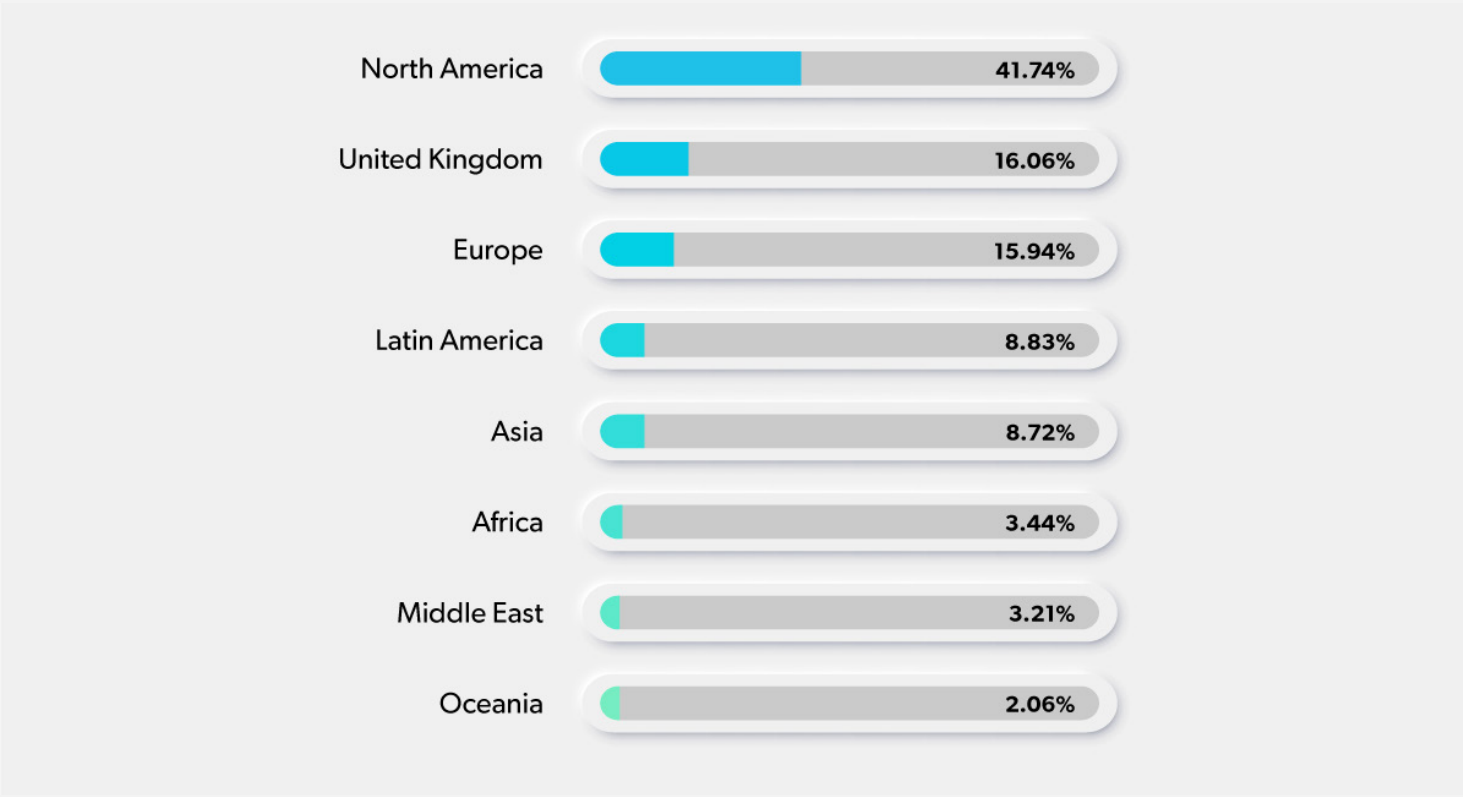
ORGANIZATION SIZE

Organizations of all sizes are working with open source, and the following graph shows the distribution of respondents by organization size.



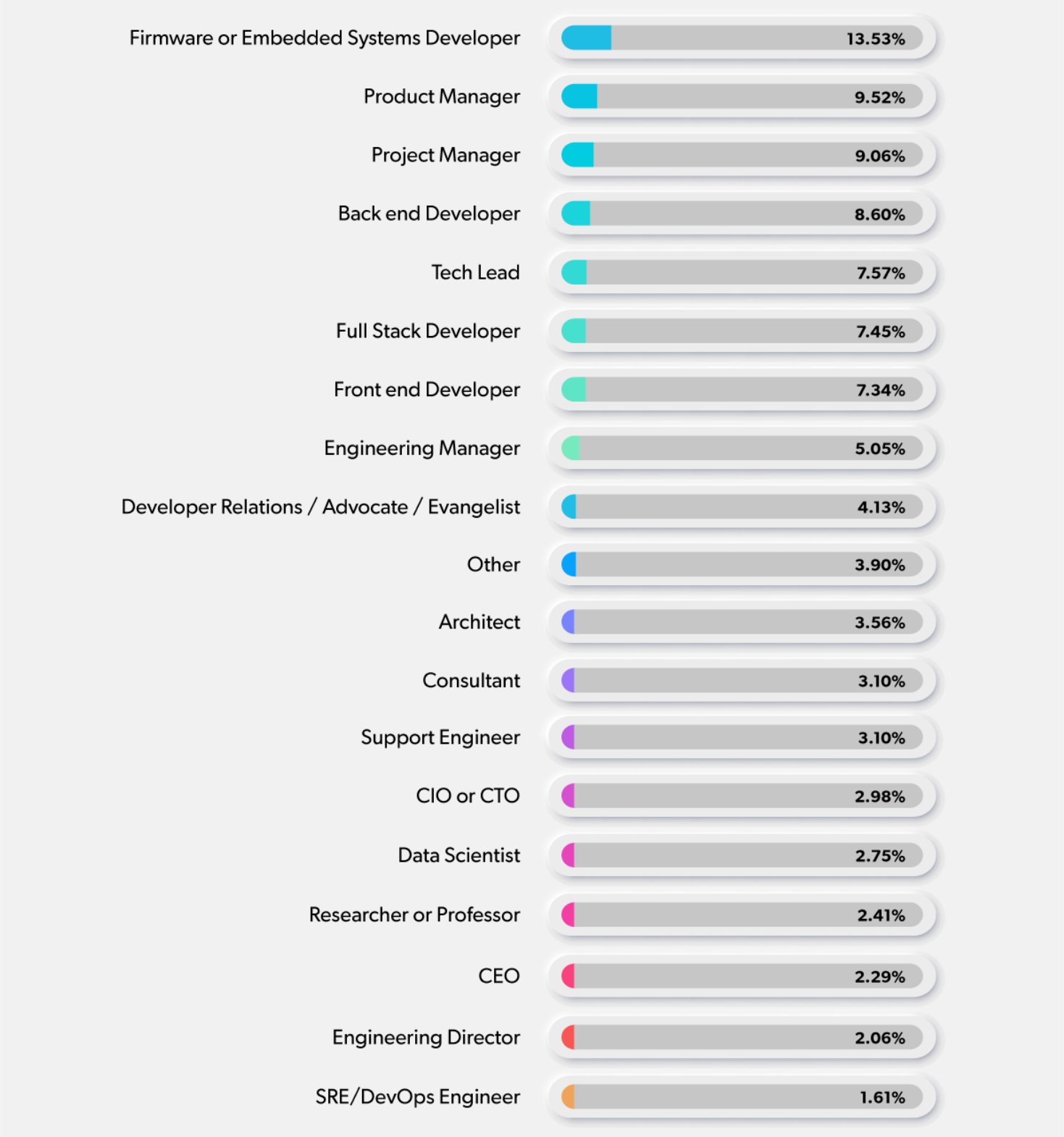
REGION

Open source software usage is truly global, and this year, we received responses from every major region in the world.



JOB TITLE

On this question, we asked respondents to select the job title that most closely matched their own. As expected, the majority of respondents are in technical roles, but they hold a variety of positions, from developers and tech leads to product managers and evangelists.



Survey Results

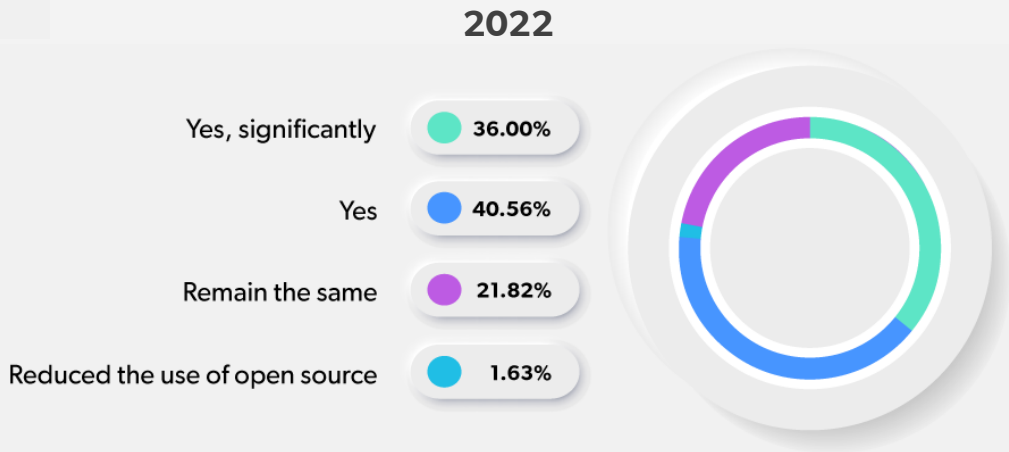
USE OF OPEN SOURCE SOFTWARE

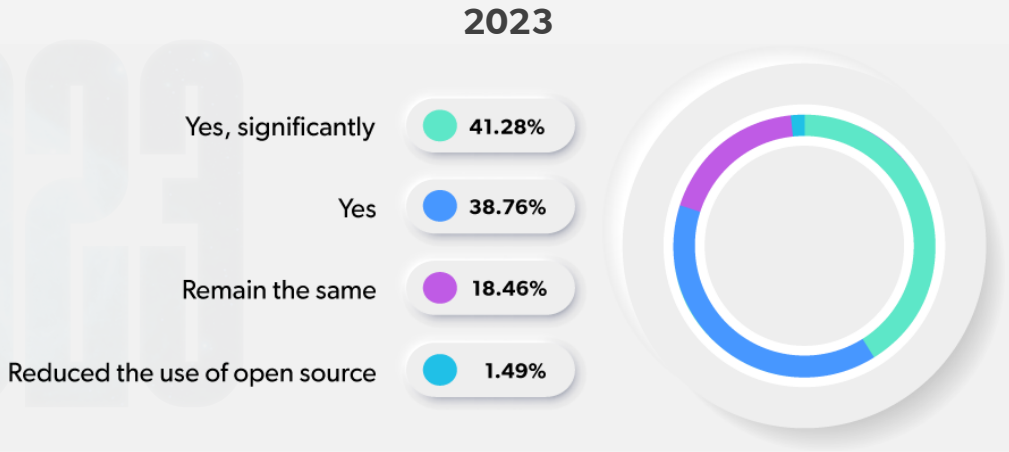
The 2023 State of Open Source Software Survey started with a question about open source use and adoption over the past 12 months. According to this year's respondents, the use of open source went up, with 80.04% affirming that they have increased their open source (compared to 77% last year), and 41.28% noting a significant increase (versus 36% last year).

80% of organizations have increased the use of open source software over the last year.

The percentage of respondents who indicated that they reduced the use of open source in their organization went down, from 1.63% to 1.49%, strongly suggesting that enterprise open source adoption is on the rise and will likely continue to climb.

Has Your Organization Increased the Use of Open Source Software Over the Last Year?





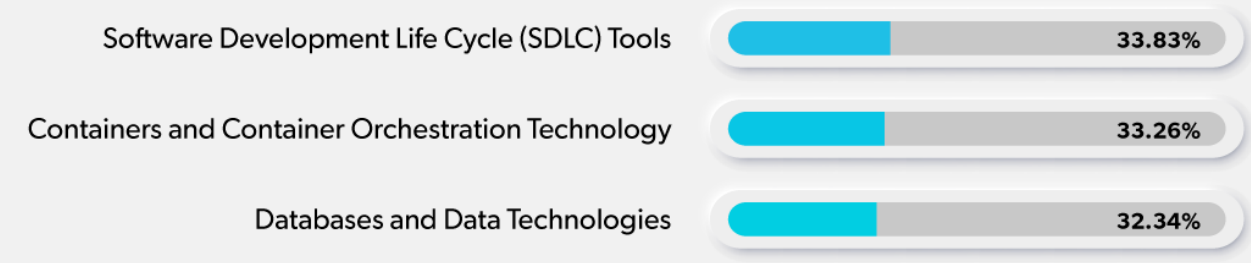
Looking at the responses to this question by industry, we see that the Telecommunications and Energy, Oil & Gas sectors are among those that have significantly increased their use and adoption of open source software in the past year.

Industry	Yes Significantly	Yes	No, it remained the same	No, we reduced the use of OSS	Total
Technology	41.82%	39.55%	17.27%	1.36%	25.52%
Consulting or Professional Services	41.96%	36.36%	20.98%	0.70%	16.59%
Telecommunications	46.77%	43.55%	8.06%	1.61%	7.19%
Banking, Insurance, or Financial Services	39.19%	43.24%	14.86%	2.70%	8.58%
Education or Research	40.48%	30.95%	26.19%	2.38%	4.87%
Vehicle, Transportation, or Logistics	27.78%	38.89%	27.78%	5.56%	4.18%
Government or Public Services	43.40%	41.51%	13.21%	1.89%	6.15%
Healthcare or Pharmaceuticals	37.70%	39.34%	22.95%	0.00%	7.08%
Manufacturing	39.53%	44.19%	16.28%	0.00%	9.98%
Retail	40.63%	28.13%	31.25%	0.00%	3.71%
Media or Gaming	45.71%	34.29%	17.14%	2.86%	4.06%
Energy, Oil, or Gas	66.67%	27.78%	5.56%	0.00%	2.09%

COMMONLY USED OPEN SOURCE TECHNOLOGIES

In order to better understand how organizations are using open source technologies, we asked what kinds of tools and software they are adopting. This year's results confirm a trend we highlighted in last year's report — that open source software is ubiquitous across a vast spectrum of technology types.

Which Categories of Open Source Software Are Being Used or Evaluated in Your Organization?



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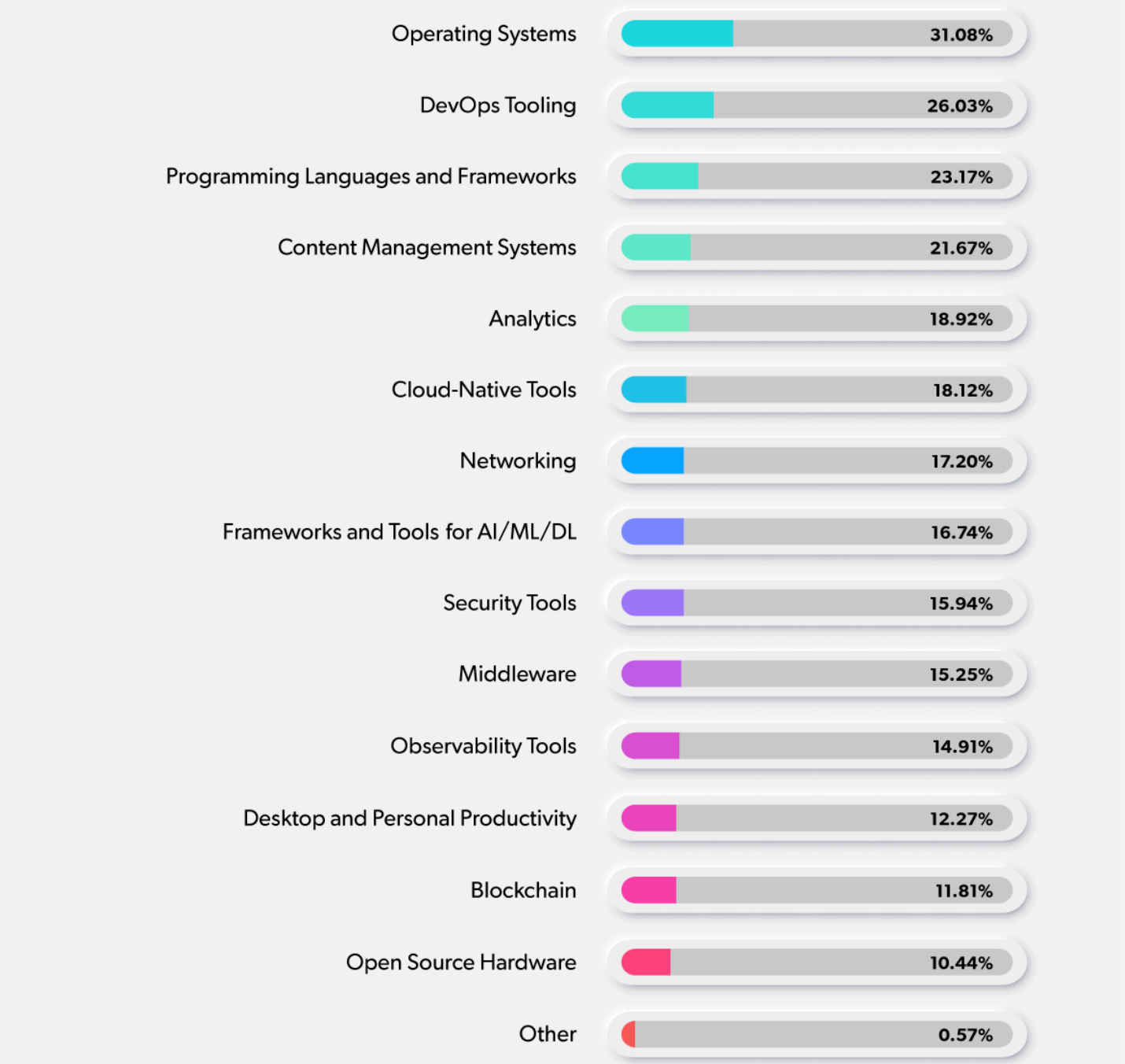


In the newly added category for open source software development life cycle (SDLC) tools, we saw a high response rate of 33.83% from all industries. Another new category, open source content management, received an impressive 21.67% of responses. Containers and container orchestration technology continue to gain adoption, with a significant increase in usage — 33.26% this year vs. 18% last year — putting it just behind SDLC tools. Regionally, organizations in North America and Europe account for 37% of usage. Notably, there is not much distinction with regards to organization size, suggesting that organizations both large and small have increased the use of containers.

Surprisingly, the use of open source security tools declined slightly to 15.94%, down from 22% in last year's survey.

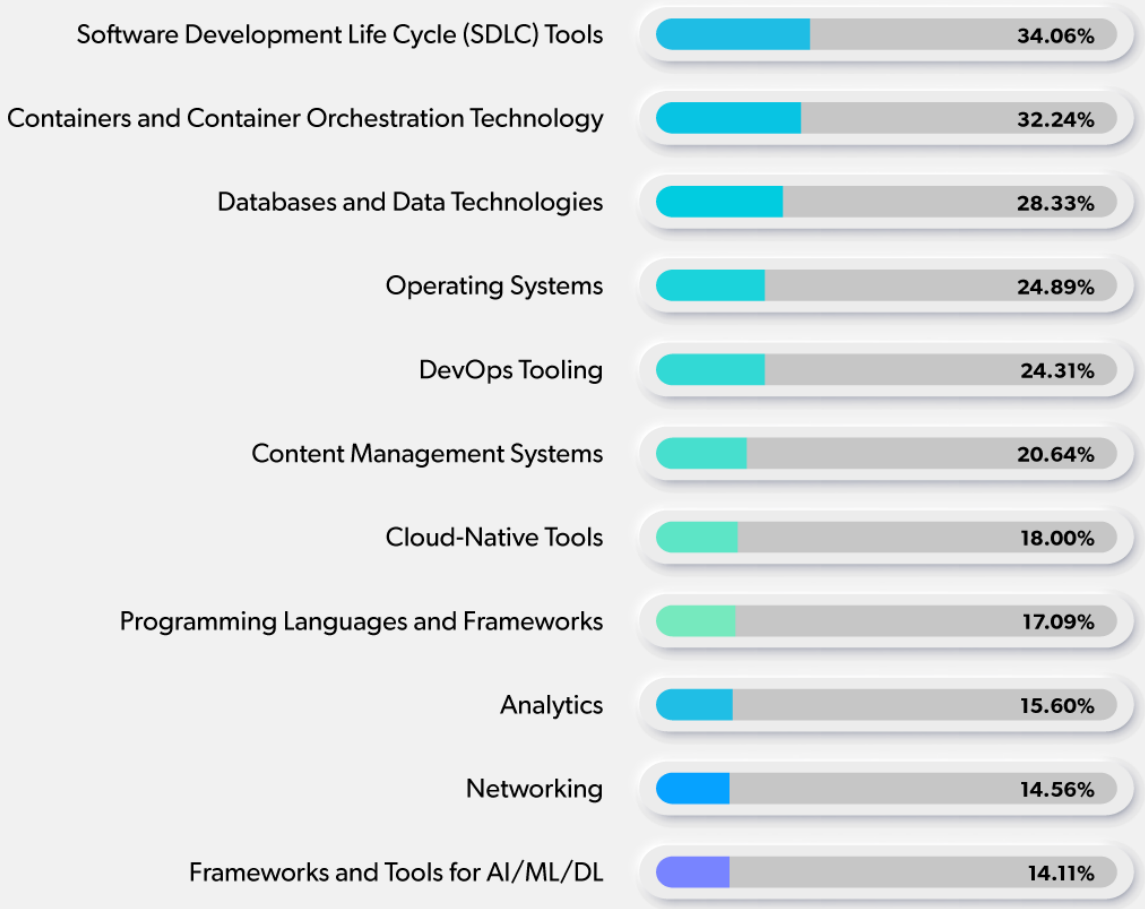
INVESTMENT IN OPEN SOURCE

Next, we asked respondents what technologies had received the most investment, in terms of budget allocation and other resources (i.e. staffing). We posed this new question to gain insight into trends and the relative levels of confidence around different technologies.

