



Global Spotlight 2023

Survey-based insights into the global landscape of open source trends, sustainability challenges, and growth opportunities

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In partnership with:



Global Spotlight 2023



On a global average, **90%** of organizations surveyed **USE OPEN SOURCE AT A MODERATE, SIGNIFICANT, OR WIDESPREAD LEVEL.**

OSS USE



77% of organizations in Europe, 71% in the Americas, and 56% in Asia Pacific **BELIEVE THAT BENEFITS EXCEED THE COSTS OF OSS USE.**

OSS VALUE

OPEN SOURCE USE AND CONTRIBUTION POLICIES WITHIN ORGANIZATIONS ARE ASYMMETRICAL, leaning toward more permissive use policies and stricter contribution policies.



OSS POLICIES

A total of 68% of respondents believe that **OSS IS MORE SECURE THAN CLOSED SOURCE SOFTWARE.**



OSS SECURITY



Only 24% of organizations surveyed **REQUIRE TRAINING IN SECURE SOFTWARE DEVELOPMENT.**

OSS SECURITY



The top action when evaluating a new OSS component is **CHECKING THE ACTIVITY LEVEL OF THE PROJECT COMMUNITY.**

OSS USE



Organizations with an OSPO or clear strategy are more likely to **FOLLOW A RIGOROUS APPROACH WHEN CONTRIBUTING CODE.**

OSS CONTRIBUTION

OSS use brings many benefits, including **IMPROVED PRODUCTIVITY & SOFTWARE QUALITY, & A LOWER COST FOR SOFTWARE.**



OSS VALUE



OSS contributions **ALWAYS OR OFTEN RESULT IN IMPROVED SOFTWARE QUALITY** according to 52% of respondents.

OSS VALUE

People contribute in their personal time for various reasons, be it for **INDIVIDUAL OR COLLECTIVE BENEFIT.**



OSS CONTRIBUTION



Leading concerns about contributions include **LEGAL, LICENSING, AND LEAKING IP ISSUES.**

OSS CHALLENGES



Dedicated **EMPLOYEE TIME** and **FINANCIAL SUPPORT** are the most popular areas respondents feel need investment to increase contributions

OSS SUSTAINABILITY

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Foreword

As a long-time advocate of open collaboration - both as a communicator engaged with European policymakers and as a researcher - it is with pleasure and anticipation that I introduce the World of Open Source Global Spotlight report. The findings not only bring valuable insights to a growing body of knowledge around open source but I hope they can also serve as a foundation for further research and informed policymaking.

When I was first introduced to open source in 2007, I quickly discovered that talking about my new passion at a dinner party in Brussels was a sure-fire way to alienate people. In the years since, open source has “won” in the market and general interest has certainly increased. Yet while witnessing how open source has transformed the tech industry, I have often found myself underwhelmed by the level of understanding among policymakers about its impact and potential, and disappointed by the level of adoption in the public sector.

Thus, having spent close to 15 years in EU public affairs, I had two main motivations for joining RISE Research Institutes of Sweden last year: I wanted to conduct research that could be used to inform and improve policy discussions around open source, and

I wanted to move my main focus from the political to the administrative level of government, to better support open source adoption in those organizations that stood to benefit but were lagging behind.

The research presented in the World of Open Source series supports both those objectives. Crucially, it represents a valuable asset when communicating with policymakers, providing them with a nuanced understanding of the significance and functioning of the global open source ecosystem. Call me an idealist and an optimist, but I believe that the dissemination of high-quality research can empower policymakers to make better decisions, to craft policies that nurture innovation, and to foster environments where open source can flourish.

In my role as a researcher, I am particularly excited about the potential for the World of Open Source findings to stimulate further investigation. An example of such further in-depth study is [The European Public Sector Open Source Opportunity](#) report which was motivated by certain findings in last year’s European spotlight report. Personally, I am now compelled to dig deeper into the discrepancy between open source consumption and open source contribution, which was highlighted in this

year’s report. A closer look at the specific drivers and challenges that underlie this divide could be translated into practical guidance, ultimately fostering a culture of active participation and collaboration in the open source community.