Containers and container orchestration technology, together with software development lifecycle tools, are the most invested in and most commonly used open source technologies.

The results show a correlation to the previous question, with the same top two technology types (SDLC and containerization) receiving the most buy-in from organizations. Open source databases and data technologies came in third for the most investment, which makes sense given that data and data analytics power the digital economy.

Which Categories of Open Source Software Has Your Organization Invested In the Most In Terms of Projects, Budget, and Resources?



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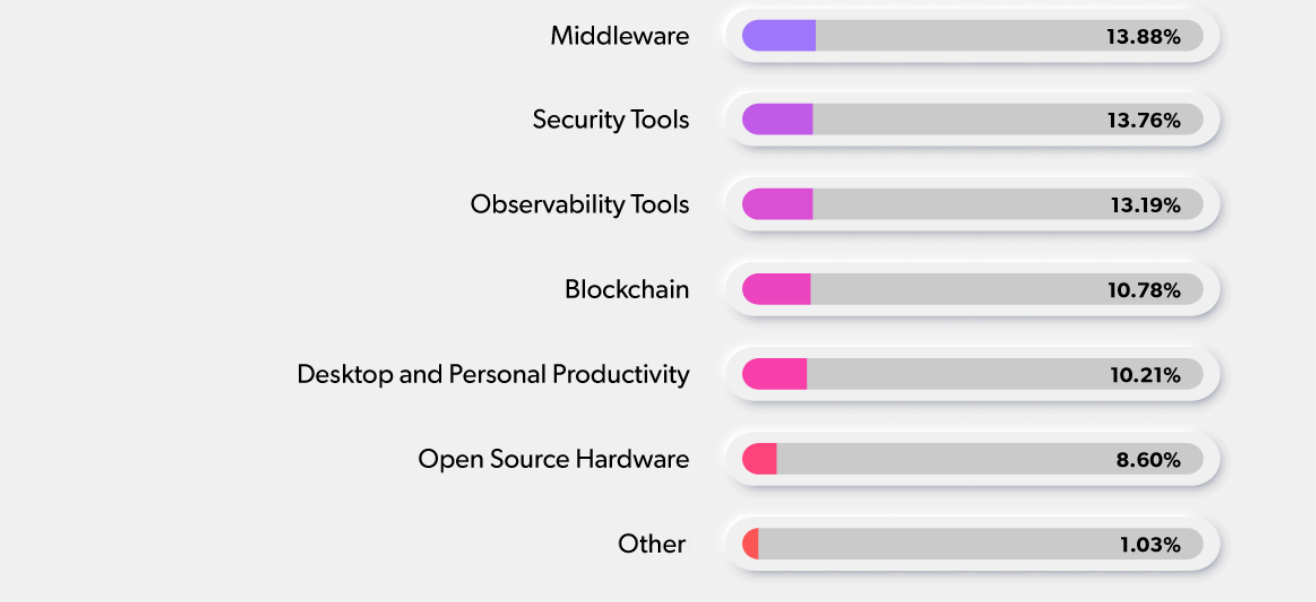
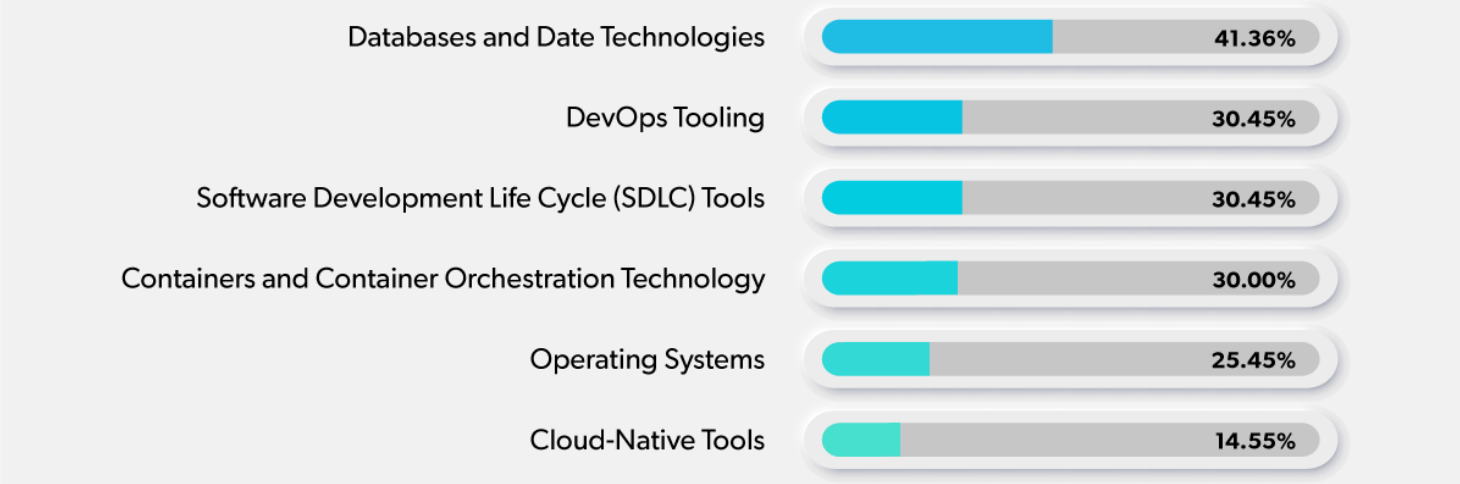


Analyzing the responses to this question by organization size yields some interesting findings. The largest organizations are investing in DevOps tooling while small organizations (under 100 employees) are investing more in databases and data technologies.

Organization Size	Databases and Data Technologies	DevOps Tooling	Software Development Life Cycle (SDLC) Tools	Containers and Container Orchestration Technology	Cloud-Native Tools
More than 5,000 employees	27.37%	31.28%	27.93%	30.73%	21.23%
500 to 5,000 employees	22.76%	25.75%	39.18%	36.94%	20.15%
100 to 499 employees	30.32%	21.66%	42.24%	35.74%	17.33%
Under 100 employees	35.81%	18.24%	16.89%	19.59%	11.49%

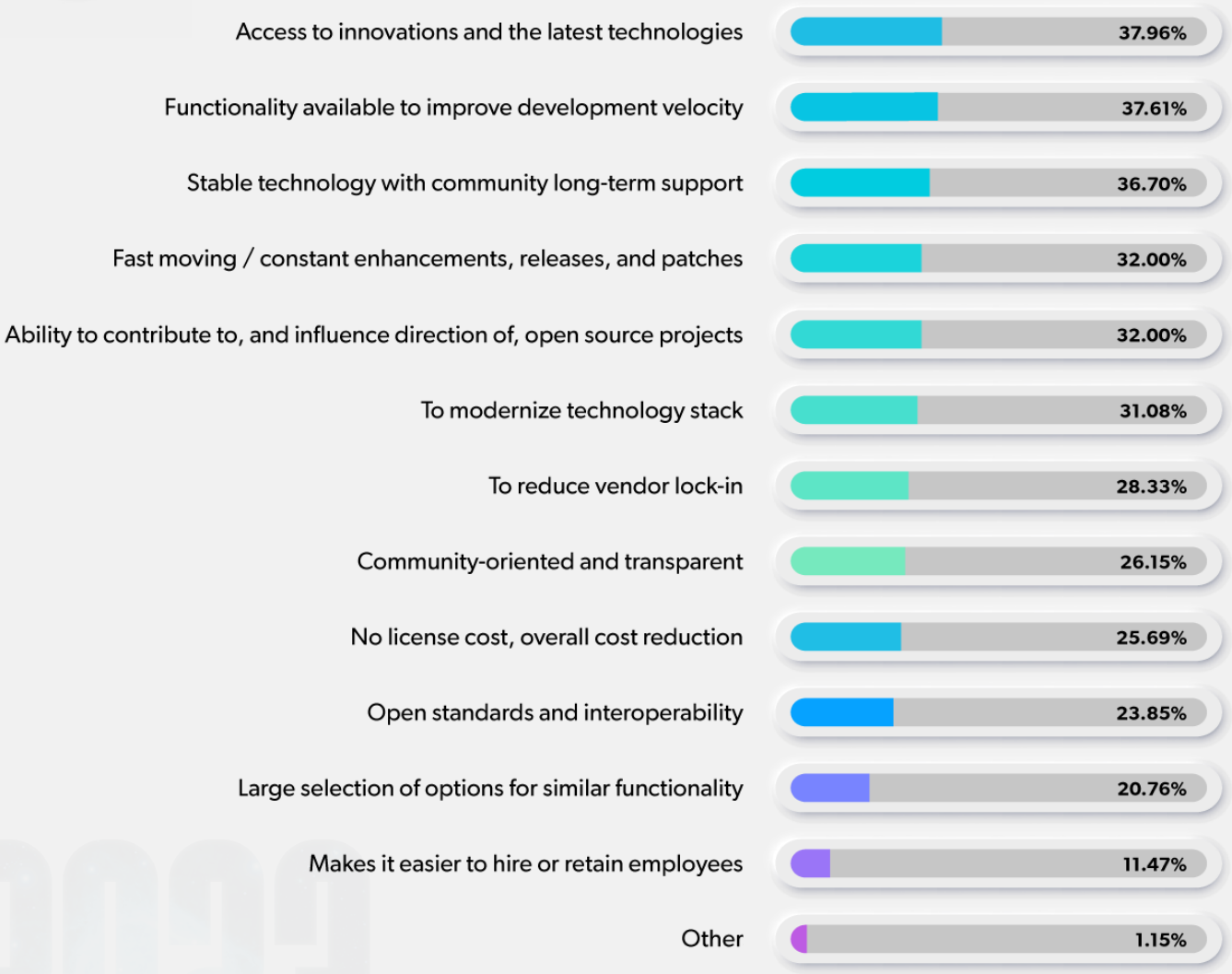
Industry-wise, technology companies are also investing the most in open source databases and data technologies:



Reasons for Organizations to Use Open Source Software

After identifying the most popular (and most invested in) open source technologies, the next step was to identify the top reasons why organizations choose open source software. We allowed respondents to select more than one answer, and the narrow gap between responses indicates that, regardless of size and industry, there is not one predominant reason why organizations choose open source software.

What Are the Top Reasons Your Organization Uses Open Source Software?



The top five reasons selected by our respondents are revealing (and encouraging):

1. Like last year, the number one motivation driving open source adoption is **access to innovations and latest technologies**. Forward-looking organizations know that the latest technologies are being developed in the open, in large part thanks to sponsorships and individual contributors that continue to improve and innovate software.

> The #1 reason organizations use open source software is to have access to innovations and the latest technologies.

2. **Functionality available to improve development velocity** was a close second, strengthening the argument that nearly all software is built on top of, or with, open source. There are millions of open source libraries such as npm, Maven, PyPi, and Nuget where developers can find open source software and improve velocity in their software development.

3. Rounding out the top three answers is **stable technology with community long-term support**, which makes sense — organizations tend to favor proven technologies backed by active support communities.

4. The same logic holds for those who selected **fast moving/constant enhancements, releases, and patches**. Understandably, organizations prefer popular projects with robust communities that continue to provide updates and patches.

5. **The ability to contribute to, and influence direction of, open source projects** was the 5th most popular response. This signifies that the collaborative spirit of the open source model is a motivating factor in open source adoption — which bodes well for the future of open source.

> Organizations also choose open source due to the ability to contribute to, and influence the direction of, open source projects.

By industry, we see some variation in reasons for adoption due to the different enterprise use cases and diverse open source technologies and applications. Notably, 40.91% of respondents working in technology selected **no license cost, overall cost reduction**, which is a significantly higher percentage than in other industries. As mentioned before, **access to innovations and latest technologies** is the top ranked reason cumulatively, but Energy, Oil or Gas organizations seem particularly motivated by that, with 61.11% choosing it compared to 30-45% in other sectors.

See tables on next page for details...

Industry	Functionality Available to Improve Development Velocity	Access to Innovations And latest Technologies	To modernize Technology Stack	Stable Technology with Community Long-Term Support	Fast Moving / Constant Enhancements, Releases and Patches	No License Cost, Overall Cost Reduction
Technology	46.82%	36.82%	33.64%	36.82%	28.18%	40.91%
Consulting or Professional Services	39.16%	39.86%	34.97%	35.66%	31.47%	16.78%
Telecommunications	35.48%	30.65%	37.10%	41.94%	35.48%	17.74%
Banking Insurance, or Financial Services	35.14%	36.49%	25.68%	37.84%	31.08%	12.16%
Education or Research	26.19%	30.95%	21.43%	26.19%	26.19%	35.71%
Vehicle, Transportation, or Logistics	25%	41.67%	33.33%	27.78%	52.78%	19.44%
Government or Public Services	35.85%	33.96%	26.42%	35.85%	32.08%	26.42%
Healthcare or Pharmaceuticals	34.43%	34.43%	27.87%	31.15%	31.15%	21.31%
Manufacturing	38.37%	45.35%	33.72%	46.51%	34.88%	10.47%
Retail	25%	31.25%	28.13%	53.13%	34.38%	21.88%
Media or Gaming	31.43%	45.71%	22.86%	25.71%	40%	37.14%
Energy, Oil, or Gas	44.44%	61.11%	33.33%	38.89%	33.33%	27.78%

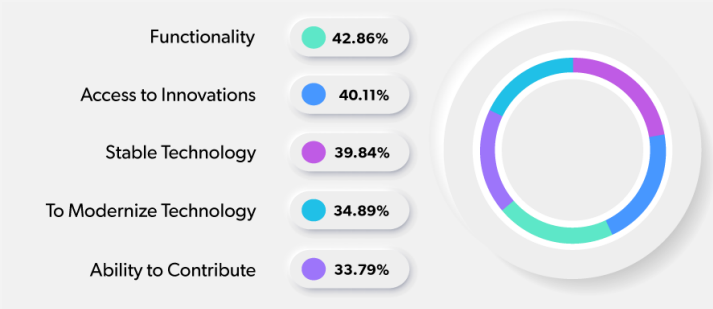
Graph continued...

Large Selection of Options for Similar Functionality	To Reduce Vendor Lock-In	Community-Oriented And Transparent	Ability to Contribute to, and Influence Direction of, Open Source Projects	Open Standards And Interoperability	Makes it Easier to Hire or Retain Employees
20.45%	30.91%	22.73%	25.91%	28.64%	12.27%
25.87%	29.37%	20.28%	33.57%	14.69%	6.29%
12.90%	24.19%	29.03%	40.32%	17.74%	14.52%
12.16%	13.51%	24.32%	24.32%	28.38%	18.92%
21.43%	33.33%	38.10%	35.71%	35.71%	9.52%
22.22%	19.44%	5.56%	36.11%	22.22%	13.89%
26.42%	32.08%	33.96%	32.08%	30.19%	9.43%
21.31%	32.79%	27.87%	34.43%	22.95%	16.39%
25.58%	26.74%	36.05%	43.02%	18.60%	11.63%
15.63%	31.25%	31.25%	25%	25%	9.38%
20%	37.14%	25.71%	42.86%	22.86%	8.57%
16.67%	33.33%	33.33%	16.67%	16.67%	5.56%

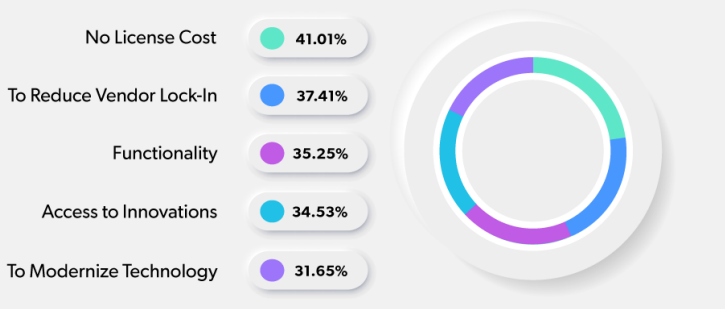
Digging a little deeper and looking at responses by geography, it turns out that **access to innovations and latest technologies** — while consistently in the top four and number one in North America and Asia — is not the first choice in other parts of the world.

In Europe, for example, **no license cost/overall cost reduction** ranks higher (as it did last year). In the UK, where we have seen advanced open source maturity in organizations, the top reason is the **ability to contribute to, and influence direction of, open source projects**. This is also the most popular response among respondents in Latin America, which traditionally has been slower to adopt open source. If participating in open source projects is a compelling factor for organizations in that region, perhaps we will see greater open source maturity and growth there in the future.

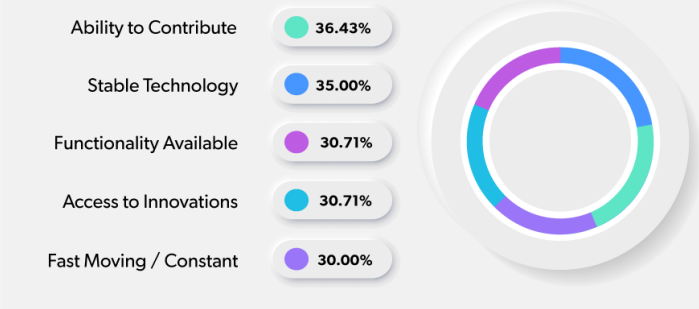
Top Reasons In North America



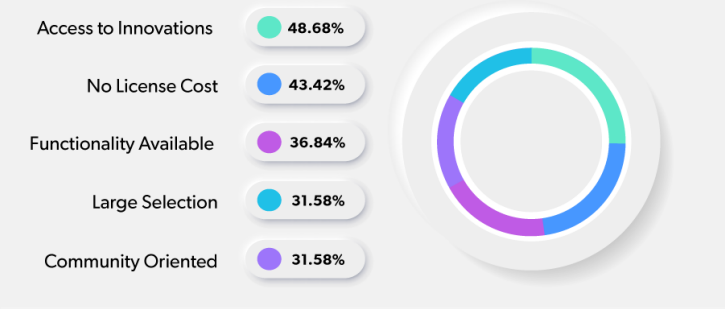
Top Reasons In Europe



Top Reasons In United Kingdom



Top Reasons In Asia

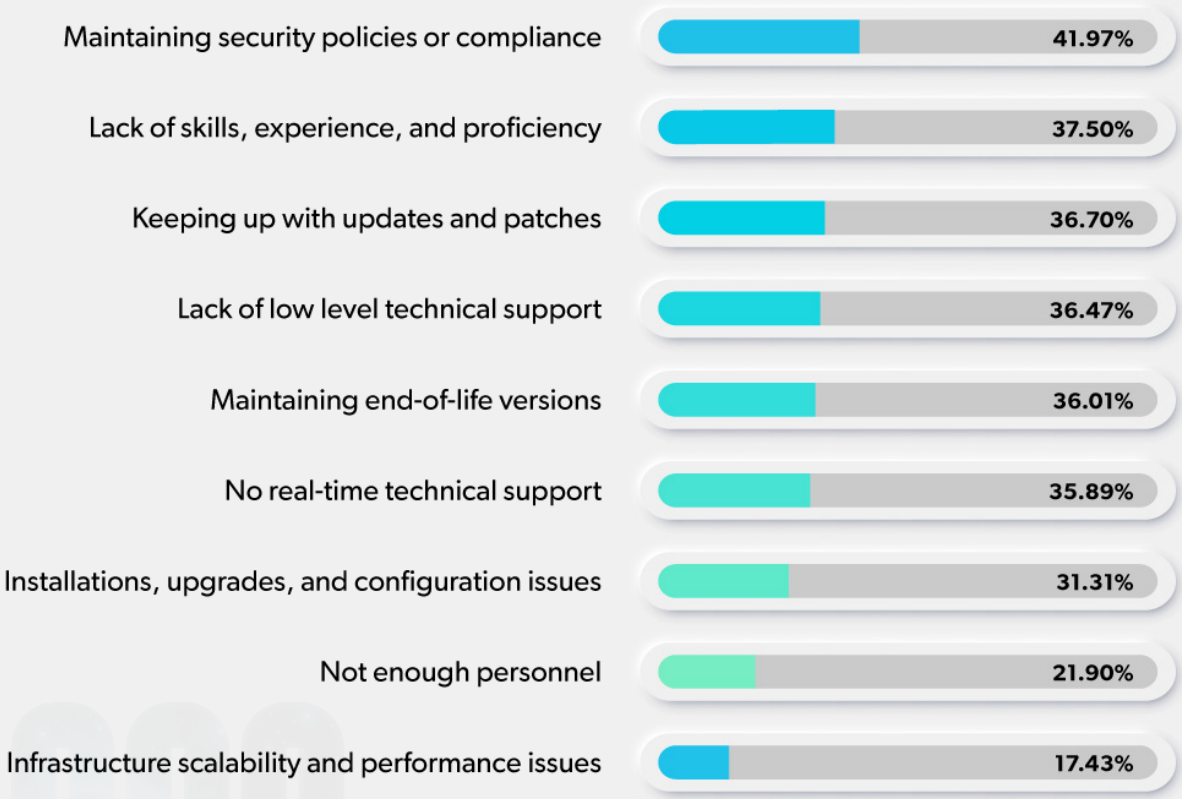


Support Challenges While Using Open Source Software

While it's evident that open source software adoption is increasing, there are certainly areas where organizations have challenges, especially when it comes to technical support. On this year's survey, we first asked about overall support challenges across all open source technologies (respondents could select multiple answers).

Maintaining security policies or compliance is the top support challenge for organizations using open source.

What Are Your Organization's Top Support Challenges While Using Open Source Software?



Let's look at the top support challenges that each garnered more than a third (33%) of votes from global respondents across different organization sizes and industries:

- The increased awareness and legislation around open source security is reflected in the top support challenge identified: **Maintaining security policies or compliance**. This indicates that organizations are concerned about their security posture and prioritizing compliance with internal or external requirements regarding open source software usage.
- As we saw in last year's survey, **lack of skills, experience, and proficiency** remains a problem for organizations around the world. It is a great time to be an engineer with open source knowledge and experience, as there are many opportunities.
- **Keeping up with updates** and **patches and maintaining end-of-life versions** are also among the top support challenges for organizations. Shorter release life cycles, constant updates, and older versions becoming end-of-life, sometimes unexpectedly, have undoubtedly impacted organizations. Continuous integration and continuous delivery (CI/CD) are a reality in open source projects, too, and it can be a struggle for organizations to keep up.
- Finally, the **lack of low-level technical support** and **no real-time technical support** continue to be an issue, and are exacerbated by all of the above, from skill gaps to constant updates that require technical support and expertise.

Perhaps unsurprisingly, support challenges vary depending on the size of the organization. For example, small organizations (under 100 employees), are less worried about **maintaining security policies or compliance**, yet that is the top challenge for larger organizations. **Installations, upgrades, and configuration issues** was selected at a higher rate for small and medium-sized organizations (<499 employees).

Organization Size	Not Enough Personnel	Lack of Skills, Experience, and Proficiency	No Real-Time Technical Support
More than 5,000 employees	24.02%	34.08%	32.40%
500 to 5,000 employees	18.66%	35.82%	40.30%
100 to 499 employees	22.74%	40.43%	35.38%
Under 100 employees	23.65%	39.19%	33.11%

Lack of Low Level Technical Support	Maintaining Security Policies or Compliance	Maintaining End-of-Life Versions	Keeping Up With Updates and Patches	Installations, Upgrades, and Configuration Issues	Infrastructure Scalability and Performance Issues
35.20%	40.78%	32.96%	34.64%	27.93%	16.20%
42.54%	42.54%	35.82%	42.91%	28.73%	19.40%
34.66%	49.46%	39.35%	33.21%	35.02%	19.86%
30.41%	28.38%	33.78%	34.46%	33.11%	10.81%

Top Open Source Infrastructure Technologies

Following these initial questions about the most widely used open source technologies, reasons for adoption, and support challenges, we then asked respondents about specific software categories, beginning with infrastructure. Of the thousands of open source infrastructure technologies, we focused on the most popular Linux distributions and other key enterprise infrastructure tools.

As in previous years, Ubuntu Linux is the most used Linux distribution; however, this year the addition of more Linux options included in the survey led to interesting results. For example, Alpine Linux and Arch Linux were popular choices.

As expected with end-of-life software, CentOS Linux usage is declining, while newer distributions such as CentOS Stream and Rocky Linux continue to gain adopters. The survey also revealed that organizations often do not use only one distribution — most respondents indicated they use two or more distributions within their organizations.

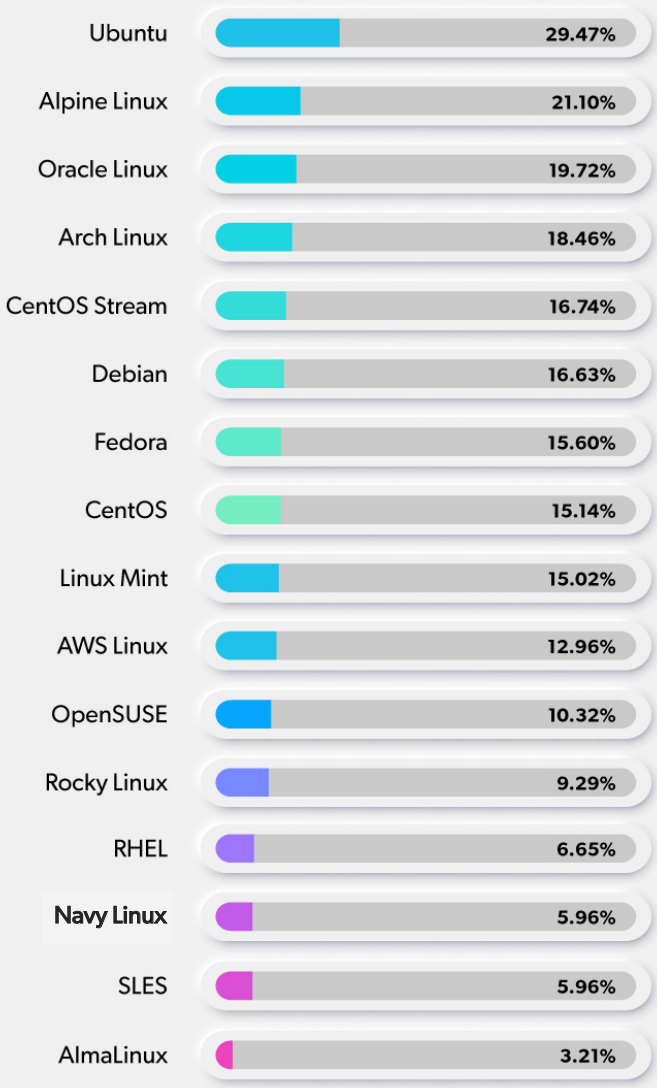
As expected with EOL software, CentOS Linux had a decline in usage while CentOS Stream and Rocky Linux became more widely adopted.

Java stacks with key open source infrastructure components such as Apache Tomcat, TomEE, and ActiveMQ remain popular.

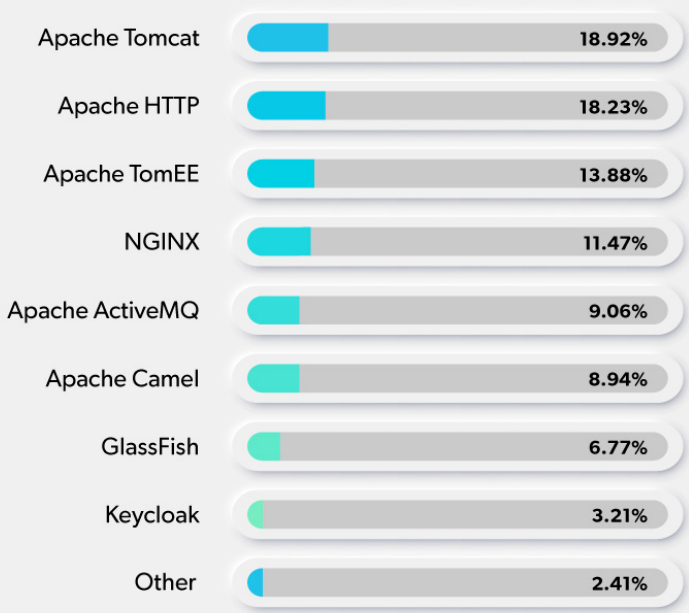
The use of Apache Tomcat, Apache TomEE, and Apache ActiveMQ shows how prevalent Java applications are across all industries. On the web server side, Apache HTTP continues to lead, with NGNIX about 7% behind. When we asked respondents to include other options, the Yocto project received several mentions.

Which Open Source Infrastructure Tools and Linux Distributions Does Your Organization Use Today to Support Your Software Infrastructure?

Linux Distributions



Other Infrastructure Software



Usage of Enterprise Linux by industry shows different preferences, probably due to the arrival of newer distributions since CentOS became end-of life. Technology companies are still predominantly using CentOS, likely because they have a large number of deployments on CentOS and have not had time to migrate. Other industries, particularly telecommunications and transportation, favor CentOS Stream, Rocky Linux, and AlmaLinux.

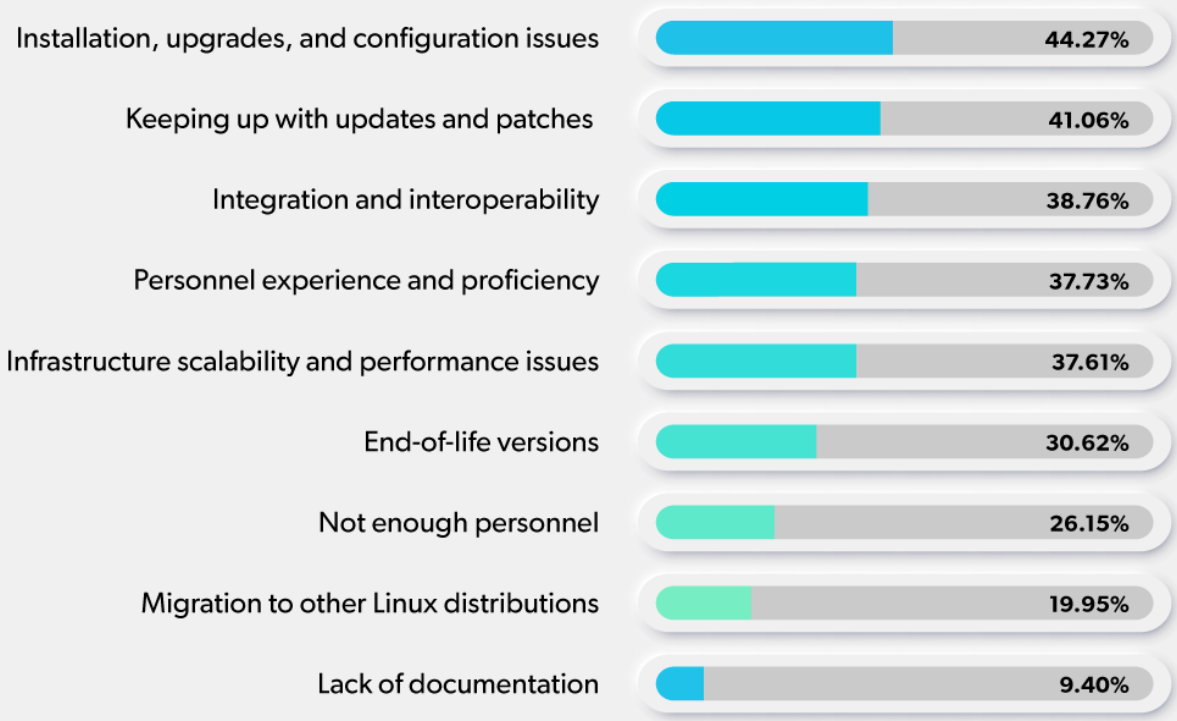
Industry	CentOS	CentOS Stream	Rocky Linux	AlmaLinux
Technology	24.09%	13.18%	7.27%	2.27%
Consulting or Professional Services	13.99%	22.38%	8.39%	2.80%
Telecommunications	11.29%	22.58%	11.29%	3.23%
Banking Insurance, or Financial Services	10.81%	8.11%	10.81%	8.11%
Education or Research	14.29%	11.90%	9.52%	7.14%
Vehicle, Transportation, or Logistics	8.33%	5.56%	11.11%	2.78%
Government or Public Services	13.21%	16.98%	5.66%	3.77%
Healthcare or Pharmaceuticals	18.03%	21.31%	6.56%	0.00%

SUPPORT CHALLENGES WITH OPEN SOURCE INFRASTRUCTURE TECHNOLOGIES

Due to the criticality and complexity of open source infrastructure, it's no surprise that the top challenge for the second year in a row is **installation, upgrades, and configuration issues**. Interestingly, **keeping up with updates and patches**, which was the 4th most selected reason last year, moved up to the number two spot. The Log4j vulnerability and recent OpenSSL vulnerabilities likely influenced this change.

Infrastructure scalability and performance reasons, integration and interoperability, and **personnel experience and proficiency** also received a lot of votes. These support challenges speak to the complexity of administration, support, and maintenance of open source infrastructure. Though open source communities are doing an excellent job releasing patches and enhancements, it is still up to the organizations to stay up to date and acquire the skills and expertise to address these support challenges.

What Are the Main Support Challenges With Your Open Source Software Infrastructure?

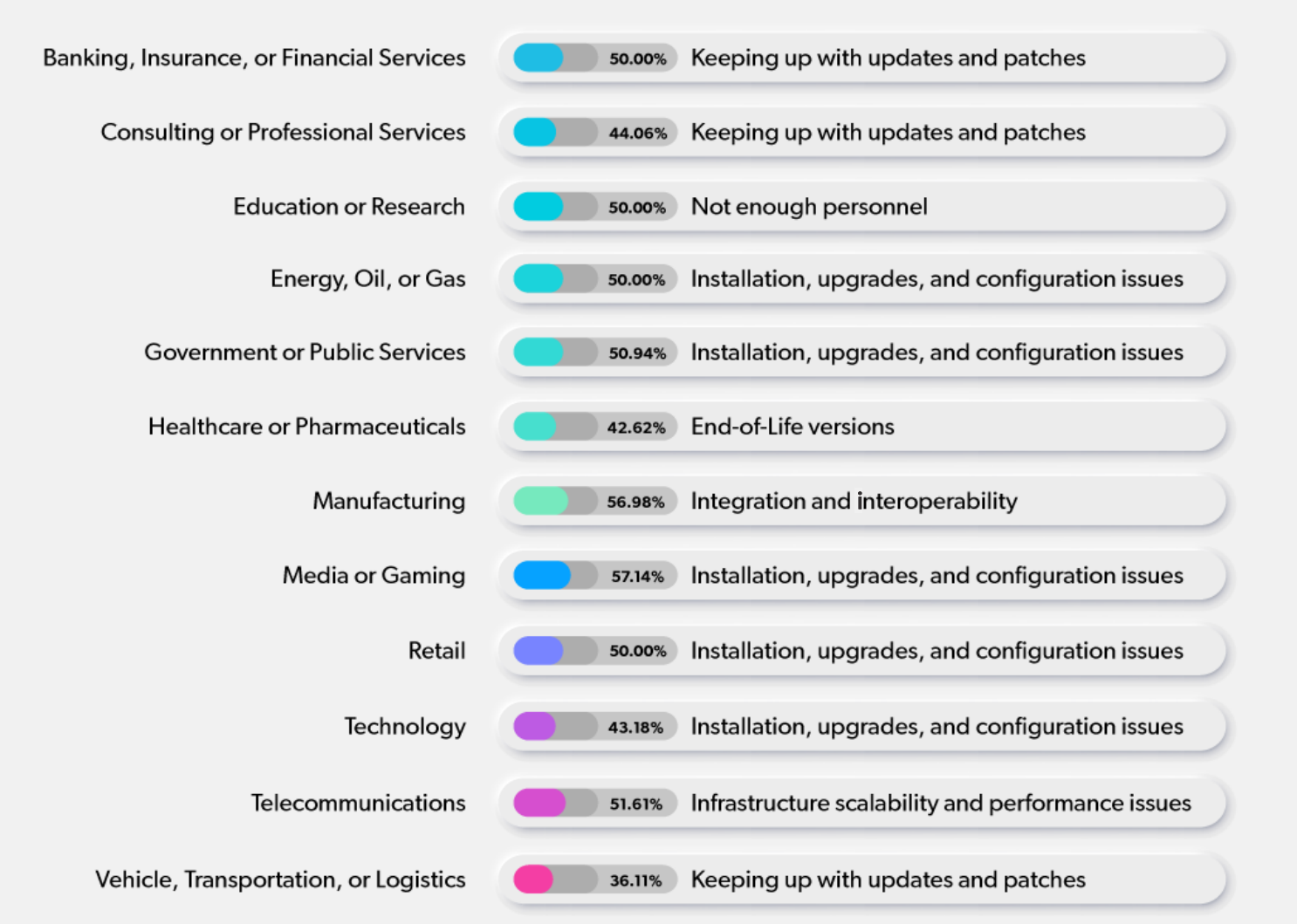


Looking at the results by organization size, we see some differences. For example, **personnel experience and proficiency** is the top challenge for organizations with fewer than 100 employees, perhaps because individuals with Linux and other infrastructure technology expertise are expensive and in high demand. For organizations with over 5,000 employees, **keeping up with updates and patches** is the top challenge, followed by **installation, upgrades, and configuration issues** and **end-of-life versions**, reenforcing that security concerns around running unpatched or older versions of software are top of mind for larger enterprises.

Organization Size	Not Enough Personnel	Personnel Experience and Proficiency	Installations, Upgrades, and Configuration Issues
100 to 499 employees	25.63%	38.27%	48.38%
500 to 5,000 employees	23.51%	36.57%	47.01%
More than 5,000 employees	28.49%	32.96%	37.99%
Under 100 employees	29.05%	44.59%	39.19%

Infrastructure Scalability and Performance Issues	Integration and Interoperability	Keeping Up With Updates and Patches	End-of-Life Versions	Migration to Other Linux Distributions	Lack of Documentation
42.96%	41.88%	45.85%	31.41%	20.94%	7.94%
44.78%	43.66%	39.93%	34.33%	22.39%	8.96%
31.28%	34.64%	38.55%	35.20%	20.11%	10.08%
22.30%	29.05%	37.16%	16.89%	13.51%	12.16%

As expected, open source infrastructure poses different challenges based on industry. Some organizations struggle to keep up with updates and patches, while for others, installation and configuration remains the top challenge. Here are the top open source infrastructure support challenges by industry:



Top Cloud-Native Open Source Technologies

Cloud-native open source software is, without a doubt, one of the biggest trends in open source. Container-based deployments are on the rise, coinciding with an increase in open source tools designed to support cloud-native environments.

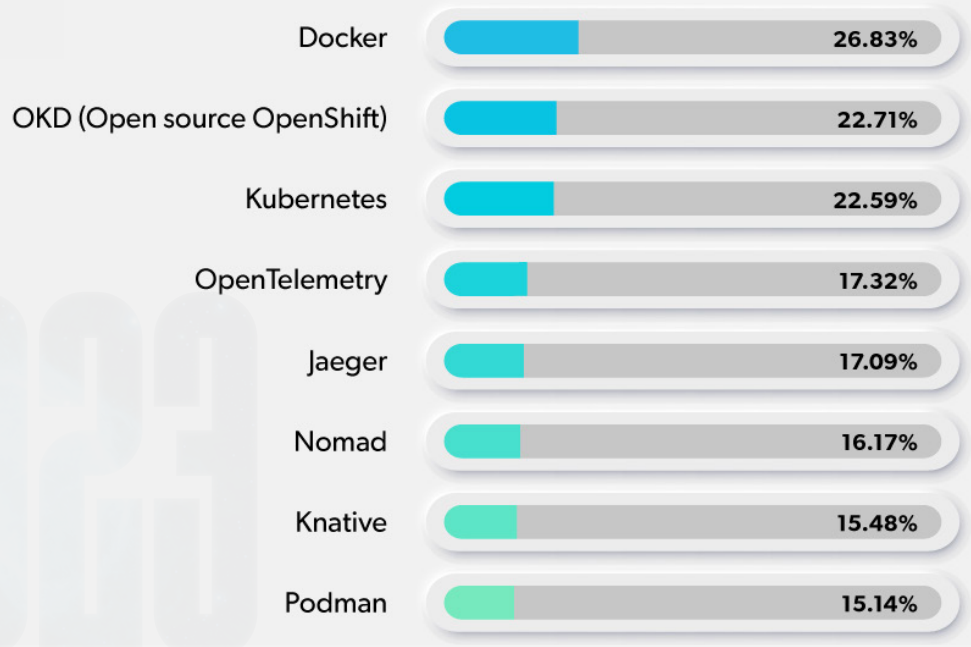
Case in point: Kubernetes usage increased by 5% in the past year; with 22.59% of the votes, it's now the third most used cloud-native technology. With the exception of OpenStack, whose usage dropped by about 10% compared to last year, every cloud-native technology grew over the last 12 months. Projects in the observability space, such as OpenTelemetry, Jaeger, and Prometheus, are also being adopted at a particularly rapid pace.

> With the exception of OpenStack, cloud-native technologies show significant adoption in organizations of all types and sizes.

Other highlights here include the increased use of Knative (15.48%), a tool for building serverless and event-driven applications, and Strimzi (12.61%), an operator that allows Apache Kafka clusters to run on Kubernetes.

Only 6.54% of respondents reported not using any cloud-native open source technologies, which is further proof that this is a "hot" trend that will likely continue to grow in the coming years.

Which Cloud-Native Open Source Technologies Does Your Organization Use Today?