The extension of this year’s report beyond Europe to include Asia and the Americas allows us to consider regional opportunities and challenges. Each continent brings its unique perspective, priorities, and approaches to open source. However, instead of fragmenting our vision, these diversities can serve as a reminder of the immense potential that emerges when we unite our strengths as a global community.

I am deeply appreciative of LF Research for their commitment to advancing our collective understanding of this dynamic field. Again, it is my hope that this research can serve as more than just an information resource. It has the power to ignite curiosity, to stimulate further research, and to fuel discussions that transcend geographical boundaries.

Sachiko Muto

Chair, OpenForum Europe
Senior Researcher, RISE Research Institutes of Sweden

Executive summary

Regional perspectives on open source trends

Our research reveals that globally, organizations widely adopt open source software (OSS), with over 90% of surveyed organizations using it to a moderate, significant, or widespread extent. Organizations in the Asia-Pacific region also use open source extensively, but the figure drops to 84%. Furthermore, a significant 73% of organizations in our survey exhibit a pro-open source stance, either actively encouraging OSS adoption or allowing development teams to decide. The European region surpasses the global average with a reported rate of 77% for such pro-open source policies. However, when it comes to contributing to OSS, around 60% of organizations openly encourage or leave the decision up to each development team. Structured strategies such as Open Source Program Offices (OSPOs) are lacking in over half of organizations across regions.

Our study reveals that organizations worldwide recognize the substantial value of OSS to their own operations and their respective industries, with over 90% agreement in the Americas, close to 90% in Europe, and 73% in Asia Pacific. When assessing organizations where the benefits of OSS use outweigh the costs, the global average stands at 69%, with the highest percentage at 77% reported in Europe. Organizations in the Americas and Europe are experiencing an upward trend in the business value derived from OSS, with 57% reporting an increase over the previous year, while Asia Pacific, although currently lagging slightly in perceived value, is showing a more substantial increase (61%), indicating a growing momentum in the region.

Responsibility in open source use and contribution

Our survey found that despite the prevailing belief that OSS is more secure than closed source software (68% of respondents agreeing), a substantial 42% of respondents expressed concerns about the security of OSS components when prompted to agree or disagree with factors limiting OSS use in their organization. This suggests that while organizations perceive open source as secure overall, they may still harbor doubts about specific components or projects. When evaluating a new OSS component, most developers opt for proxies (e.g., activity levels, frequency of releases) instead of conducting time-consuming direct inspections of the source code. However, even less time-intensive approaches such as automated tools are not yet commonplace in this evaluation process, with only 36% of organizations employing them.

In terms of responsible contribution, organizations with a well-defined OSPO or clear strategy demonstrate a more systematic approach to contributing code, as evidenced by their engagement across all the steps outlined in the survey, such as quality and security testing and providing documentation.

Value proposition of open source contribution

Contributing to open source projects offers a wide range of benefits for organizations, including innovation, as 51% of respondents believe it often fosters innovation in the IT industry through collaboration and idea sharing. Additionally, 52% think that open source contributions frequently improve their organizations' work environments by promoting teamwork and skill development. Many organizations also view such contributions as a moral obligation, aligning with principles of transparency and community

support, and they can lead to economic gains through improved software quality. These diverse benefits underscore the multifaceted advantages of open source contribution, appealing to both the economic interests and the broader values of organizations, ultimately contributing to the collective progress and vitality of the open source ecosystem and the technology industry as a whole.

Improving open source sustainability

To enhance open source sustainability through increased contributions within organizations, it is crucial to address the barriers faced by organizations. Our survey found that the most significant obstacle, reported by 43% of organizations, is legal and licensing concerns, coupled with a fear of intellectual property (IP) leakage. This underscores the importance of navigating the legal landscape in open source initiatives. Additionally, 38% of organizations cite a lack of policy or training materials as a challenge, highlighting the need for clear guidelines and educational resources. Interestingly, while 36% consider a lack of monetary return as a barrier, 23% do not view it as a significant obstacle, suggesting diverse perspectives within organizations.

Our survey findings show regional differences in priorities for advancing open source. In the Americas and Europe, respondents emphasize the government adoption of open source, with 42% and 48% respectively choosing this as a top priority. They also prioritize pursuing open source alternatives to tech monopolies and improving academic education on open source. In contrast, in the Asia-Pacific region, better funding for the commercial open source startup ecosystem is the top priority (36%), followed by fostering open source global tech standards (31%), and government adoption of open source. These regional variations highlight the diverse needs in the open source landscape, suggesting the importance of tailored strategies and investments for effective adoption and sustainability in each region.