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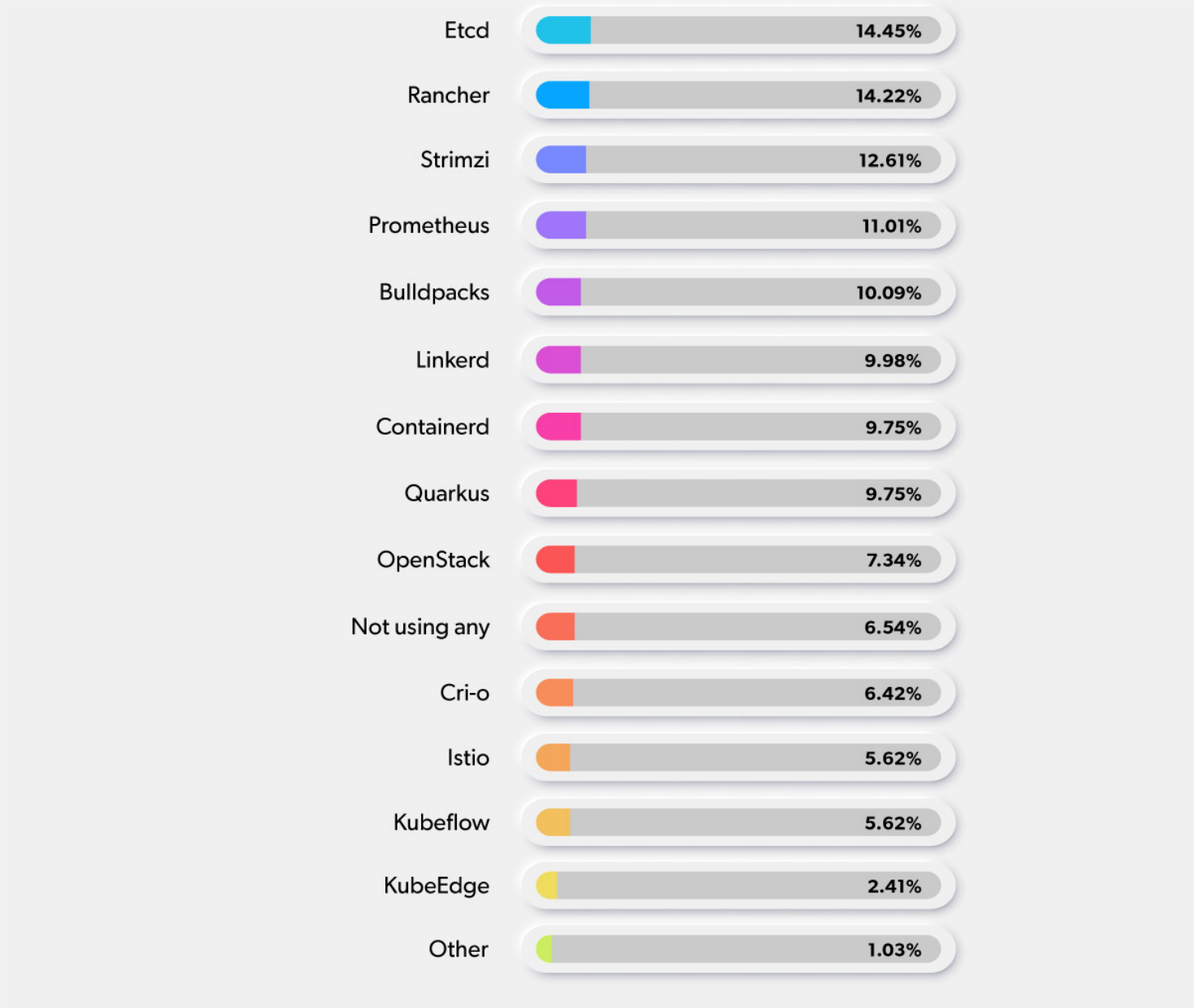
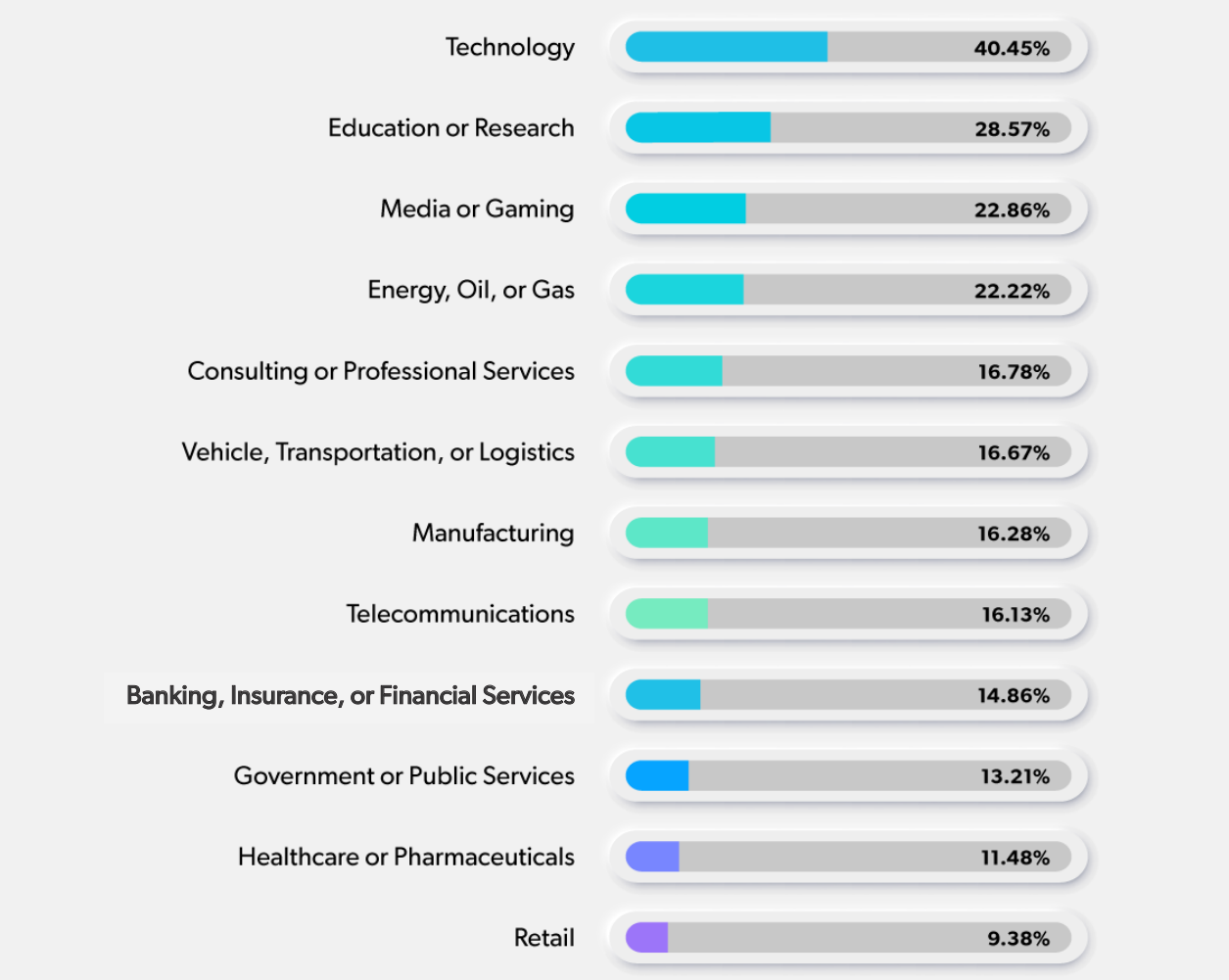


Breaking down the data by organization size, we see that among mid-size and large organizations, less than 4% do not use cloud-native technologies, whereas about 21% of small organizations (100 employees or fewer) do not.

Cloud-native technologies exist primarily in Kubernetes-native environments. Nearly a third (32.40%) of respondents who work for organizations with more than 5,000 employees are using Kubernetes, which is 10% higher than the overall average of 22.59% for Kubernetes usage. On the other hand, 27.70% of small organizations are using Kubernetes, which suggests that smaller and/or younger organizations, like startups, are immediately beginning their software development with trending technologies like Kubernetes.

Organization Size	Not Using Any	Kubernetes
More than 5,000 employees	3.91%	32.40%
500 to 5,000 employees	3.36%	19.40%
100 to 499 employees	3.61%	16.61%
Under 100 employees	20.95%	27.70%

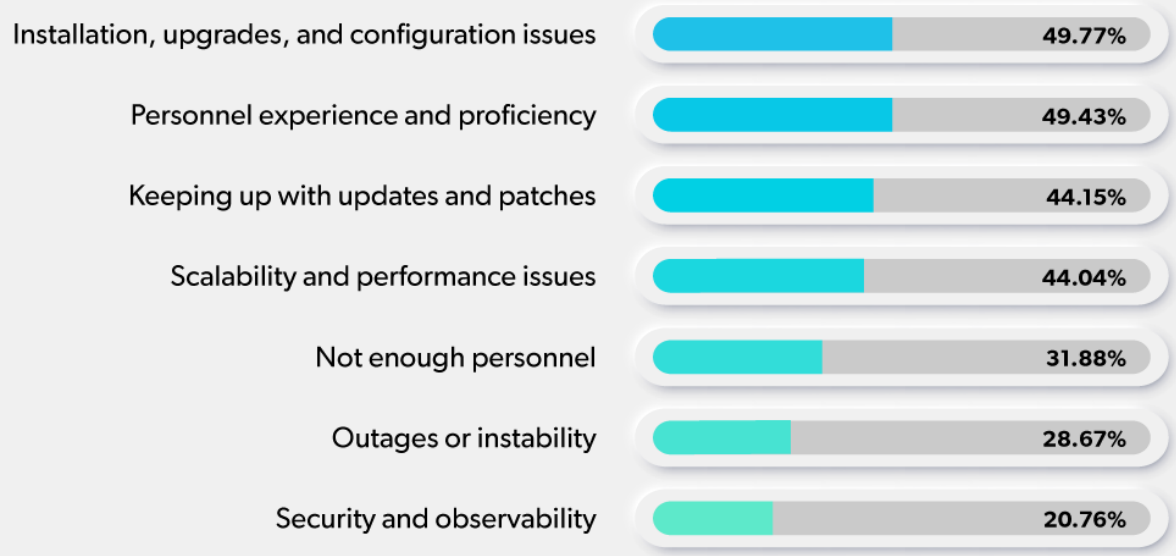
This table with Kubernetes usage by industry shows that technology companies represent the largest group by far (40.45%), and retail organizations have the lowest adoption (9.38%).



SUPPORT CHALLENGES WITH OPEN SOURCE CLOUD-NATIVE TECHNOLOGIES

When it comes to support challenges for open source cloud-native technologies, the data revealed a clear top four: **Installation, upgrades, and configuration issues; personnel experience and proficiency; keeping up with updates and patches;** and **scalability and performance issues**. Clearly, implementing and scaling cloud-native deployments and having a team with the skills and expertise required to keep those deployments up-to-date, secure, and running optimally is a priority for organizations all over the world.

What Are the Main Support Challenges With Your Organization's Cloud-Native Technologies?



The following chart shows how the top four support challenges with open source cloud-native technologies break out by the size of the organization. **Personnel experience and proficiency** is especially an obstacle for small organizations, while **installation, upgrades, and configuration issues** rank higher for larger organizations.

Organization Size	Personnel Experience and Proficiency	Installations, Upgrades, and Configuration Issues	Scalability and Performance Issues	Keeping Up With Updates and Patches
More than 5,000 employees	41.34%	45.81%	44.69%	42.46%
500 to 5,000 employees	51.49%	54.48%	45.90%	52.61%
100 to 499 employees	52.35%	53.43%	51.26%	44.04%
Under 100 employees	50.00%	39.19%	26.35%	31.08%

Here's how the #1 support challenge responses break out by industry:

Installation, upgrades, and configuration issues

1. Manufacturing (63.9%)
2. Consulting or Professional Services (57.3%)
3. Banking, Insurance, or Financial Services (52.7%)

Scalability and performance issues

1. Retail (59.3%)
2. Healthcare or Pharmaceuticals (55.7%)
3. Education or Research (52.3%)

Personnel experience and proficiency

1. Energy, Oil or Gas (66.6%)
2. Telecommunications (58%)
3. Technology (50%)
4. Vehicle, Transportation, or Logistics (44.4%)

Keeping up with updates and patches

1. Media or Gaming (57.1%)
2. Government or Public Services (54.7%)

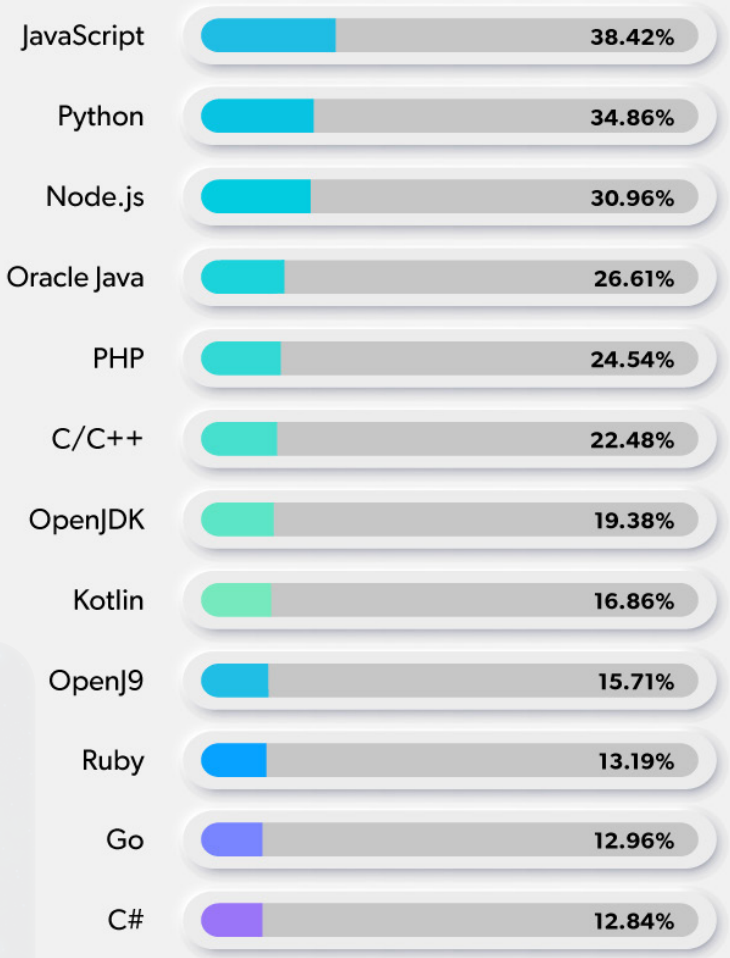
Top Open Source Programming Languages/Runtimes

Programming languages continue to be the open source entry point for thousands of software developers. This year, we expanded the list of popular open source programming languages and runtimes in this question to 19 options, including Rust, R, Julia, Scala, Clojure, and more.

As we saw in last year's report, JavaScript and Python continue to be the leaders, but only show a modest 1-2% increase in usage across industries. Other programming languages also had small gains, including a few selections under the "other" category where respondents could write in a response (Typescript was a popular write-in).

For the second year in a row, the three most popular open source Java runtimes are OpenJDK, OpenJ9, and Oracle Java. Oracle Java usage declined by 4% from last year's survey, while OpenJDK and OpenJ9 remained stable.

Which Technologies Does Your Organization Use to Code Applications Today?



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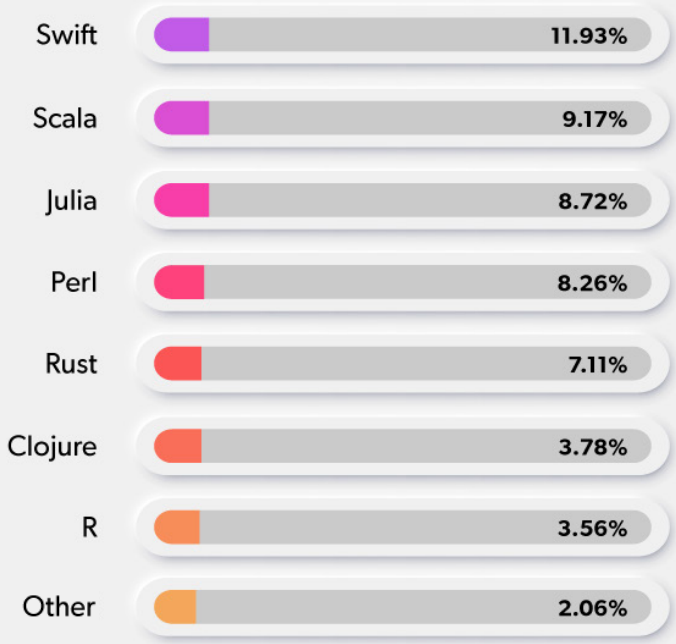


Some programming languages are better than others for certain functions or types of applications; nevertheless, skills of personnel are typically the determining factor for the adoption and use of open source programming languages and runtimes.

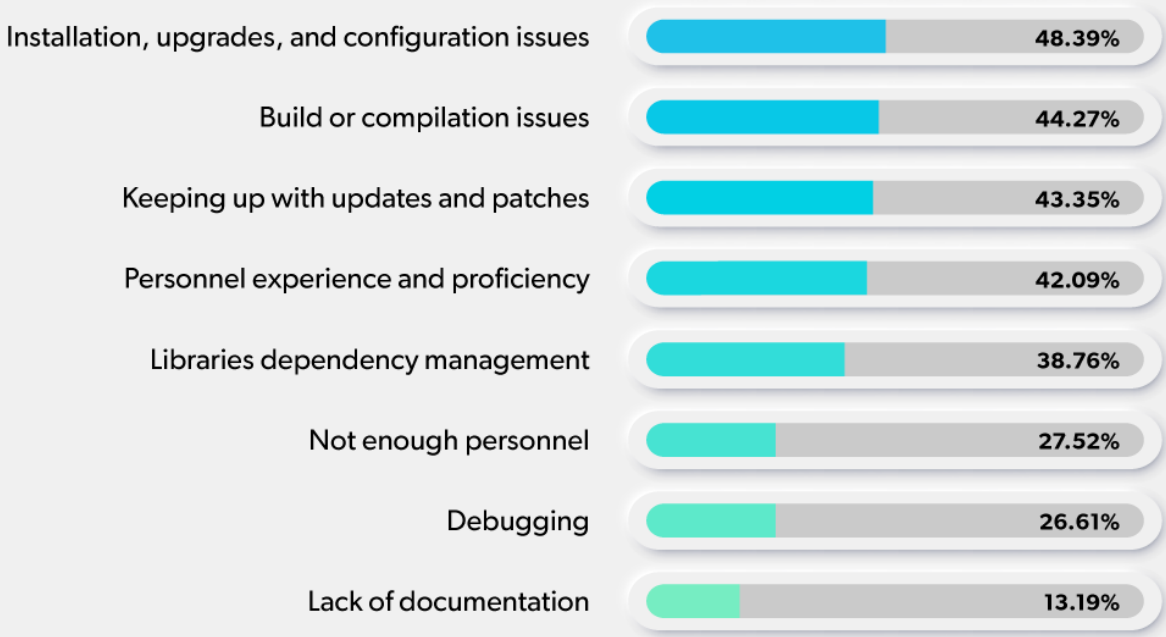
This table shows the top programming language usage by organization size, and we can see the clear winners are Python, JavaScript, and Node.js.

Organization Size	Most used language	Second most used language	Third most used language
More than 5,000 employees	Python	C/C++	JavaScript
500 to 5,000 employees	Node.js	JavaScript	Python
100 to 499 employees	JavaScript	Python	Oracle Java
Under 100 employees	JavaScript	PHP	Python

SUPPORT CHALLENGES WITH OPEN SOURCE PROGRAMMING LANGUAGES/RUNTIMES

Installations, upgrades, and configuration issues was the most selected support challenge associated with using open source programming languages and runtimes, chosen by 48.39% of the respondents. **Build or compilation issues** came in second, selected by 44.27% of respondents. Interestingly, **libraries dependency management** got a slightly lower response rate this year, declining from 40.42% to 38.76%.

What Are the Main Support Challenges With the Open Source Software Your Organization Uses to Build Applications?



On this question, it is interesting to compare how respondents in different technical roles ranked their support challenges with programming languages and runtimes. Firmware or Embedded Systems Developers made up the greatest percentage of those who picked **build or compilation issues**, which clearly ties back to programming languages used in embedded systems such as C and C++. For Architects and Engineering Managers, **personnel experience and proficiency** is less of a challenge than **keeping up with updates and patches**, which makes sense given their responsibility to keep their software secure and up-to-date.

It is also worth noting that in terms of resources, headcount (not having enough personnel) is not as big of a problem as personnel having the right experience and proficiency.

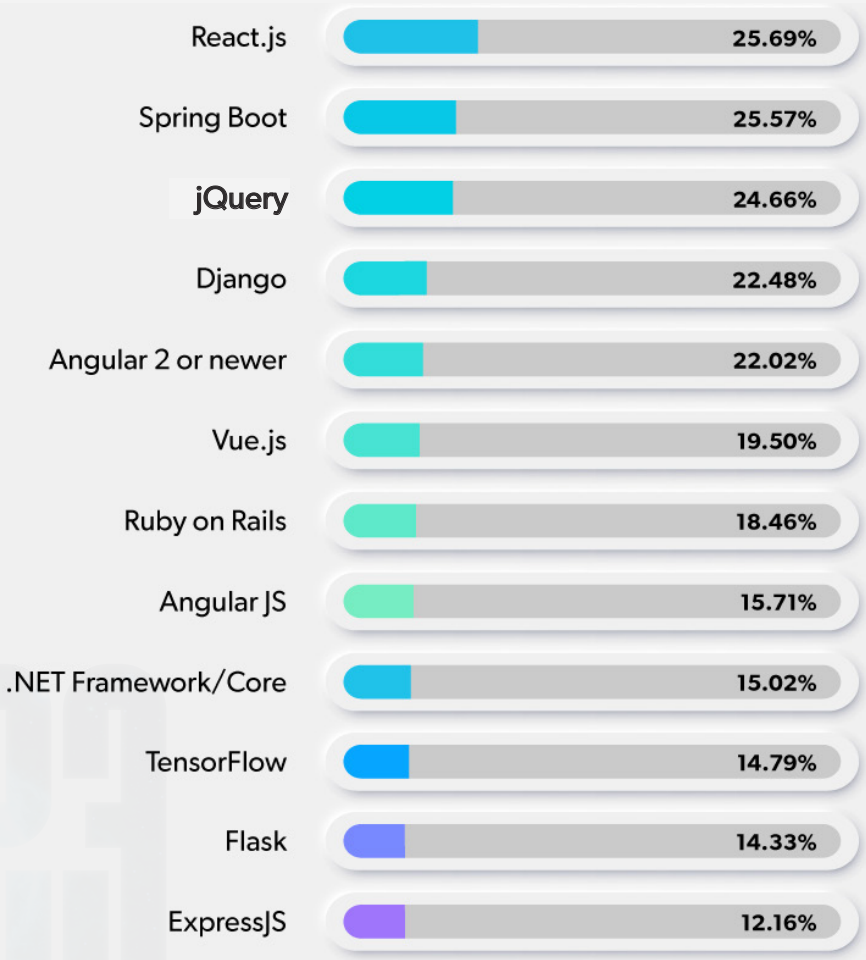
Title	Not Enough Personnel	Personnel Experience and Proficiency	Installations, Upgrades, and Configuration Issues	Keeping Up With Updates and Patches	Build or Compilation Issues	Libraries Dependency Management	Debugging
Front end Developer	35.94%	43.75%	62.50%	45.31%	45.31%	34.38%	15.63%
Back end Developer	29.33%	38.67%	52.00%	53.33%	45.33%	41.33%	25.33%
Firmware or Embedded Systems Developer	19.49%	39.83%	55.08%	42.37%	58.47%	34.75%	27.97%
Full stack Developer	27.69%	40.00%	43.08%	41.54%	30.77%	33.85%	23.08%
Architect	38.71%	35.48%	32.26%	58.06%	35.48%	54.84%	19.35%
Tech Lead	22.73%	39.39%	40.91%	46.97%	40.91%	50.00%	25.76%
Engineering Manager	25.00%	31.82%	63.64%	50.00%	52.27%	45.45%	36.36%
Consultant	14.81%	51.85%	40.74%	55.56%	51.85%	51.85%	25.93%
Data Scientist	37.50%	54.17%	66.67%	54.17%	50.00%	50.00%	45.83%

Top Open Source Framework Technologies

Open source frameworks are heavily used by software developers and continue to evolve, thanks to very active open source communities providing fixes and enhancements. This year, we added more options to the open source frameworks question to get a more comprehensive snapshot of the category.

As we saw in the programming languages and runtimes category, organizations tend to use more than one framework technology. This year's top 3 open source frameworks are identical to last year's top 3: React.js, Spring Boot, and jQuery. Usage of Django, the web framework for Python, increased by 6% compared to last year. The JavaScript frameworks, Angular (2 or newer) and Vue.js, declined by 4% each.

Which Open Source Frameworks Does Your Organization Use to Build Applications Today?



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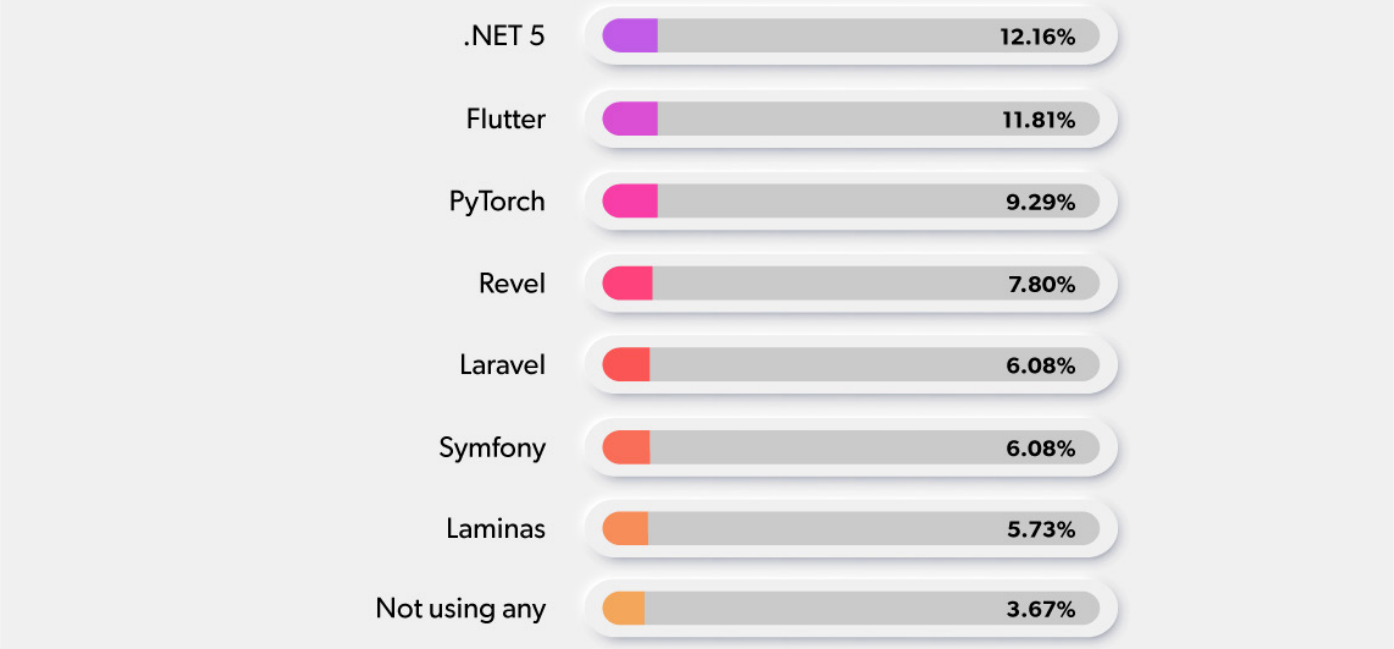
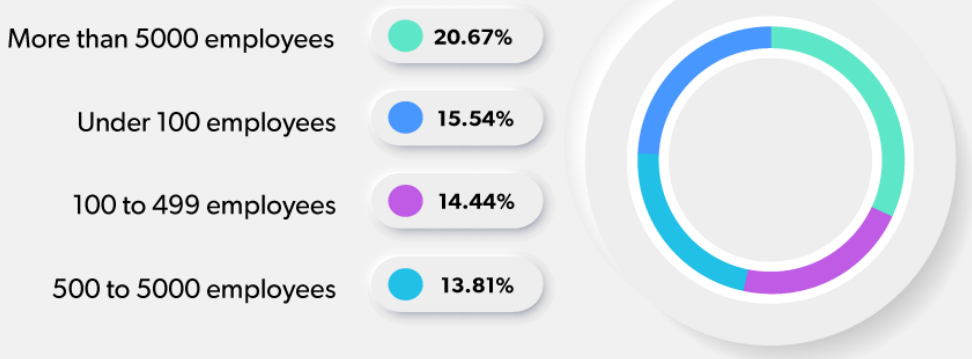
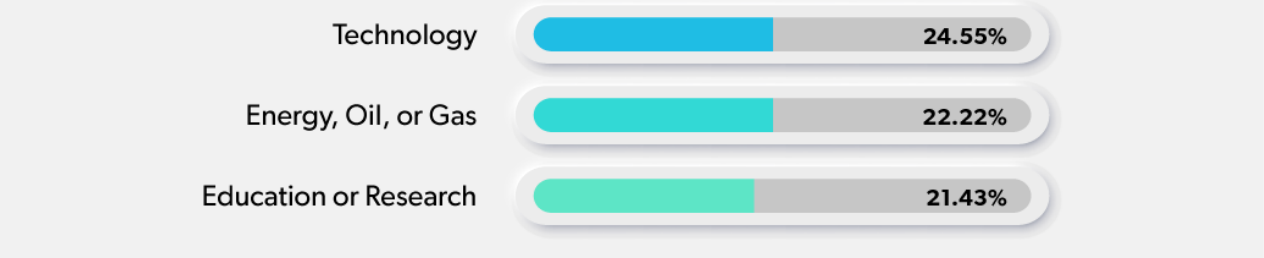


Interestingly, usage of AngularJS, which reached end-of-life (EOL) on December 31, 2021, has not changed — 15.71% of the respondents are still using EOL AngularJS. Diving more deeply into the data, we see that 20.67% of large organizations (more than 5K employees) are still running applications with EOL AngularJS.

Nearly 12 months after AngularJS became end-of-life, 15% of respondents are still using it — the exact same percentage we saw in the 2022 report. In larger organizations, 20% say they are still using the EOL AJS framework.



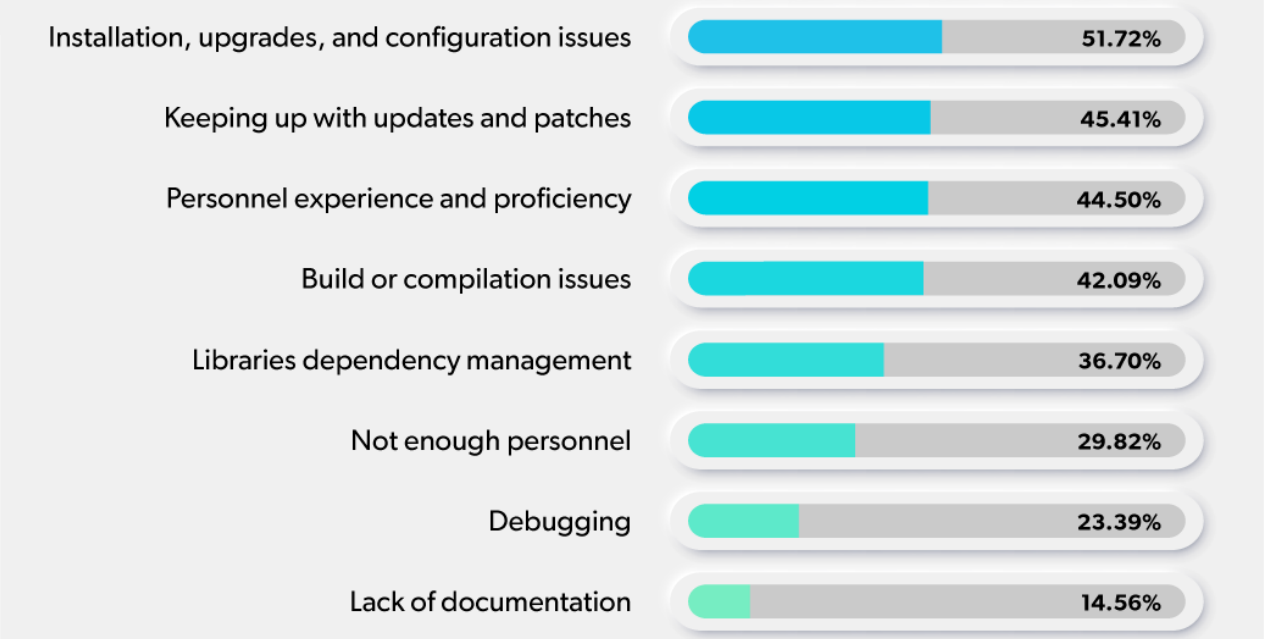
In terms of industry, three show particularly high usage of EOL AngularJS: Technology; Education or Research; and Energy, Oil, or Gas.



SUPPORT CHALLENGES WITH OPEN SOURCE FRAMEWORKS

The top challenge encountered when working with open source frameworks is **installation, upgrades, and configuration issues**, followed by **personnel experience and proficiency** and **keeping up with updates and patches**. As previously mentioned, open source framework projects have active communities that continually advance the software, which means that they require a level of expertise and specialized skills to set up, configure, and maintain. As a result, this is a pain point for some organizations that struggle to keep up.

What Are the Main Support Challenges With the Open Source Frameworks You Use?



When we look at answers based on the organization size, the top 3 support challenges are the same. Notably, however, **installation, upgrades, and configuration issues** present more of a challenge for organizations with between 500 and 5,000 employees, while **keeping up with updates and patches** is less challenging for organizations with fewer than 100 employees.

Organization Size	Personnel Experience and Proficiency	Installations, Upgrades, and Configuration Issues	Keeping up with updates and patches
More than 5,000 employees	44.13%	47.49%	43.58%
500 to 5,000 employees	43.28%	60.45%	44.03%
100 to 499 employees	47.29%	51.62%	51.99%
Under 100 employees	41.89%	41.22%	37.84%

Support Challenge	Top Industry with this challenge	Second Industry	Third Industry
Not enough personnel	Energy, Oil, or Gas	Media or Gaming	Telecommunications
Personnel experience and proficiency	Retail	Healthcare or Pharmaceuticals	Government or Public Services
Installation, upgrades, and configuration issues	Government or Public Services	Manufacturing	Media or Gaming
Keeping up with updates and patches	Energy, Oil, or Gas	Banking, Insurance or Financial Services	Manufacturing
Build or compilation issues	Healthcare or Pharmaceuticals	Manufacturing	Energy, Oil, or Gas
Libraries dependency management	Healthcare or Pharmaceuticals	Energy, Oil, or Gas	Consulting or Professional Services
Debugging	Media or Gaming	Education or Research	Technology
Lack of documentation	Government or Public Services	Media or Gaming	Banking, Insurance or Financial Services

Top Open Source Data Technologies

In our digital era, data is king, and the need to better manage data has resulted in a proliferation of open source data technologies that go far beyond the capabilities of traditional databases. Today's data technologies cover streaming data, functionality for the efficient creation of analytics, memory databases, objects-oriented formats, and a variety of integration capabilities. We allowed respondents to select multiple answers to reflect all the different data technologies being used in their organizations.

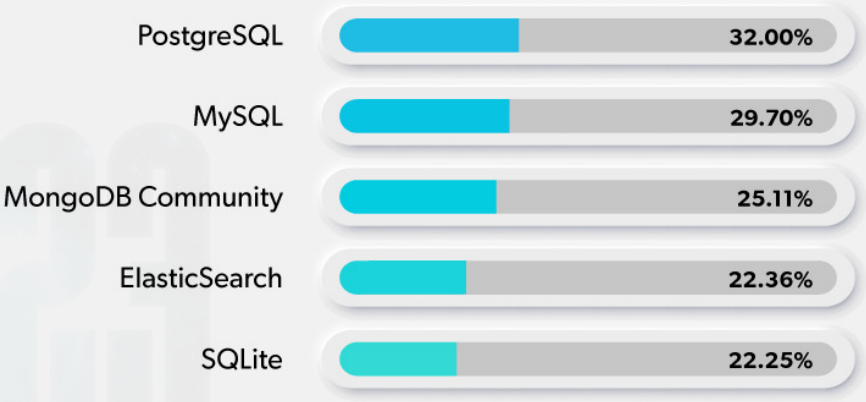
Consistent with the last several years, the top three most used data technologies are PostgreSQL, MySQL, and MongoDB. This year's surprise is that MySQL and PostgreSQL swapped places by a few percentage points and now PostgreSQL is the most used data technology. Last year, PostgreSQL passed MongoDB to move to second place, so it's interesting to see the growth in usage over the last two years.

The top three most used data technologies are PostgreSQL, MySQL, and MongoDB. In the last two years, PostgreSQL moved up from third to first place.

We decided to include ElasticSearch and CockroachDB in this question even though their licenses are not compatible with OSI's Open Source Definition, meaning they are not truly open source. This year, ElasticSearch usage went up by 6%. OpenSearch, which is a recent fork of ElasticSearch, is showing signs of rapid adoption at 10.89%. It is going to be interesting to see whether OpenSearch will surpass ElasticSearch in usage in the years to come.

Two new additions to this question in this year's survey, SQLite and Timescale, showed significant usage — while not new projects, we were surprised to see double-digits usage reported for each (22.25% and 16.63%, respectively).

Which Open Source Data Technologies Does Your Organization Use Today?



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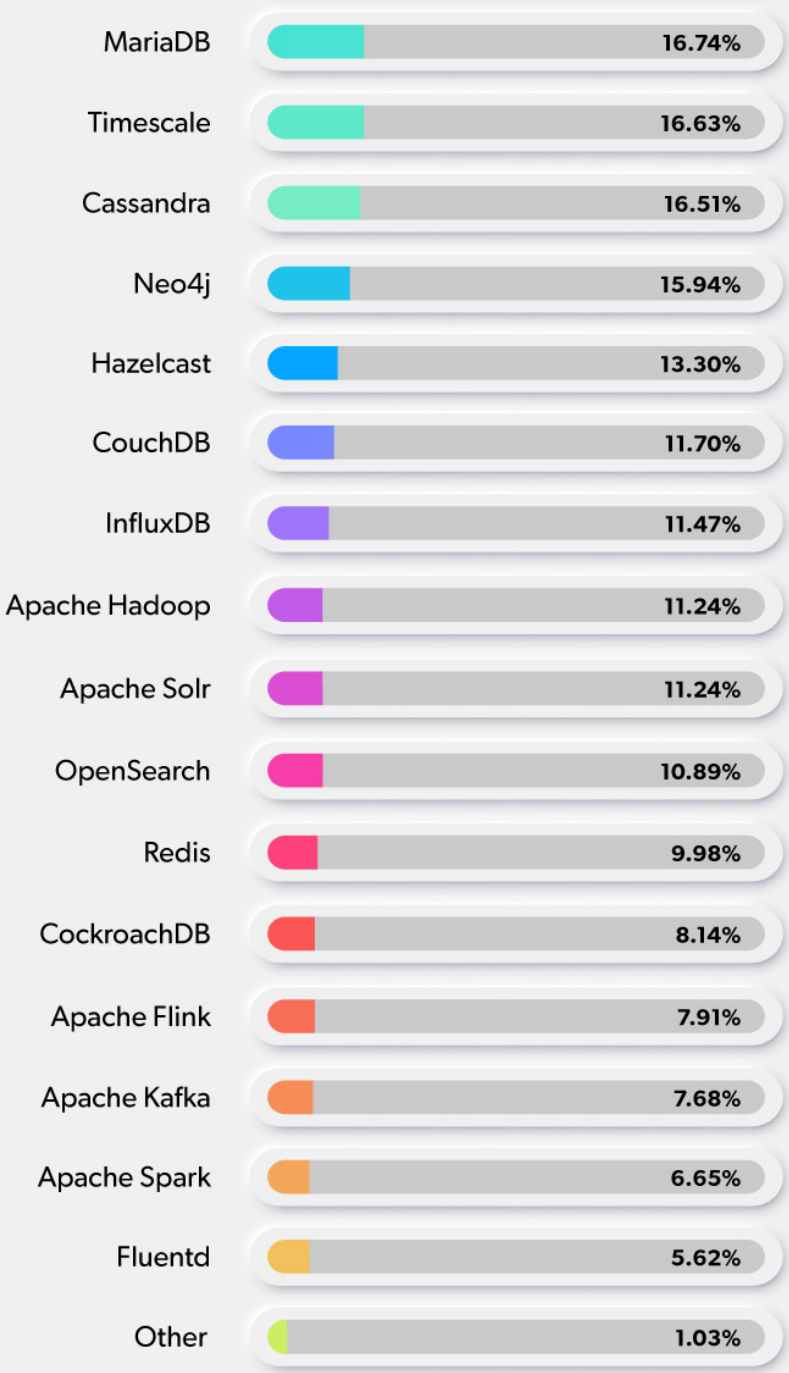


It's always illuminating to examine the most used open source data technologies by the size of the organizations. Compared to last year, we saw a reduction in MySQL and MongoDB Community Sever usage, and increased usage of PostgreSQL, especially for larger organizations. However, for small organizations with fewer than 100 employees, MySQL usage increased by 9% over the last year.

Organization Size	MYSQL	PostgreSQL	MongoDB Community Server
More than 5,000 employees	27.93%	38.55%	24.58%
500 to 5,000 employees	24.25%	23.88%	24.63%
100 to 499 employees	25.63%	33.57%	27.08%
Under 100 employees	49.32%	35.81%	22.97%

AI/ML applications are in large part responsible for the growing usage of open source data technologies, as AI/ML models are trained off of vast amounts of data. The graph below shows that some industries continue to use SQL-based databases, while others are diversifying their use of open source data technologies. For example, Apache Spark, Apache Cassandra, ElasticSearch, and OpenSearch are being used for many AI/ML solutions.

See tables on next page for details...

Industry	MariaDB	MySQL	PostgreSQL	Cassandra	MongoDB Community Server	CouchDB	CockroachDB
Technology	24.09%	45.45%	43.64%	14.09%	20.00%	10.00%	7.27%
Consulting or Professional Services	15.38%	25.87%	34.27%	20.28%	28.67%	9.79%	4.90%
Telecommunications	14.52%	20.97%	33.87%	11.29%	25.81%	17.74%	6.45%
Banking Insurance, or Financial Services	12.16%	18.92%	24.32%	16.22%	22.97%	21.62%	10.81%
Education or Research	14.29%	42.86%	33.33%	11.90%	21.43%	14.29%	11.90%
Vehicle, transportation, or Logistics	13.89%	25.00%	19.44%	22.22%	13.89%	11.11%	13.89%
Government or Public Services	20.75%	32.08%	26.42%	15.09%	30.19%	1.89%	11.32%
Healthcare or Pharmaceuticals	11.48%	22.95%	21.31%	22.95%	22.95%	11.48%	6.56%
Manufacturing	10.47%	19.77%	31.40%	17.44%	32.56%	17.44%	9.30%
Retail	9.38%	21.88%	18.75%	34.38%	25%	9.38%	9.38%
Media or Gaming	17.14%	20.00%	20.00%	5.71%	40.00%	5.71%	14.29%
Energy, Oil, or Gas	22.22%	16.67%	33.33%	11.11%	38.89%	5.56%	0.00%

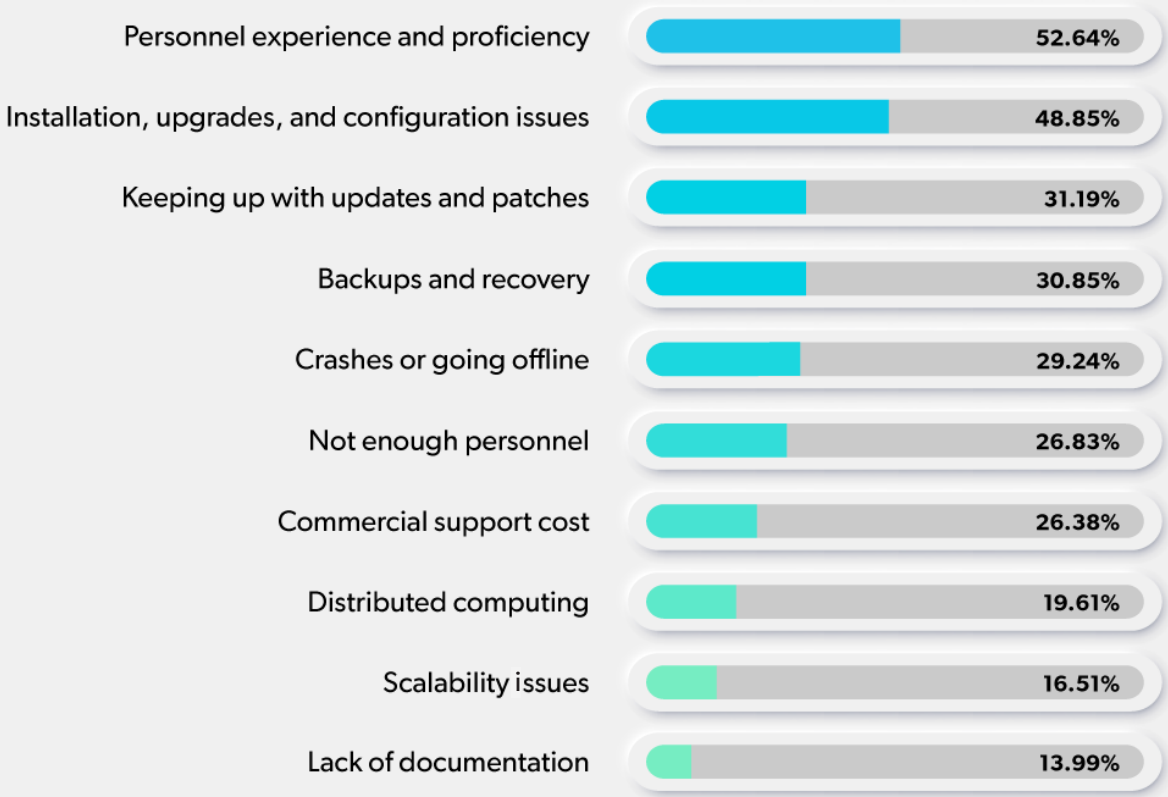
Graph continued...