Introduction

In 2023, the Linux Foundation (LF) Research Team set out to undertake research on the global landscape of open source following the success of the 2022 World of Open Source: Europe Spotlight survey and report. The Global Spotlight 2023 project greatly expanded our view of open source participation in different regions, providing valuable insight to better understand and support open source participation worldwide. The research is relevant to decision-makers from all functions and sectors, including managers, executives, policymakers, and others involved in open source initiatives. The 2023 survey contained enough data and information for us to create three reports. The [2023 Europe Spotlight report](#)¹, already published, dives further into specific trends within Europe, and the 2023 Japan Spotlight, published later this year, will give special attention to the open source landscape in Japan. The Global Spotlight report you are reading now encompasses the globe, aiming to mentally cross borders while realizing the different needs and priorities of the studied regions.

The report gives a special focus to open source sustainability, which refers to the ability of open source projects to stay maintained and evolve, ensuring their continued availability and reliability for their users. The main voices of the survey include open source contributors and developers who understand the role of OSS in their organization or within a given industry. The LF Research team would like to especially thank all participants in the survey who gave us their invaluable time. Your insights have been the backbone of this report and the potential critical discussions stemming from it.

Research overview

Data collection for the worldwide online survey took place between April and June of 2023. We received 916 valid responses, which are the basis for the analysis presented in this report. The survey included questions in the following areas: demographics, the current state of open source consumption and contribution, benefits and challenges of open source usage and contribution, the value proposition of open source, and open source sustainability. We will introduce the geographic distribution of the sample below, but for more information about the research approach and further demographics on participants and their organizations, see the Methodology section.

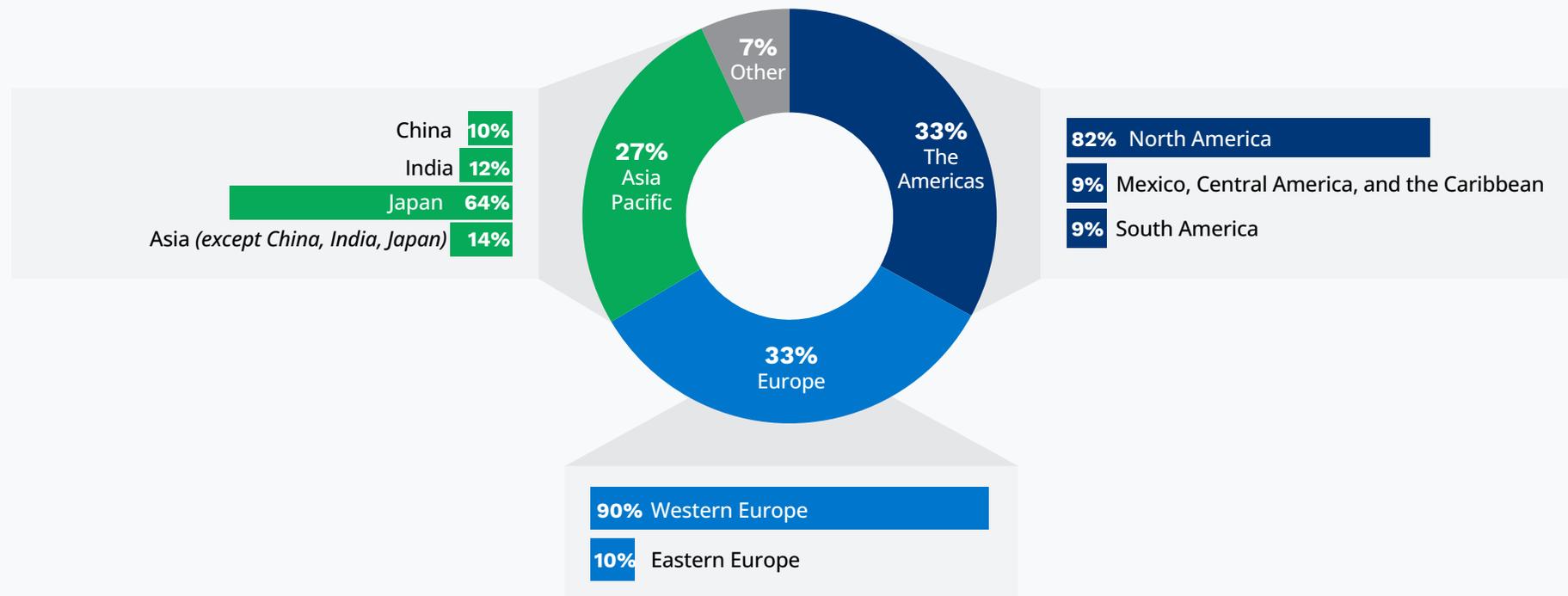
Geographic distribution

As the report greatly focuses on the regional differences and similarities in open source trends across the globe, the geographic distribution of the sample deserves special attention. We aimed to gather responses from all parts of the world, but given the Linux Foundation's primary presence in North America and Europe, we received most responses from those regions. A third-party panel provider supported our efforts to gather data from Asia Pacific. 64% of responses from this region came from Japan in order to create a World of Open Source: Japan Spotlight report to be published in December 2023. Three regions that we segment our data on are the Americas, Europe, and Asia Pacific. More detailed distribution within these three regions is summarized in Figure 1.

¹ Colin Eberhardt, Graham Odds, and Matthew Dunderdale, "Europe Spotlight 2023: Exploring the State of European Open Source Innovation, Opportunities, and Challenges," foreword by Gabriele Columbro, The Linux Foundation, September 2023.

FIGURE 1

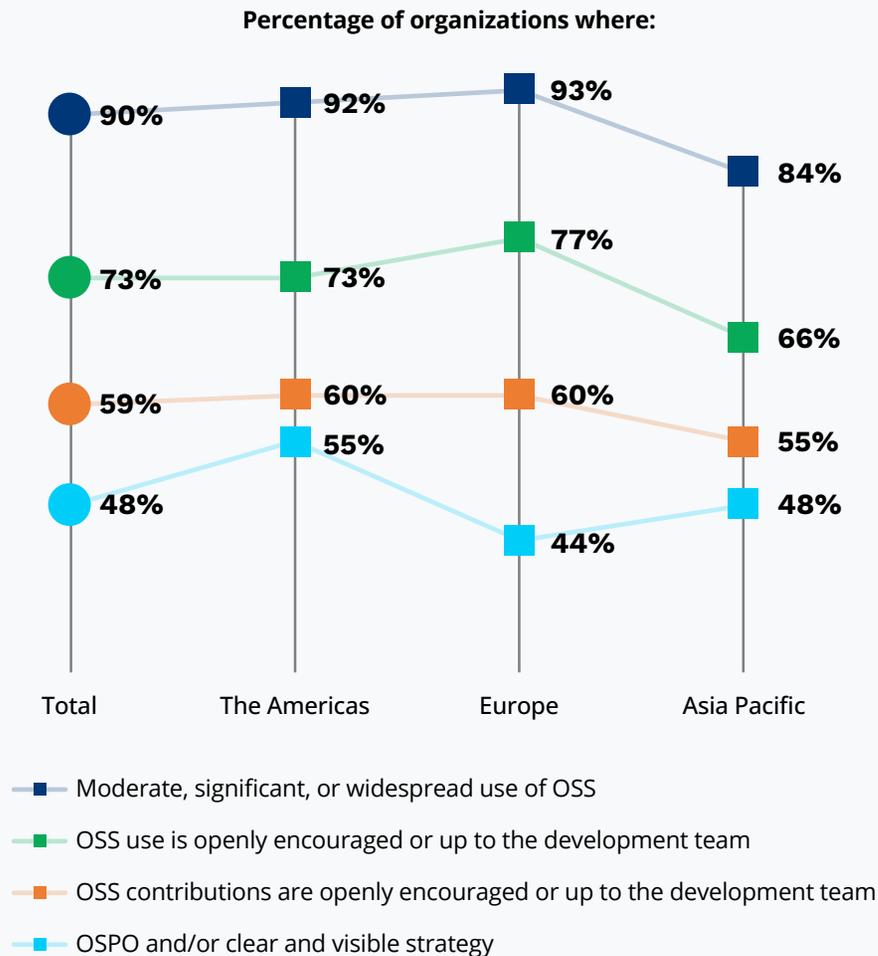
Geographic distribution in the sample of the 2023 World of Open Source: Global Spotlight Survey