Apache Spark	Apache Hadoop	SQLite	Neo4j	Timescale	ElasticSearch	OpenSearch	Redis
8.18%	11.82%	23.18%	10.45%	10.00%	23.64%	9.55%	17.73%
4.90%	11.19%	16.78%	15.38%	16.08%	25.17%	12.59%	6.99%
4.84%	6.45%	20.97%	22.58%	24.19%	27.42%	8.06%	4.84%
12.16%	14.86%	16.22%	18.92%	20.27%	22.97%	12.16%	9.46%
14.29%	14.29%	21.43%	16.67%	11.90%	11.90%	11.90%	7.14%
8.33%	19.44%	30.56%	8.33%	13.89%	27.78%	8.33%	5.56%
0.00%	3.77%	33.96%	11.32%	20.27%	18.87%	13.21%	5.56%
3.28%	14.75%	22.95%	18.03%	22.95%	31.15%	3.28%	13.11%
5.81%	12.79%	23.26%	24.42%	26.74%	19.77%	12.79%	2.33%
12.50%	3.13%	18.75%	25.00%	12.50%	12.50%	12.50%	9.38%
2.86%	11.43%	25.71%	17.14%	14.29%	11.43%	14.29%	8.57%
0.00%	5.56%	33.33%	16.67%	16.67%	5.56%	27.78%	22.22%

SUPPORT CHALLENGES WITH OPEN SOURCE DATA TECHNOLOGIES

In this category, **personnel experience and proficiency** surpassed **installations, upgrades, and configuration issues** by a margin of about 4% (52.64% vs. 48.85%). This speaks loudly to the need for skills on these complex data technologies; even if you're deploying stable, well-established tools with large contributor communities, things can go wrong. This is why experts who know data technologies and contribute upstream to open source are in high demand.

What Are the Main Support Challenges With the Open Source Data Technologies Your Organization Is Using?



Paying for commercial open source that includes technical support is an option, but comes with a hefty price tag and vendor lock-in. Organization size comes into play here, as more than 28% of respondents from mid-size to large organizations listed **commercial support cost** as a challenge, compared to under only 17% of those from small organizations. This is likely because smaller organizations are using community open source versions and not paying for commercial support.

See tables on next page for details...

Organization Size	Not Enough Personnel	Personnel Experience and Proficiency	Installations, Upgrades, and Configuration Issues	Keeping Up With Updates and Patches
More than 5,000 employees	26.82%	45.25%	52.51%	25.14%
500 to 5,000 employees	26.12%	55.22%	51.12%	38.81%
100 to 499 employees	27.80%	56.68%	51.99%	31.77%
Under 100 employees	26.35%	49.32%	34.46%	23.65%

Scalability Issues	Distributed Computing	Backups an Recovery	Crashes or going offline	Commercial Support Cost	Lack of Documentation
17.32%	18.44%	28.49%	24.58%	28.49%	14.53%
17.91%	19.40%	32.84%	33.58%	28.36%	14.18%
13.36%	23.47%	35.38%	33.94%	28.16%	13.72%
18.92%	14.19%	21.62%	18.24%	16.89%	13.51%

Here's how the data breaks out on this question by industry:

Support Challenge	Top Industry with this challenge	Second Industry	Third Industry
Not enough personnel	Government or Public Services	Healthcare or Pharmaceuticals	Education or Research
Personnel experience and proficiency	Consulting or Professional Services	Telecommunications	Manufacturing
Installation, upgrades, and configuration issues	Manufacturing	Government or Public Services	Media or Gaming
Keeping up with updates and patches	Healthcare or Pharmaceuticals	Government or Public Services	Energy, Oil, or Gas
Scalability issues	Technology	Media or Gaming	Government or Public Services
Distributed computing	Energy, Oil, or Gas	Vehicle, Transportation, or Logistics	Manufacturing
Backups and recovery	Media or Gaming	Energy, Oil, or Gas	Manufacturing
Crashes or going offline	Healthcare or Pharmaceuticals	Retail	Manufacturing
Commercial support cost	Manufacturing	Media or Gaming	Energy, Oil, or Gas
Lack of documentation	Government or Public Services	Retail	Telecommunications

Top Open Source SDLC and Build Technologies

As with some of the other categories, we saw a need to include more software development life cycle (SDLC) and build application technologies on this year's survey to better capture the variety and popularity of all the software in this space. We know that some organizations not only use multiple programming languages and frameworks, but also often have more than one open source tool they rely on for their SDLC.

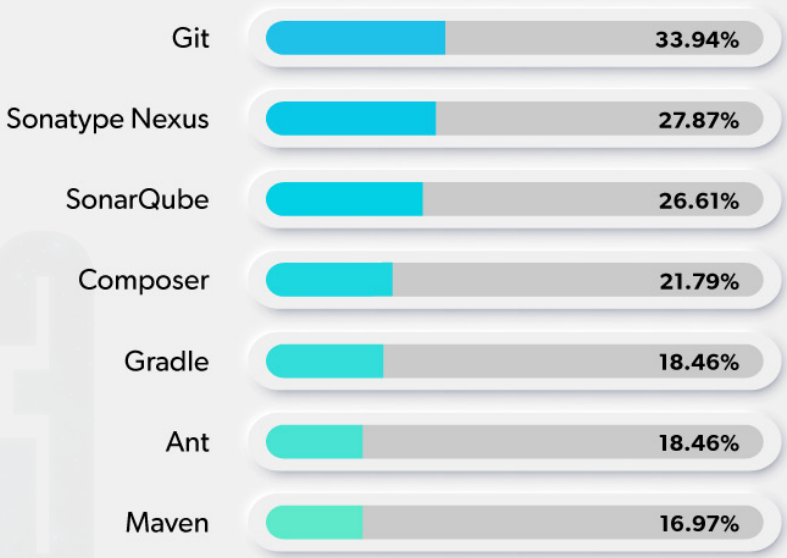
More than a third of respondents selected Git, affirming that community and commercial open source versions of Git are without a doubt the top choice in software development today. For Java build tools, Gradle and Maven are neck and neck, with 18.46% of respondents selecting Gradle vs. 16.97% for Maven. This is similar to what we saw on last year's survey, with less than 2% difference in usage between the two.

> Gradle and Maven are still the top Java build tools, and this year's usage data is almost identical to last year's.

The open source Nexus repository showed a significant increase in usage compared to last year, perhaps because of greater security awareness and the well-publicized news about the Log4j vulnerability that affected so many Java-based applications.

No big changes this year for open source testing tools, with Selenium ranking again at the top.

Which Open Source SDLC and Build Technologies Does Your Organization Use Today?



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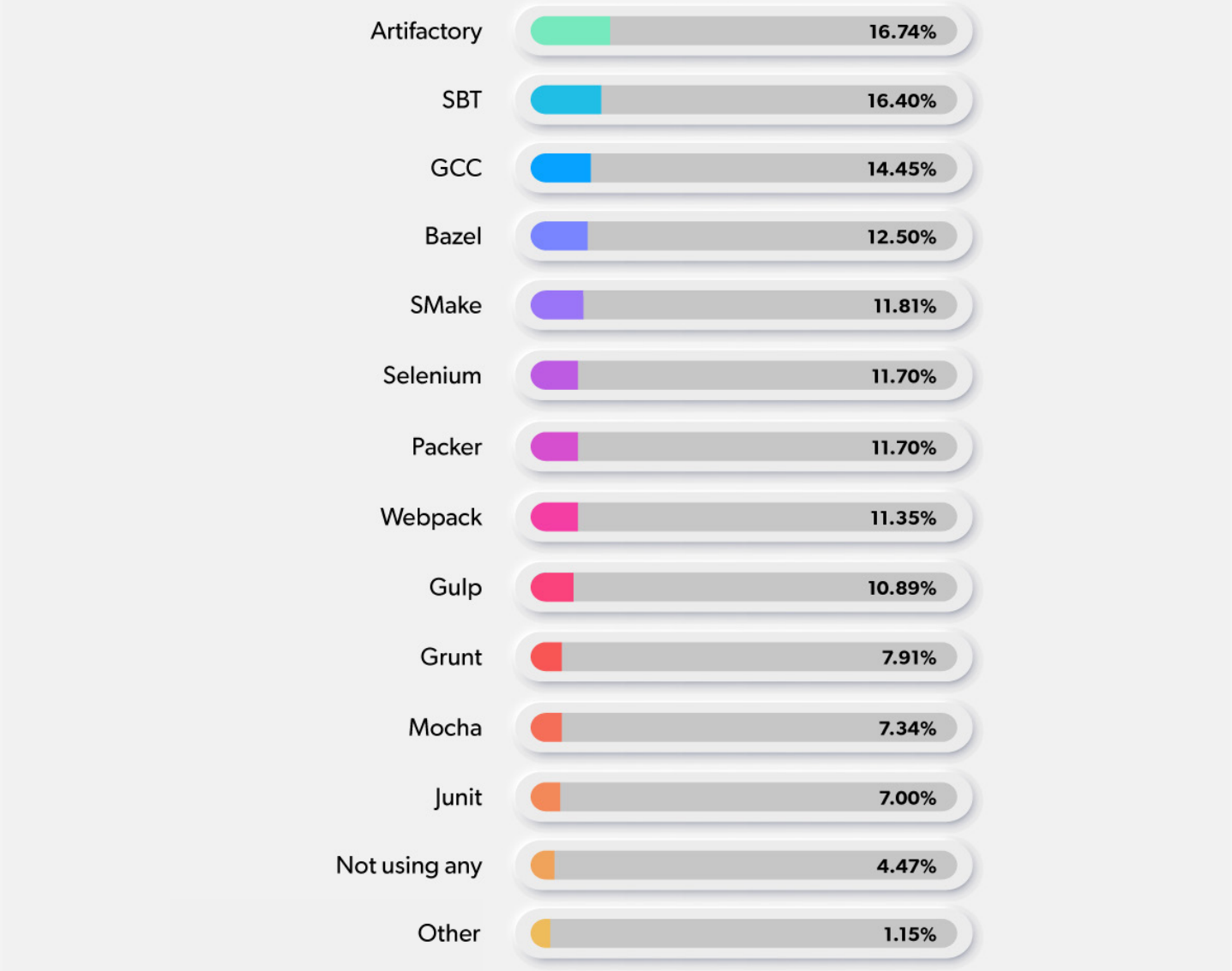
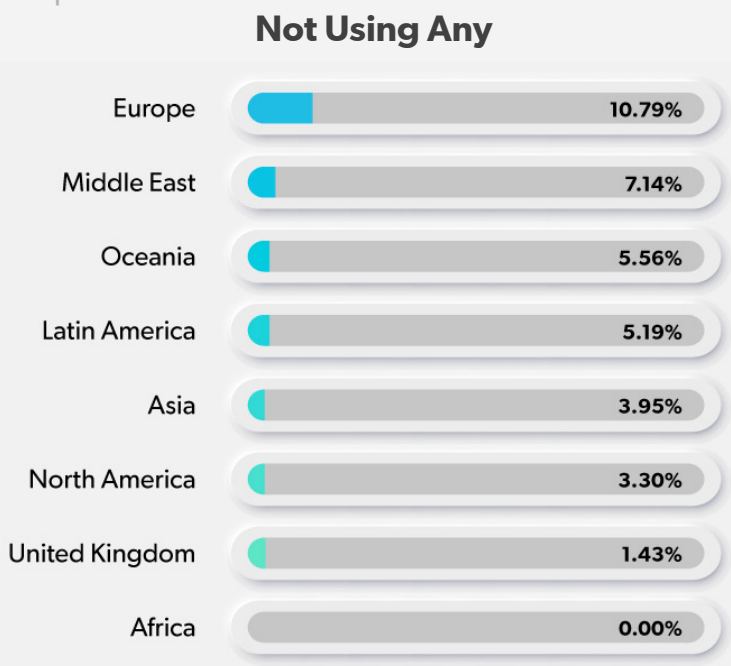


Notably, only 4.97% of respondents this year said they were "Not using any" SDLC and build technologies, down from 7% last year, indicating increased usage of open source SDLC and build tools. Of those who selected "not using any," there was little differentiation by industry, but looking at geographical region and size, Europe and the smallest organizations (under 100 employees) garnered the greatest percentage of responses.

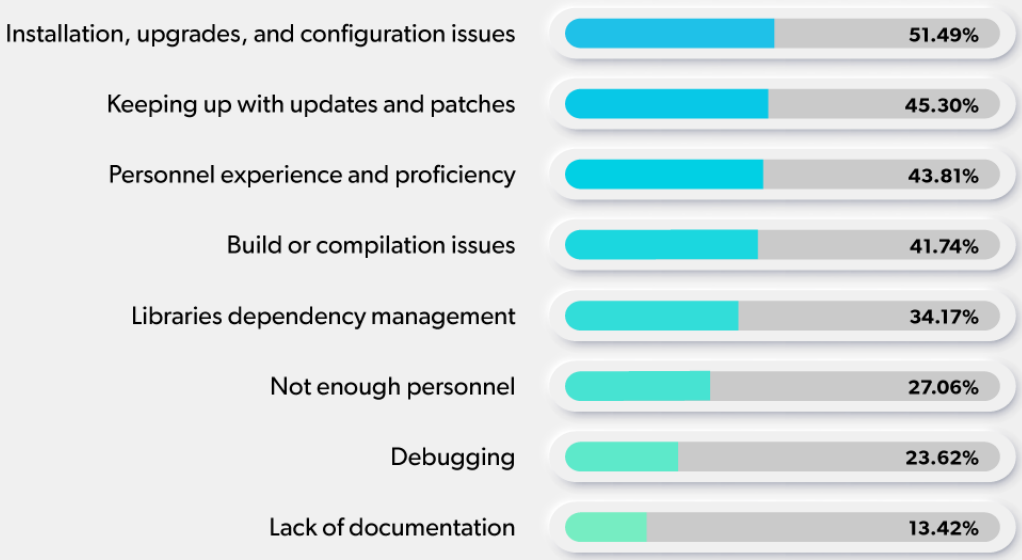
Organization Size	Not Using Any
More than 5,000 employees	3.91%
500 to 5,000 employees	2.99%
100 to 499 employees	3.25%
Under 100 employees	10.14%



SUPPORT CHALLENGES WITH OPEN SOURCE SDLC AND BUILD TECHNOLOGIES

Once again, **installations, upgrades, and configuration issues** is the top support challenge for open source SDLC and build technologies, selected by more than half of respondents (51.49%, a reduction of 3% from last year's survey). This is one of the highest percentages among support challenges across all the technology categories. SDLC and build tools interact with many other tools and libraries, and this complexity results in developers spending a great deal of time dealing with installations, upgrades, and configuration issues. **Keeping up with updates and patches** is the number two support challenge, thanks to very active and engaged communities that are constantly improving and changing the tools, making it hard for organizations to keep up.

What Are the Main Support Challenges on the Open Source Software Your Organization Uses For SDLC and Build?



Examining the support challenges among respondents based on organization size reveals the same top two (**installation, upgrades, and configuration issues** and **keeping up with updates and patches**) for organizations with more than 100 employees. For small organizations (<100 employees), however, **personnel experience and proficiency** is the number one challenge.

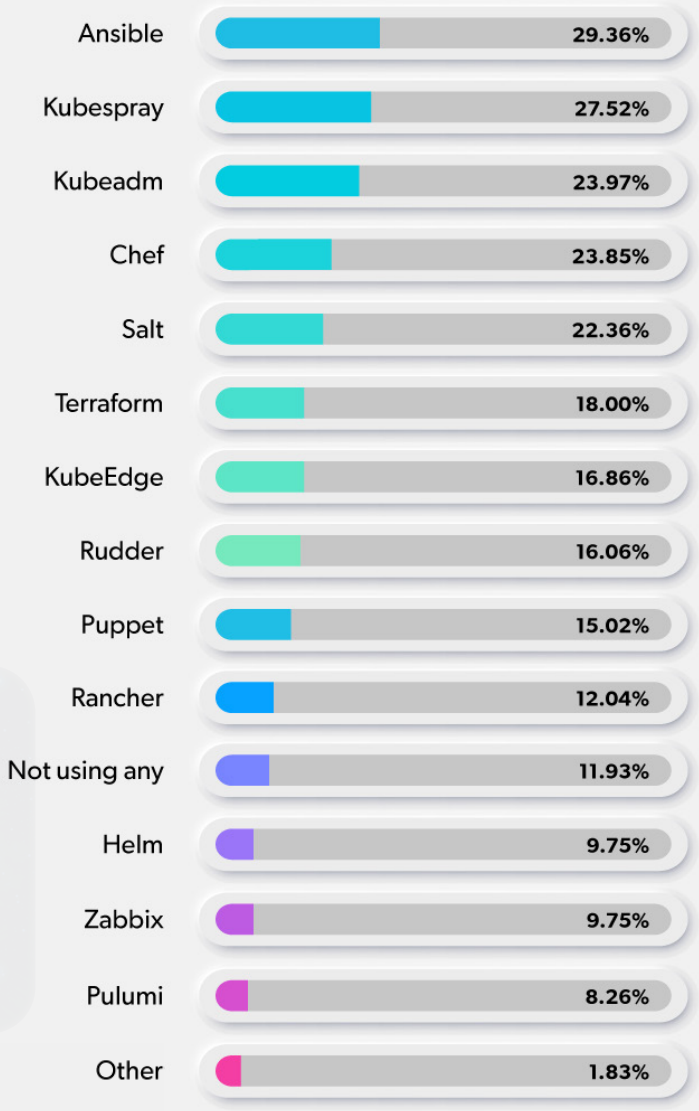
Organization Size	Not Enough Personnel	Personnel Experience and Proficiency	Installations, Upgrades, and Configuration Issues	Keeping Up With Updates and Patches	Build or Compilation issues	Libraries Dependency Management	Debugging
More than 5,000 employees	27.37%	37.43%	54.75%	42.46%	43.58%	28.49%	22.91%
500 to 5,000 employees	25.00%	48.88%	56.34%	48.88%	44.03%	39.18%	30.22%
100 to 499 employees	25.99%	42.60%	53.07%	47.65%	45.49%	36.10%	22.38%
Under 100 employees	32.43%	44.59%	35.81%	37.84%	28.38%	28.38%	14.86%

Top Open Source Infrastructure Automation and Configuration Technologies

In the DevOps category of open source automation and configuration tools once again we expanded the options to get insight into the usage trends and challenges encountered by organizations across all industries and of all sizes. Across the board, there was an uptick in the adoption of these technologies and with some specific tools, there was significant growth.

Usage of Kubespray, which is used to deploy Kubernetes clusters, increased by 6% in the last 12 months, with 27.52% of the respondents choosing it. Kubeadm, which is also popular in Kubernetes environments and is used to create Kubernetes clusters, was selected by 23.97% of respondents. These numbers show that organizations are increasingly using these two tools to create and deploy Kubernetes clusters.

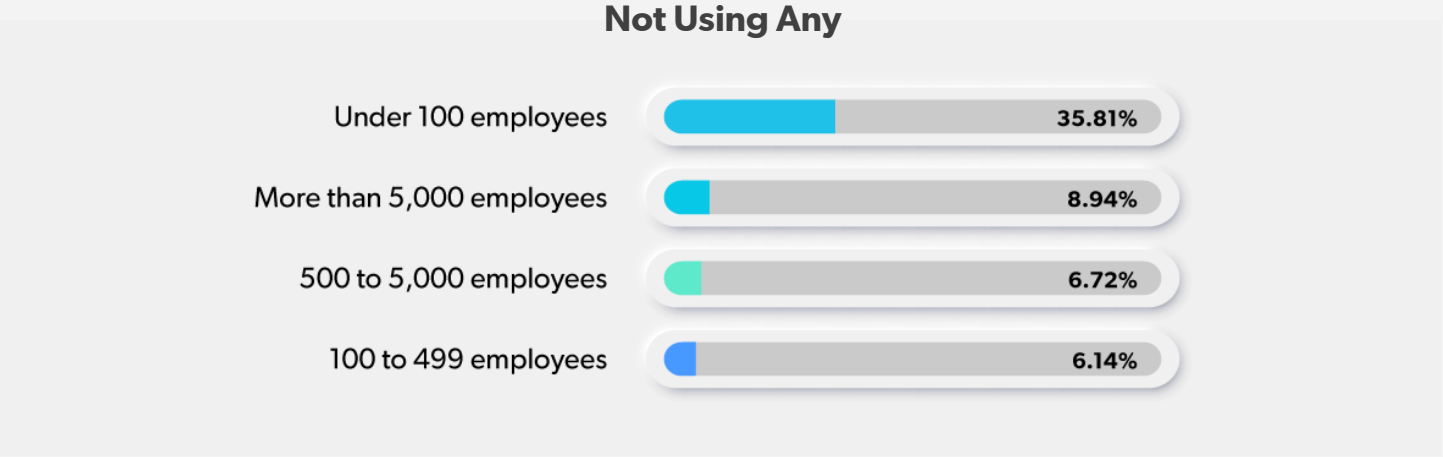
Which Open Source Infrastructure Automation and Configuration Tools Does Your Organization Use Today?



Again, we decided to look a little more closely at the "not using any" response, which diminished from 16% last year to just under 12% this year. Remarkably, just two years ago, nearly 50% of respondents said they were not any technologies in this category of DevOps tools.

Every year, more and more organizations choose open source automation and configuration tools.

It turns out that small organizations account for the majority of the "not using any" responses. This likely correlates with not having enough personnel, expertise, need, or simply not using cloud services typically associated with open source automation and orchestration tools.



Surprisingly, some industries are overwhelmingly using open source infrastructure automation and configuration tools. For example, in the telecommunications industry, only 1.61% of respondents indicated that they are not using any tools in this category. Similarly, only 2.70% of respondents working in banking, insurance, or financial services report not using any infrastructure automation and configuration tools.