Source: 2023 World of Open Source: Global Spotlight Survey, Q5. Sample Size = 916

FIGURE 2

Regional differences but an overarching pattern in open source use and contribution



Source: 2023 World of Open Source: Global Spotlight Survey, Q12, Q13, Q22, Q11, Sample Size = 705-916

Regional perspectives

Use and contribution patterns

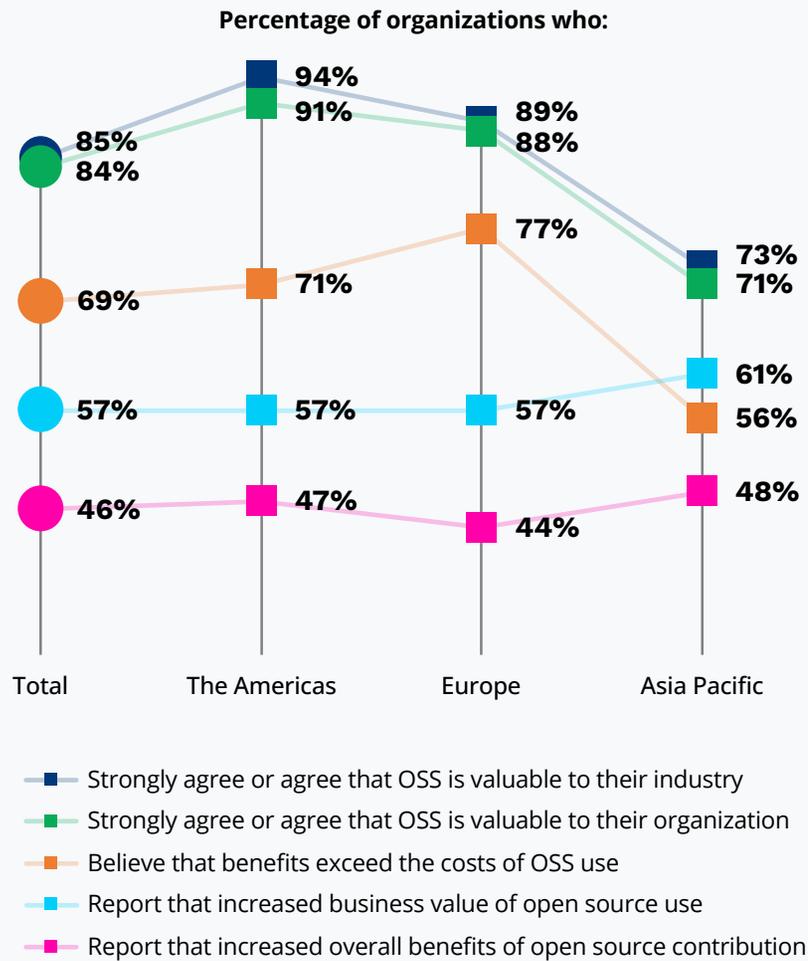
Although regional differences persist in the state of open source, overarching patterns can be observed in Figure 2. The adoption of OSS is widespread across organizations globally. More than 90% of organizations who participated in the survey report that they use OSS at least at a moderate level (moderate, significant, or widespread use of OSS). The only exception is Asia Pacific, where 84% of organizations reported using open source at least at a moderate level.

Beyond the extent of usage, exploring organizational policies sheds light on the broader landscape. Across the entire survey sample, a substantial 73% of organizations exhibit a pro-open source stance. This manifests as either active encouragement of open source adoption or a flexible approach that leaves the decision in the hands of individual development teams. The European region exceeds this global average with a reported rate of 77%.

When considering what policy organizations have for contributing to OSS, more organizations shy away from permissive policies. Around 60% of companies openly encourage or let each development team decide on OSS contributions. Therefore, in most organizations, OSS contribution is less encouraged than OSS use, and this finding is consistent across regions. A more structured approach to open source policies would suggest the presence of an OSPO or other clear and visible strategies within companies. For most regions, more than half of organizations lack such a strategy. In Europe, 16% of organizations were yet unable to leap to a more structured OSS approach while already having permissive policies. By contrast, in the Americas, only 5% of organizations with permissive policies are without an OSS initiative.

FIGURE 3

Value of open source recognized across regions with increasing value reported in about half of organizations



Source: 2023 World of Open Source: Global Spotlight Survey, Q37, Q36, Q42, Q20, Q27, Sample Size = 599-702

Value proposition of open source

A high-level view of the value proposition of open source (Figure 3) shows that most organizations realize the value of open source to their organizations and respective industries. There is consensus that open source is valuable to the industry the organization is part of. Perceived value to organizations is almost as high as value to the industry, both above 90% in the Americas, and almost at 90% in Europe. Although enthusiasm is lower in Asia Pacific, an overwhelming majority of organizations (73%) report value to industry, and 71% see value to their organizations. When explicitly asked about whether the benefits exceed the costs of open source use, the global average is at 69%, and the highest percentage across regions is at 77% in Europe.

Reflecting both backward and forward, it becomes evident that the business value of OSS continues to grow. Remarkably, 57% of organizations in the Americas and Europe have reported an increase in the business value derived from open source when compared to the previous year. This upward trajectory suggests that organizations in these regions are recognizing the existing value and capitalizing on it more effectively over time.

Interestingly, the Asia-Pacific region presents a nuanced perspective. While a smaller percentage of organizations (56%) currently report that the benefits of open source usage outweigh the costs, they have reported a more substantial increase in value (61%) compared to other regions. This dynamic suggests that while the perceived value of open source may not yet match that of the Americas and Europe, the momentum for its growth is building in the Asia-Pacific region, potentially positioning it to reach similar perceived value levels in the near future.

When it comes to open source contributions, the overall increase in benefits is perceived to be less pronounced compared to open source usage. However, nearly half of the organizations across regions still report a growing sense of benefits resulting from their open source contributions.

Asymmetry in open source use and contribution

Organizations are more likely to lean toward more permissive open source use policies than contribution policies

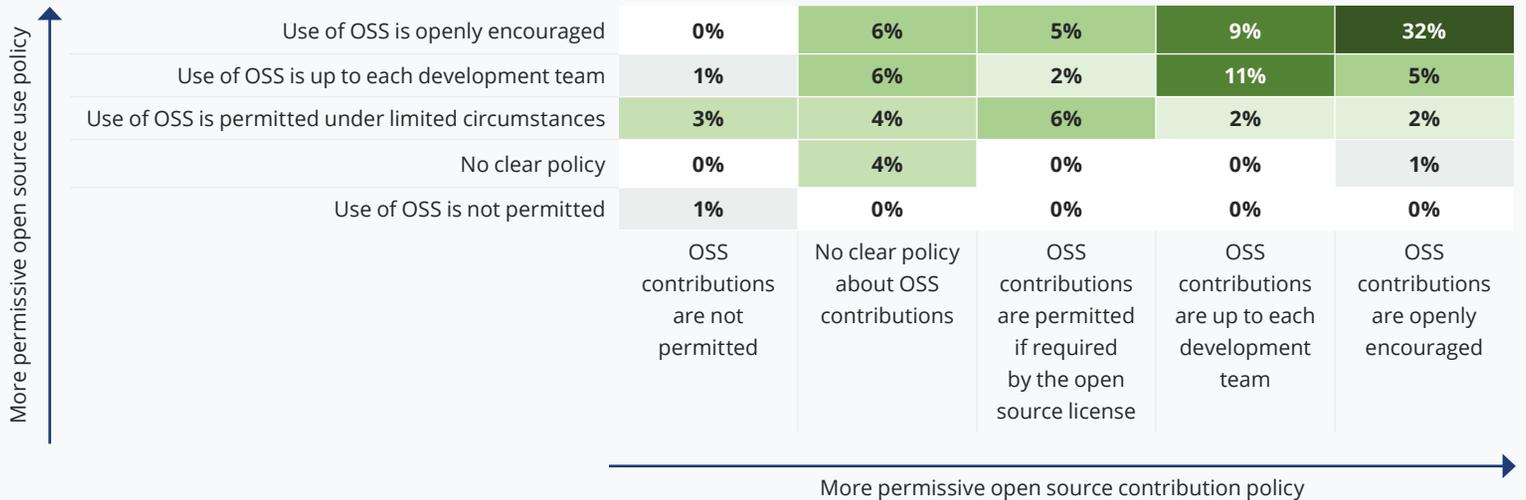
The descriptive statistics presented in Figure 4 shed light on the asymmetry in open source use and contribution policies within organizations. It is clear from the data that these policies can vary significantly, ranging from highly restrictive, where open source use and contribution are not permissible, to those that actively encourage both. Notably, 32% of the surveyed organizations have adopted a very permissive stance, allowing both open source use and contribution. Fortunately, only 1% of the organizations in our sample reported a complete prohibition of OSS usage and contribution, although it is essential to acknowledge that this figure