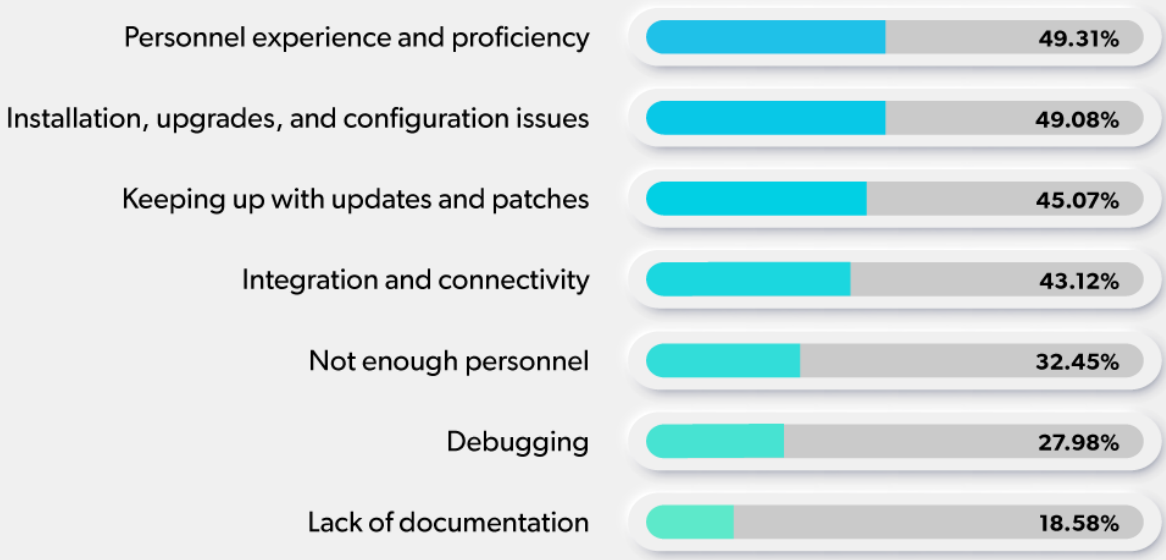
In the case of Kubespray and Kubeadm, we see certain industries with higher adoption than others, with telecommunications, financial services, manufacturing, consulting, and healthcare outpacing the technology sector.

Industry	Kubespray	Kubeadm
Technology	17.73%	15.00%
Manufacturing	39.53%	37.21%
Consulting or Professional Services	22.38%	29.37%
Telecommunications	41.94%	27.42%
Banking Insurance, or Financial Services	31.08%	29.73%
Healthcare or Pharmaceuticals	36.07%	27.87%

SUPPORT CHALLENGES WITH OPEN SOURCE INFRASTRUCTURE AUTOMATION AND CONFIGURATION TECHNOLOGIES

Interestingly, there is a more even distribution of responses to this question this year, especially among the top 4 answers. We also have a new top support challenge: **Personnel experience and proficiency**. Last year in this category, this came second to **installations, upgrades, and configuration issues**. Unquestionably, these technologies require a great deal of expertise. Within an organization, as software infrastructure grows, DevOps becomes even more specialized, demanding a high degree of proficiency to keep the automation and configuration tools running.

What Are the Main Support Challenges With the Open Source Software Your Organization Uses for Automation and Configuration?



The breakout of responses by role/title yields some fascinating insights. Half (50.77%) of the full stack developers who responded consider **personnel experience and proficiency** their biggest obstacle, and an even greater percentage of SRE/DevOps Engineers (71.43%) chose it as well. Tech Leads, on the other hand, ranked **installation, upgrades, and configurations** and **keeping up with updates and patches** as bigger concerns. **Keeping up with updates and patches** is apparently not much of a challenge for SRE/DevOps Engineers, probably due to their ability to keep their tooling versions up to date.

Job Title	Personnel Experience and Proficiency	Installations, Upgrades, and Configuration Issues	Keeping Up With Updates and Patches
Full stack Developer	50.77%	38.46%	49.23%
Architect	48.39%	54.84%	51.61%
SRE/DevOps Engineer	71.43%	50.00%	35.71%
Support Engineer	70.37%	40.74%	44.44%
Tech Lead	45.45%	50.00%	51.52%
Engineering Manager	54.55%	59.09%	59.09%
Consultant	59.26%	51.85%	48.15%

Top Open Source Continuous Integration/Continuous Delivery Tools

The adoption of open source continuous integration (CI) and continuous delivery/deployment (CD) tools, particularly cloud-native CI/CD tools, is still on the rise. This is a trend we observed last year, and CI/CD has remained a "hot" development area for open source projects.

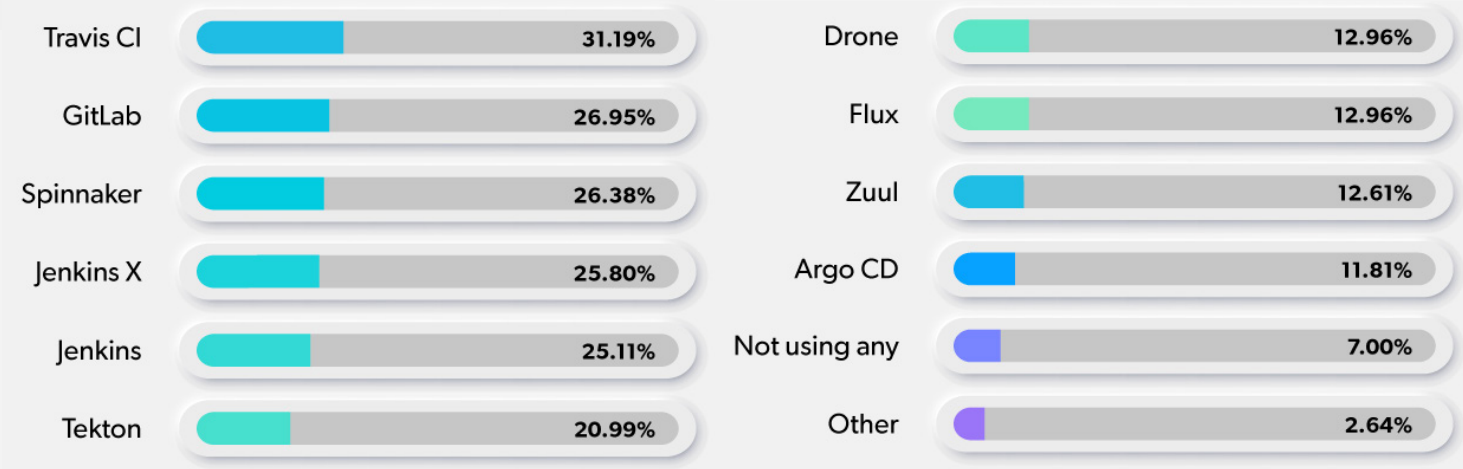
Popular tools such as GitLab, Jenkins, and Jenkins X stayed relatively flat in comparison to last years' numbers. On the whole, tools that run natively in containers (Jenkins X, Spinnaker, Tekton) saw a boost in usage this year.

The number of respondents who selected "not using any" open source CI/CD tools declined, from 9% last year to 7% this year. It's likely these respondents are in fact using non-open source versions for CI/CD tooling such as GitHub Actions, Circle CI, Azure Pipelines, or others. This tells us that the implementation of CI/CD tools is widespread as part of the software development life cycle.

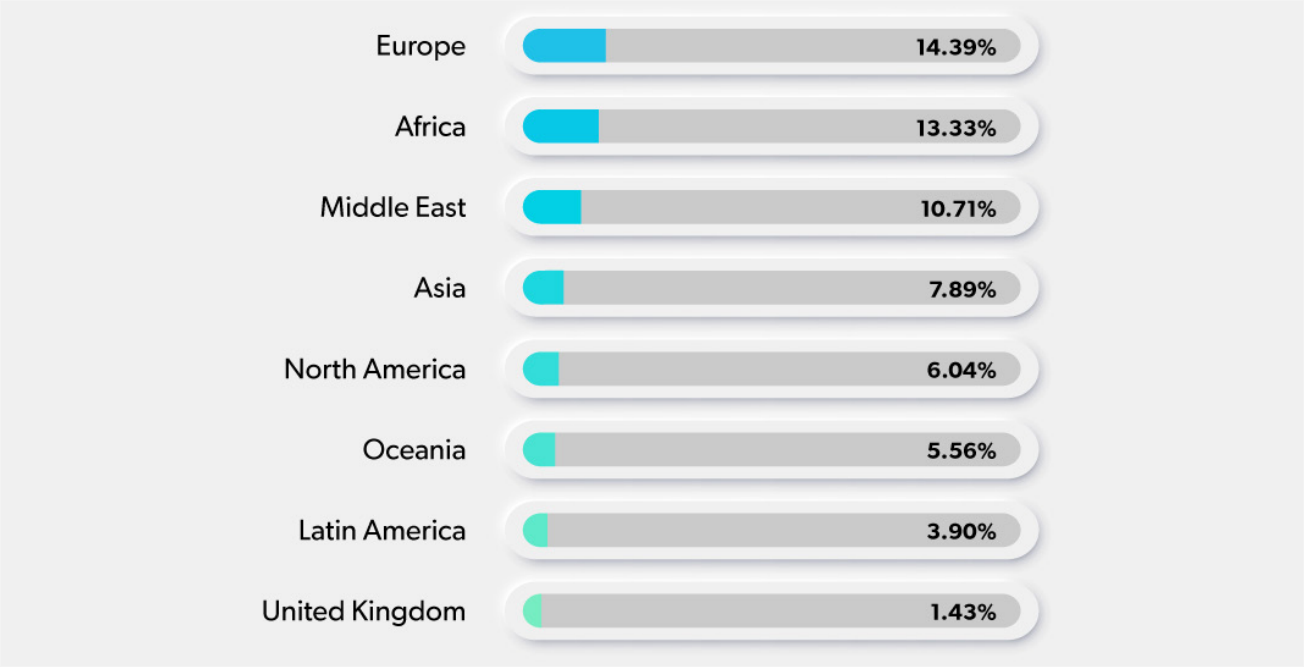
> Open source CI/CD tools that run natively in containers (such as Spinnaker, Jenkins X, and Tekton) continue to gain adoption, while only 7% of organizations do not use open source CI/CD tooling.

Note: Despite being heavily used by open source projects, GitHub Actions was removed from this year's survey because it is not open source software.

Which Open Source CI/CD Tools Does Your Organization Use Today?

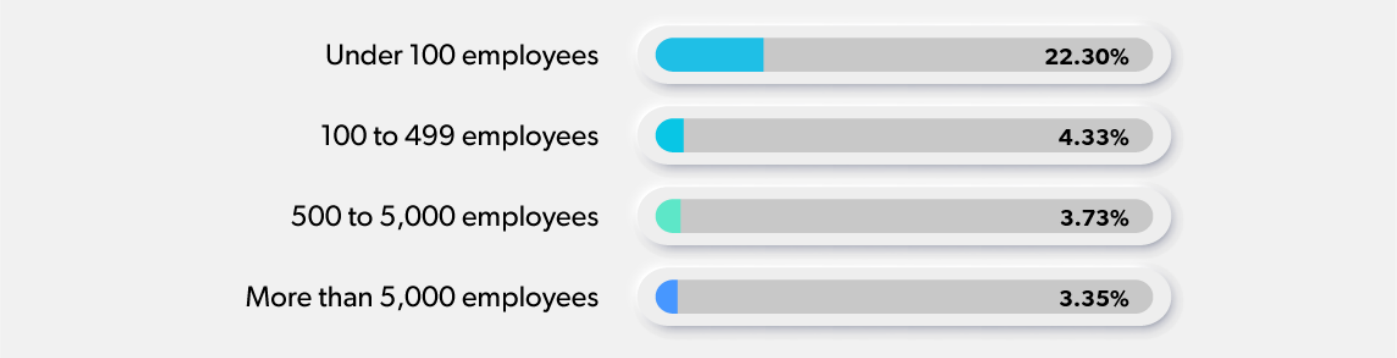


Regionally, the "not using any" response revealed a stark contrast between the UK (1.43%) and Europe (14.39%). Again, this does not mean that organizations in Europe do not use CI/CD tools; it could be that they are using more commercial tools, while in the UK more organizations are choosing open source options.



Most respondents who said they are not using open source CI/CD tools come from small organizations — 22.30%, which is a 4% increase from last year. There could be reasons for this; smaller teams with just a few software projects may not require automation, or they could be using legacy software with not enough releases to justify full automation. It's also possible that small organizations simply lack personnel with the skills to implement CI/CD.

Not Using Any



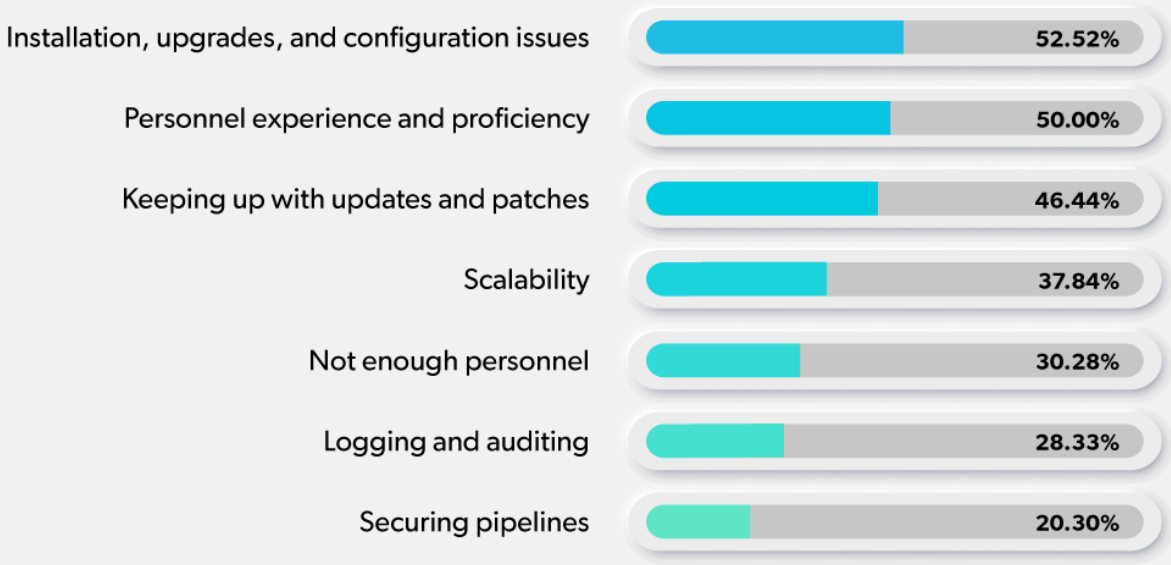
The following table shows that it is not just technology companies adopting CI/CD tools; we see widespread usage across many different industries. We can also see industries favoring certain tools over others; for example, Jenkins and GitLab are popular in the tech and transportation sectors, whereas Spinnaker is the tool of choice for banking/insurance/financial services and media/gaming organizations, and Travis CI is favored in telecommunications and manufacturing.

Industry	Jenkins	Jenkins X	Spinnaker	Gitlab	Zuul	Travis CI	Tekton	Argo CD	Drone
Technology	41.36%	20.00%	15.91%	42.27%	8.64%	21.82%	14.09%	8.64%	12.27%
Consulting or Professional Services	16.08%	36.36%	26.57%	18.18%	15.38%	29.37%	26.57%	14.69%	13.99%
Telecommunications	19.35%	20.97%	35.48%	25.81%	14.52%	43.55%	20.97%	4.84%	9.68%
Banking Insurance, or Financial Services	21.62%	31.08%	32.43%	17.57%	13.51%	37.84%	21.62%	9.46%	9.46%
Education or Research	14.29%	19.05%	19.05%	40.48%	14.29%	26.19%	16.67%	14.29%	4.76%
Vehicle, transportation, or Logistics	30.56%	8.33%	36.11%	27.78%	8.33%	30.56%	16.67%	5.56%	8.33%
Government or Public Services	24.53%	32.08%	24.53%	18.87%	15.09%	28.30%	22.64%	3.77%	16.98%
Healthcare or Pharmaceuticals	16.39%	26.23%	27.87%	19.67%	16.39%	37.70%	29.51%	11.48%	13.11%
Manufacturing	26.74%	39.53%	37.21%	19.77%	16.28%	44.19%	31.40%	23.26%	16.28%
Retail	12.50%	12.50%	34.38%	12.50%	15.63%	37.50%	21.88%	9.38%	31.25%
Media or Gaming	17.14%	25.71%	34.29%	22.86%	8.57%	28.57%	14.29%	22.86%	14.29%
Energy, Oil, or Gas	16.67%	11.11%	27.78%	38.89%	5.56%	38.89%	16.67%	22.22%	11.11%

SUPPORT CHALLENGES WITH OPEN SOURCE CI/CD TOOLS

The data told a clear story here in terms of the main three support challenges for open source CI/CD tools, and there was statistically no change from last year's findings. **Installations, upgrades, and configuration issues** is still the top challenge (52.52%), followed closely by **personnel experience and proficiency** (50.00%), and **keeping up with updates and patches** (46.44%). Challenges around **scalability** came in a distant fourth (37.84%).

What Are the Main Support Challenges With the Open Source Software Your Organization Uses For CI/CD?



For organizations with more than 100 employees, the number one support challenge is **installation, upgrades, and configuration issues**, but for organizations with under 100 employees, **personnel experience and proficiency** is a bigger issue. These skill gaps are likely the reason why such a high percentage of small organizations report that they are not using CI/CD tools.

Organization Size	Personnel Experience and Proficiency	Installations, Upgrades, and Configuration Issues
More than 5,000 employees	47.49%	44.13%
500 to 5,000 employees	46.27%	57.09%
100 to 499 employees	52.71%	61.37%
Under 100 employees	54.73%	37.84%

Given the different use cases for CI/CD tools, it's interesting to see how industry impacts the challenges that arise. The table below shows the top three industries that selected each one of the support challenges for open source CI/CD technologies.

Support Challenge	Top Industry with this challenge	Second Industry	Third Industry
Not enough personnel	Media or Gaming	Energy, Oil, or Gas	Telecommunications
Personnel experience and proficiency	Vehicle, Transportation, or Logistics	Healthcare or Pharmaceuticals	Manufacturing
Installation, upgrades, and configuration issues	Healthcare or Pharmaceuticals	Manufacturing	Technology
Keeping up with updates and patches	Energy, Oil, or Gas	Manufacturing	Healthcare or Pharmaceuticals
Scalability Issues	Manufacturing	Retail	Healthcare or Pharmaceuticals
Logging and auditing	Manufacturing	Government or Public Services	Media or Gaming
Securing pipelines	Manufacturing	Government or Public Services	Healthcare or Pharmaceuticals

Open Source Maturity in Organizations

Across every industry, organizations develop and use software as an essential part of their business operations. In the last few years, the global pandemic has accelerated the digital economy, resulting in many more companies using, maintaining, and producing software.

More than ever, open source software is present in all software. Organizations are realizing the importance of open source technologies and components in their ecosystems. Many organizations are moving from being merely consumers of open source to engaging with open source communities and in some cases, even becoming leaders, driving and influencing the direction of new open source projects.

Some organizations don't realize how much OSS they are already using inside their software. Some pay attention to open source licensing and then mature into having expert legal teams for everything related to software licenses. And some provide education to their employees about open source technologies. The more mature an organization becomes, the more strategic they are with open source as a key part of their technology initiatives.

In this year's State of Open Source survey, we asked about the level of open source maturity in organizations. The goal of these questions was to understand where organizations are in terms of their usage of open source software and how strategic open source has become in their organization.

While organizations of all sizes are using various categories of open source software, we asked about the most business-critical OSS. As expected, respondents listed all types of open source technologies and some listed multiple projects, but the most prominent were **Linux, Apache HTTP, Git, Node.js, WordPress, Tomcat, Jenkins, PHP, and NGINX**.

> Respondents listed Linux, Apache HTTP, Git, Node.js, WordPress, Tomcat, Jenkins, PHP, and NGINX as the most business-critical open source software for their organizations.

Software in general has become business-critical for many organizations, and consequently open source software, including the previously listed technologies, are key pieces of their digital infrastructure. The more mature organizations acquire expertise in these key technologies, and recognize the importance of being part of communities to participate in the innovation coming from open source.

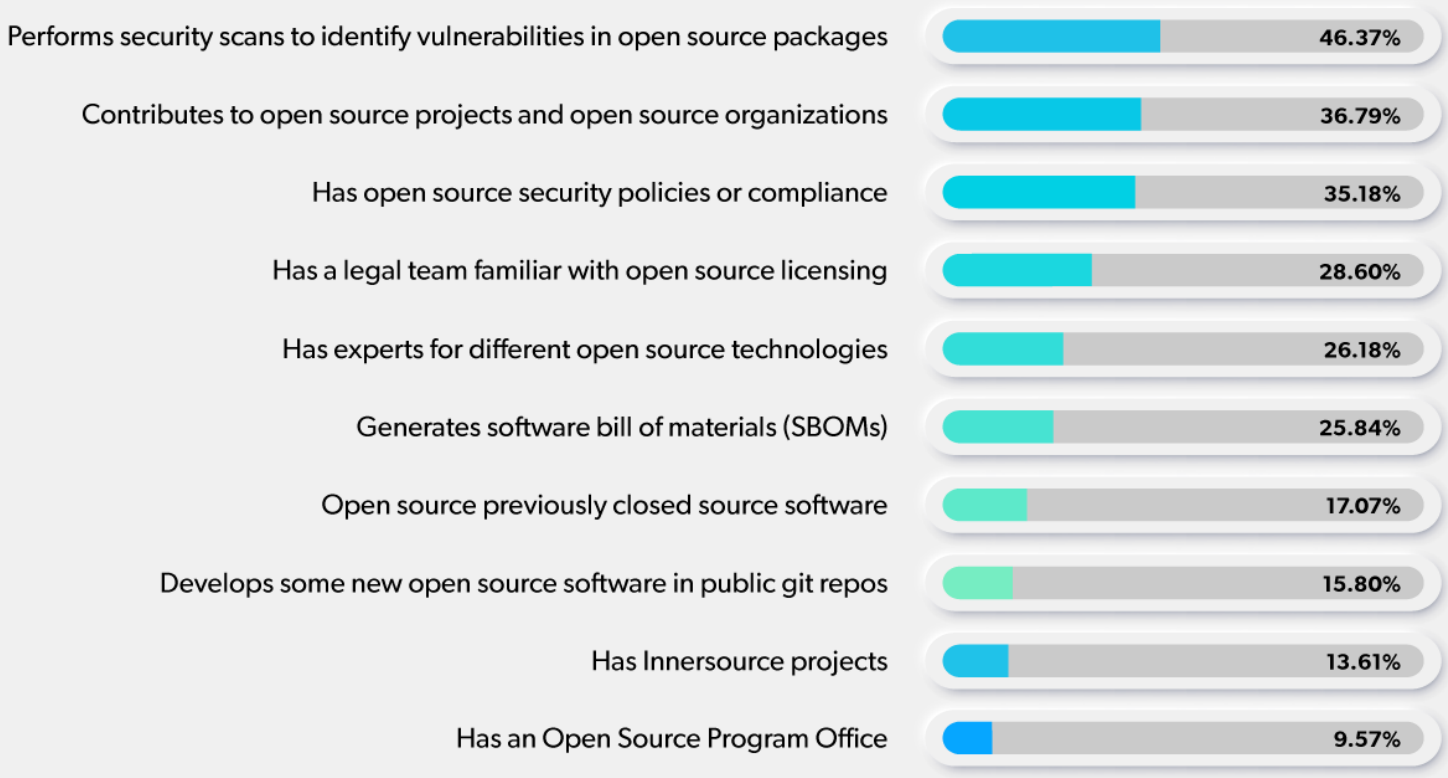
To assess the level of open source maturity in organizations, we selected 10 representative activities that can be considered steps in the journey to becoming more strategic in the use and adoption of open source software. The activities ranged from entry-level activities, such as basic security scans, to more mature activities like having an Open Source Program Office (OSPO).

One of the stats that stood out immediately was that 36.79% of organizations **contribute to open source**, which includes contributions to open source projects or to open source organizations (code or other activities). This is a 5% increase from last year, so it's trending in the right direction, which is a good sign for open source communities.

The top activity, selected by 46.37% of respondents, was **perform security scans to identify vulnerabilities in open source packages**. This highlights that there is more open security awareness and a variety of tools (open source and commercial) that can help organizations make security scans part of their software development life cycle. Along similar lines, it's also promising to see **open source security policies or compliance** in the top 3, since defining external or internal compliance processes is a marker of open source maturity.

Over 46% of organizations are performing security scans to identify vulnerabilities in open source software.

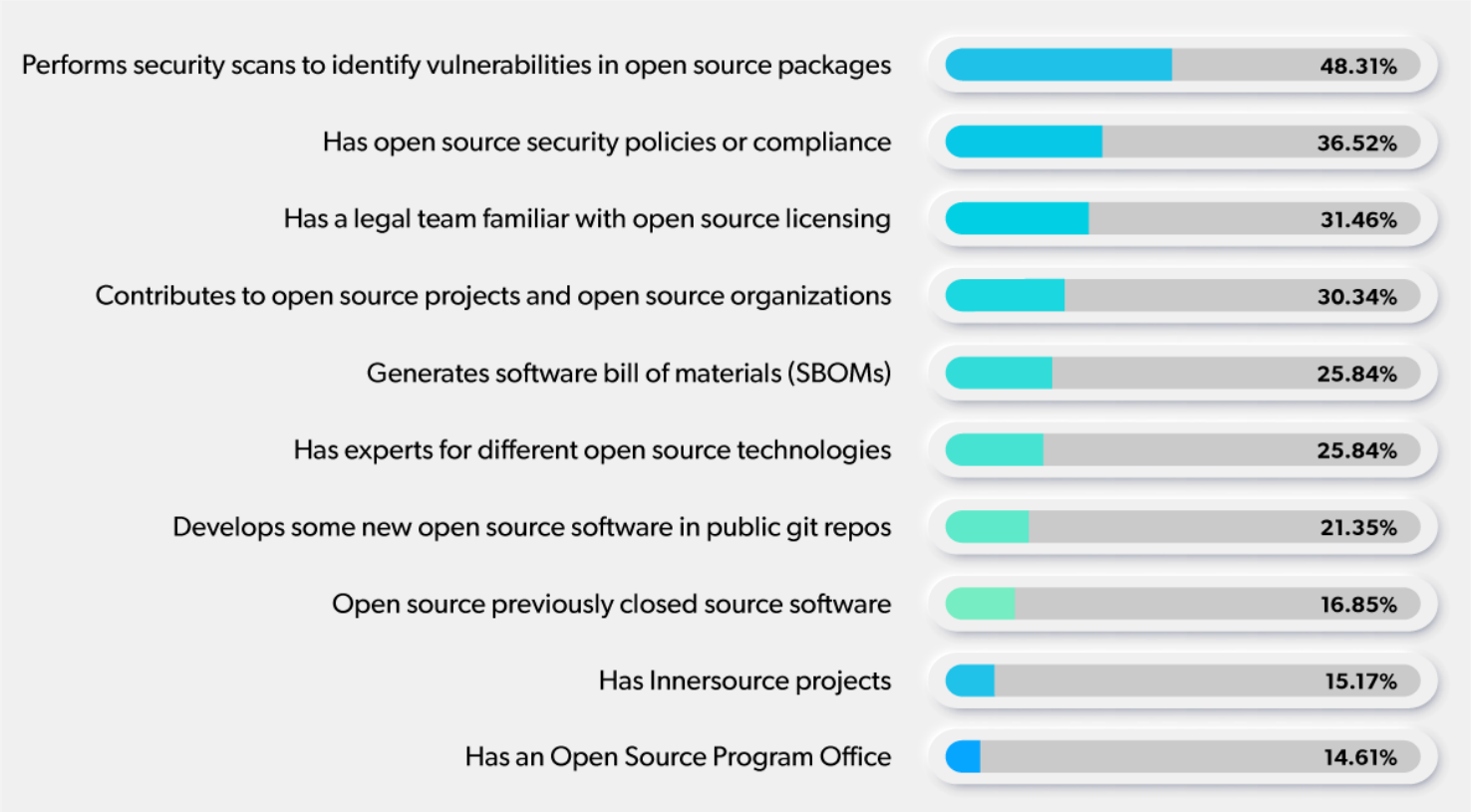
How Do You Describe the Level of Open Source Maturity In Your Organization?



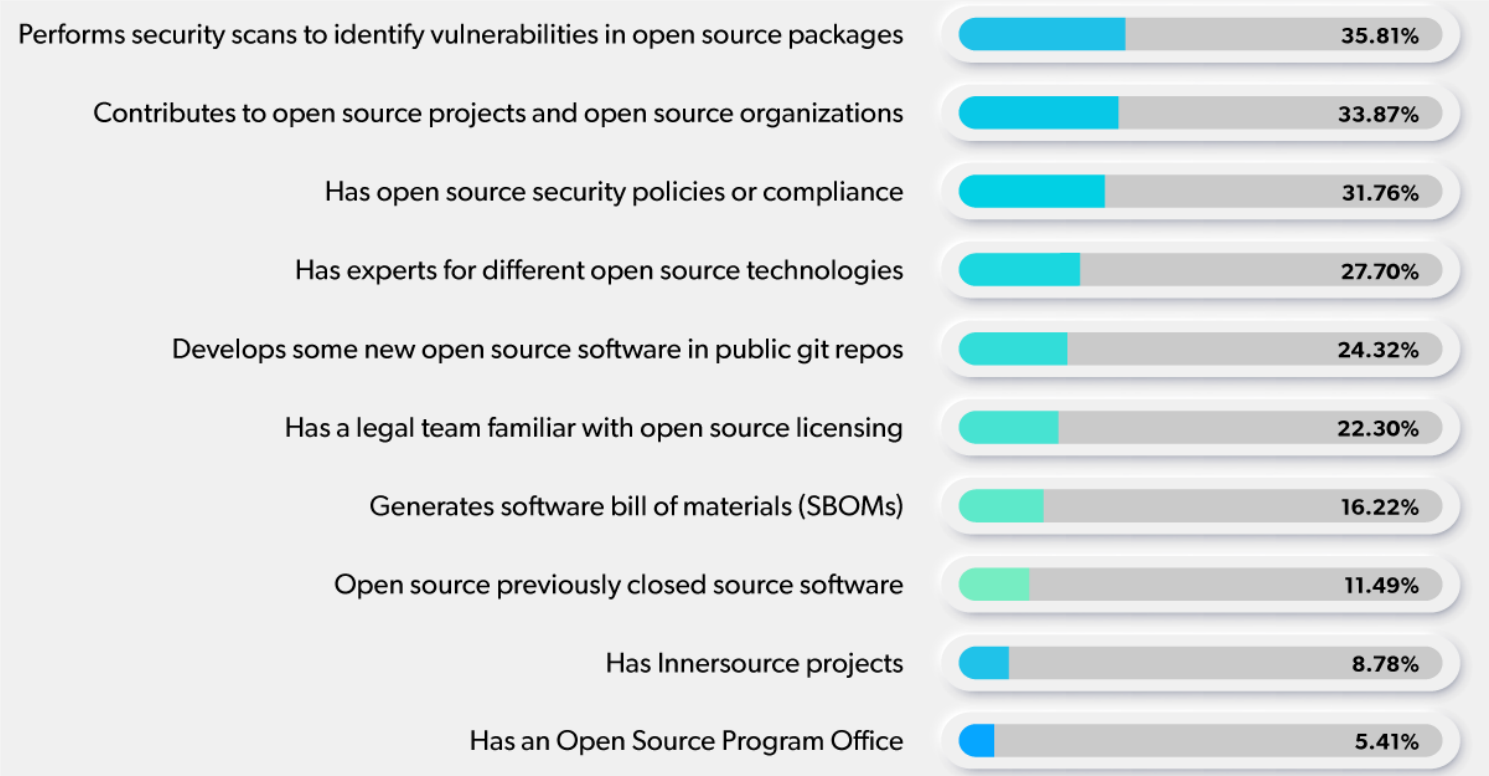
Examining the level of open source maturity based on the size of the organization reveals some compelling trends. By some metrics, small organizations with fewer than 100 employees, which could include highly technical startups as well as system integrators and boutique software development businesses, show similar open source maturity levels compared to the largest organizations (those with more than 5,000 employees). For instance, their numbers are comparable when it comes to having open source **security policies or compliance** and **experts for different open source technologies**, and even slightly exceed bigger organizations in terms of **contributing to open source projects and open source organizations**.

However, in areas and activities where the amount of resources and available budget might put smaller organizations at a disadvantage, we do see some gaps. As we might expect, larger organizations outpace smaller ones in their ability to **perform security scans to identify vulnerabilities in open source packages** and **have Innersource projects**. They are also are more likely to **have a legal team familiar with open source licensing** and a dedicated **Open Source Program Office**.

Largest Organizations (over 5,000 employees)



Small Organizations (under 100 employees)



Across industries, we see some differences in activities associated with open source maturity levels. The highly regulated healthcare/pharmaceuticals industry is at the top for **performing security scans to identify vulnerabilities in open source packages** — 59% of the respondents from this industry are performing security scans, which is significantly higher than the overall average of 46%.

Generating a software bill of materials (SBOM) correlates to the availability of tooling as well as policies and compliance as defined by the organization or industry. More than 25% of respondents in most industries say they are generating SBOMs, which is very encouraging considering that only a few years ago, SBOMs did not exist. The retail industry is leading the pack at 37.5%, followed closely by Government or Public Services with 35.85%, and Banking, Insurance, or Financial Services at 30.14%.

More than 25% of respondents in most industries are generating SBOMs. Retail, Government, and Banking, Insurance, or Financial Services lead this category in terms of their SBOM generation.

The prevalence of both **Innersource projects** and **OSPOs** grew only slightly for large organizations and in select industries, particularly Media or Gaming, and Retail. While these types of projects and organizational initiatives are being more widely adopted, there is still plenty of room for growth here.

When we look at the maturity results by industry, it gives us some insight into needs and trends. The following table represents a view of the top 3 industries with the highest percentage selected on each one of the open source maturity milestones.

Open source related activities	Top Industry with this activity	Second Industry	Third Industry
Performs security scans to identify vulnerabilities in open source packages	Healthcare or Pharmaceuticals	Manufacturing	Consulting or Professional Services
Has open source security policies or compliance	Telecommunications	Healthcare or Pharmaceuticals	Energy, Oil, or Gas
Generates software bill of materials (SBOMs)	Retail	Government or Public Services	Banking, Insurance, or Financial Services
Has experts for different open source technologies	Education or Research	Technology	Media or Gaming
Develops some new open source software in public git repos	Technology	Energy, Oil, or Gas	Media or Gaming
Open sources previously closed source software	Energy, Oil, or Gas	Vehicle, Transportation, or Logistics	Government or Public Services
Has a legal team familiar with open source licensing	Manufacturing	Media or Gaming	Government or Public Services
Contributes to open source projects	Media or Gaming	Consulting or Professional Services	Telecommunications
Has Innersource projects	Retail	Technology	Government or Public Services
Has an open source program office (OSPO)	Media or Gaming	Education or Research	Telecommunications

Open Source Stewardship

A good measurement of open source maturity is community participation. Mature organizations give back, contribute, lead, and sponsor projects as well as support non-profit open source organizations. We asked respondents to share how much they contribute to, and participate in, open source communities and organizations and which ones they are involved with.

At almost 40%, the Linux Foundation received the largest percentage of responses. No surprise there; the Linux Foundation is one of the largest and well-established open source foundations and hosts over 850 projects, including popular ones like the Linux Kernel, Kubernetes, Node.js, and their recent addition, PyTorch.

OpenLogic by Perforce sponsors the next two organizations that received the second and third most responses: the Apache Software Foundation and the Rocky Enterprise Software Foundation. The Open Source Initiative (OSI), our partner in producing this report, has grown its membership over the last year, and we encourage anyone not familiar with their work to consider getting involved. Overall, participation is up across all open source organizations compared to last year, which is exciting to see.

> The Open Source Initiative's membership has grown over the last year, and we encourage greater participation with OSI and all open source organizations.

Some respondents who selected "Other" wrote in that they don't sponsor financially, but encourage their employees to participate in community forums, webinars, and events.

Do You or Your Organization Sponsor Any of the Following Open Source Non-Profit Organizations?

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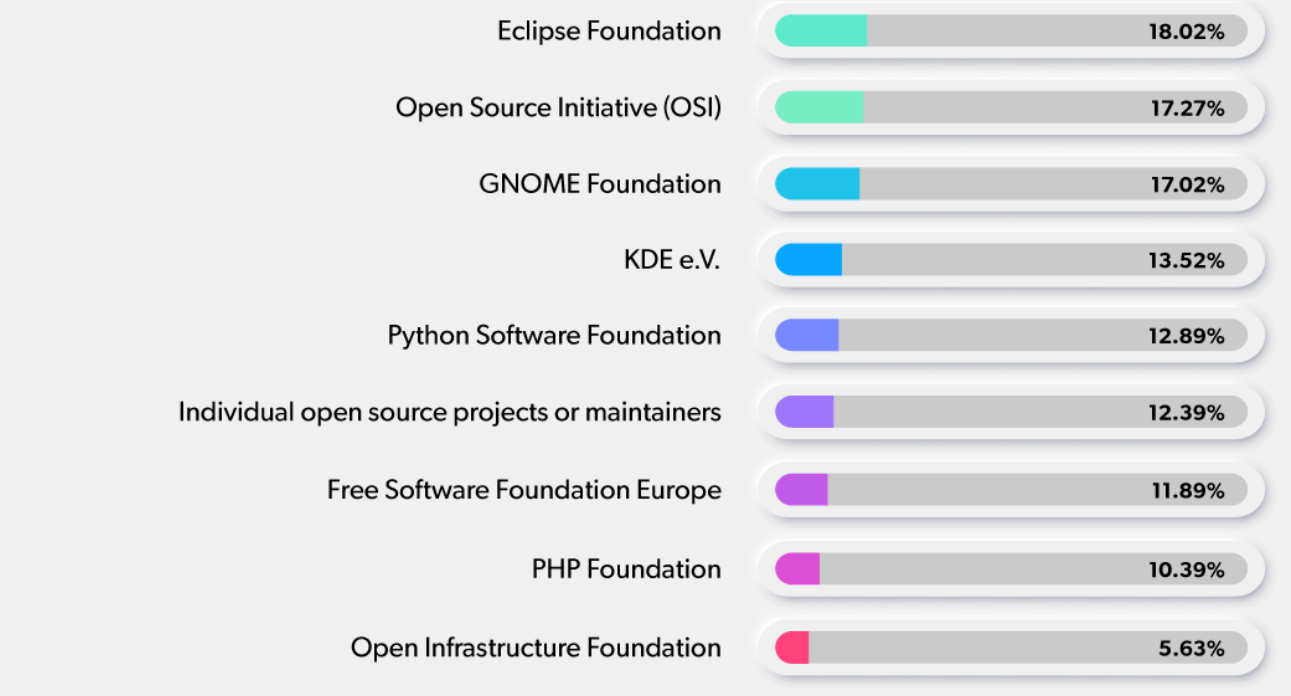

In addition to high participation from the technology industry, which we would expect, the other industries that are actively sponsoring open source organizations include Manufacturing, Consulting or Professional Services; Banking, Insurance or Financial Services; Telecommunications; and Media or Gaming.

Looking at the respondents' job titles within those industries, we noticed that within Manufacturing, which came in second behind technology in terms of sponsorship, Firmware or Embedded Systems Developers seem to be particularly involved.

Open Source Technologies in the Next 18 Months

To wrap up the 2023 State of Open Source Report, let's look at what's ahead for organizations in terms of their adoption of open source technologies. We asked respondents, "In order of importance, rank the following technologies in relation to your organization's desire to implement them in the next 18 months?"

This question came with a list of new, popular open source technologies and respondents ranked their desire to use these new technologies from not important to the most important.

Last year, Kubernetes or Kubernetes Operators got the most votes, but this was not the case this year. This year, Artificial Intelligence (AI)/Machine Learning (ML)/Deep Learning (DL) edged Kubernetes by 1% as the most desirable and important technology in the next 18 months. Virtual Reality or Augmented Reality was also chosen by more than 10% of respondents as the most important technology.

AI/ML/DL are the most desired technologies among respondents, 1% more than Kubernetes and Kubernetes Operators.

The highest percentage of "Not Important" votes went again this year to nonfungible tokens (NFT) at 25.30%, which is 6% higher than last year. Blockchain/Crypto also got 5% more "Not Important" responses compared to last year. Needless to say, it has not been a good year for crypto currencies, which explains the decline in interest in these technologies.

In Order of Importance, From Not Important to Most Important, Rank the Following Technologies in Relation to Your Organization's Desire To Implement Them in the Next 18 Months

Technology	Not Important	Mildly Important	Important	Very Important	Most Important
Kubernetes or Kubernetes Operators	16.34%	20.30%	31.97%	21.00%	10.39%
Data Science	11.88%	23.52%	29.22%	27.20%	8.19%
Artificial Intelligence / Machine Learning / Deep Learning	11.29%	20.82%	30.12%	26.24%	11.53%
Virtual Reality or Augmented Reality	19.74%	20.21%	24.82%	24.94%	10.28%
Blockchain/Crypto	20.98%	20.38%	27.46%	21.22%	9.95%
Nonfungible Tokens	25.30%	17.87%	28.66%	20.02%	8.15%
Serverless/Functions	11.88%	21.26%	33.25%	25.06%	8.55%
Quantum Computing	20.72%	22.16%	26.35%	22.28%	8.50%

Breaking down the results by organization size, the desire to use Kubernetes or Kubernetes Operators was favored by the largest organizations (over 5,000 employees). The smaller the organization, the less important Kubernetes or Kubernetes Operators is to implement.

Organization Size	Not Important	Mildly Important	Important	Very Important	Most Important
More than 5,000 employees	15.34%	19.32%	25.00%	28.41%	11.93%
500 to 5,000 employees	13.31%	22.05%	32.32%	21.67%	10.65%
100 to 499 employees	10.26%	21.25%	38.46%	20.51%	9.52%
Under 100 employees	38.46%	16.55%	27.59%	11.72%	9.66%

For AI/ML/DL, "Important" and "Very Important" responses are evenly distributed among medium to large organizations. As we saw with Kubernetes, AI/ML/DL is the "Most Important" desired technology for the largest organizations. This indicates that we are likely going to see more cloud-native and more AI/ML/DL in the months and years to come, all driven by open source software innovation.

Organization Size	Not Important	Mildly Important	Important	Very Important	Most Important
More than 5,000 employees	6.36%	23.12%	25.43%	24.86%	20.23%
500 to 5,000 employees	11.07%	21.37%	32.06%	26.72%	8.78%
100 to 499 employees	8.89%	18.52%	34.07%	30.74%	7.78%
Under 100 employees	22.07%	21.38%	24.83%	18.62%	13.10%

Finally, let's look at which technologies are the most desirable by industry, which offers insight into how particular industries might innovate with open source in the near future. The prospect of seeing these technologies deployed in the next 18 months is exciting — just imagine how the implementation of virtual/augmented reality, AI/ML/DL, and quantum computing could transform these industries and shape our lives in the coming years.

Most desirable open source technology to implement	Top Industry selecting "Most Important"	Second industry selecting "Most Important"	Third industry selecting "Most Important"
Kubernetes or Kubernetes Operators	Technology	Media or Gaming	Banking, Insurance, or Financial Services
Data Science	Education or Research	Vehicle, Transportation, or Logistics	Energy, Oil, or Gas
Artificial Intelligence / Machine Learning / Deep Learning	Technology	Education or Research	Banking, Insurance, or Financial Services
Virtual Reality or Augmented Reality	Media or Gaming	Banking, Insurance, or Financial Services	Healthcare or Pharmaceuticals
Blockchain / Crypto	Media or Gaming	Vehicle, Transportation, or Logistics	Retail
Nonfungible Tokens (NFT)	Energy, Oil, or Gas	Education or Research	Banking, Insurance, or Financial Services
Serverless / Functions	Retail	Telecommunications	Manufacturing
Quantum Computing	Retail	Manufacturing	Education or Research

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About the Open Source Initiative

The Open Source Initiative (OSI) is the steward of the Open Source Definition, setting the foundation for the global open source ecosystem. Founded in 1998, OSI protects and promotes open source software, development and communities, championing software freedom in society through education, collaboration and infrastructure. The OSI is a 501(c)3 non-profit, and anyone interested in supporting the defense of Open Source Definitions can join today at join.opensource.org.