could be higher outside our survey sample, as we did not include organizations that had no familiarity with OSS in our survey.

These findings underscore the nuanced landscape of open source adoption within organizations. While there is some symmetry in the policies, with a greater emphasis on permissive open source use policies compared to contribution policies, it is evident that there is room for improvement in aligning use and contribution policies by making these policies more permissive. This asymmetry may reflect the differing attitudes and concerns organizations have regarding the consumption and contribution to open source projects. Addressing these disparities could lead to more consistent and effective open source strategies and increase the sustainability of the open source ecosystem.

FIGURE 4
Open source use and consumption policies are asymmetrical

Source: 2023 World of Open Source: Global Spotlight Survey, Q13 and Q22, Sample size: 670 (DKNS excluded), cells add up to 100%



Insights into the use and contribution to different open source software technologies within organizations

Figure 5 compares the percentage of organizations using key OSS technologies to the percentage of organizations contributing to these same OSS technologies and shows the extent to which OSS technologies support business-critical activities.

OSS technology use

Figure 5 shows that 64% of organizations use Linux in our sample and notes the extent to which Linux has become a core operating system for organizations surveyed worldwide. Equal in stature are OSS cloud and container technologies, which 63% of organizations use. Together with Kubernetes, they provide an efficient and cost-effective approach to providing the foundation of cloud native environments. Database and data management tools, which continue today to represent the single biggest investment that organizations make in technology, have attracted many open source SQL, No-SQL, and distributed file system solutions over the last decade. Collectively, 54% of organizations use OSS database and data management tools, which also encompasses OSS penetration of DevOps devices, including foundation CI / CD tools for application development. We note that 52% of organizations use web and application development, including web assembly, with the combination of DevOps / GitOps / DevSecOps seeing use by 50% of organizations.

A second leading tranche of technology use includes advanced analytics and data science (43%), Kubernetes (42%), cybersecurity (41%), and AI / ML (40%). While the focus on cybersecurity does not rank higher at present, this will likely change as we will see later in this report.

OSS technology contributions

Figure 5 also shows the percentage of organizations that contribute to OSS projects by technology area. While we have come to expect OSS contribution to trail the use of OSS, what is surprising is how closely the pattern of OSS contribution matches OSS use. The correlation when comparing OSS use and OSS contribution is 95%, despite how the gap widens as OSS use increases. This means that OSS contribution is indeed occurring everywhere.

Figure 5 shows that 43% of organizations contribute to cloud and container technologies, which could be due in part to the high level of OSS use seen in this market as well as a wide scope of tooling that provides many opportunities for involvement. Beyond cloud and container technologies, OSS contribution is relatively tightly clustered across the leading OSS technologies areas in use. Contributions to web & application development (35%) rank second, but contributions to Linux (34%), advanced analytics and data science (33%), CI / CD and DevOps (31%), AI / ML (31%), DevOps / GitOps / DevSecOps (30%), cybersecurity (29%), and database / data management (28%) follow closely. This list of leading OSS technology areas where organizations contribute largely mirrors the leading technology areas where OSS is used.

FIGURE 5

Open source technologies are used for a wide variety of business critical activities

Source: World of Open Source Global Spotlight Survey, Q16 (OSS use), Sample Size = 691, Total Mentions = 4,508 (DKNS excluded)

Source: World of Open Source Global Spotlight Survey, Q24 (OSS contribution), Sample Size = 488, Total Mentions = 2,133 (DKNS excluded)

In which of the following areas does your organization use / contribute to OSS? (select all that apply)

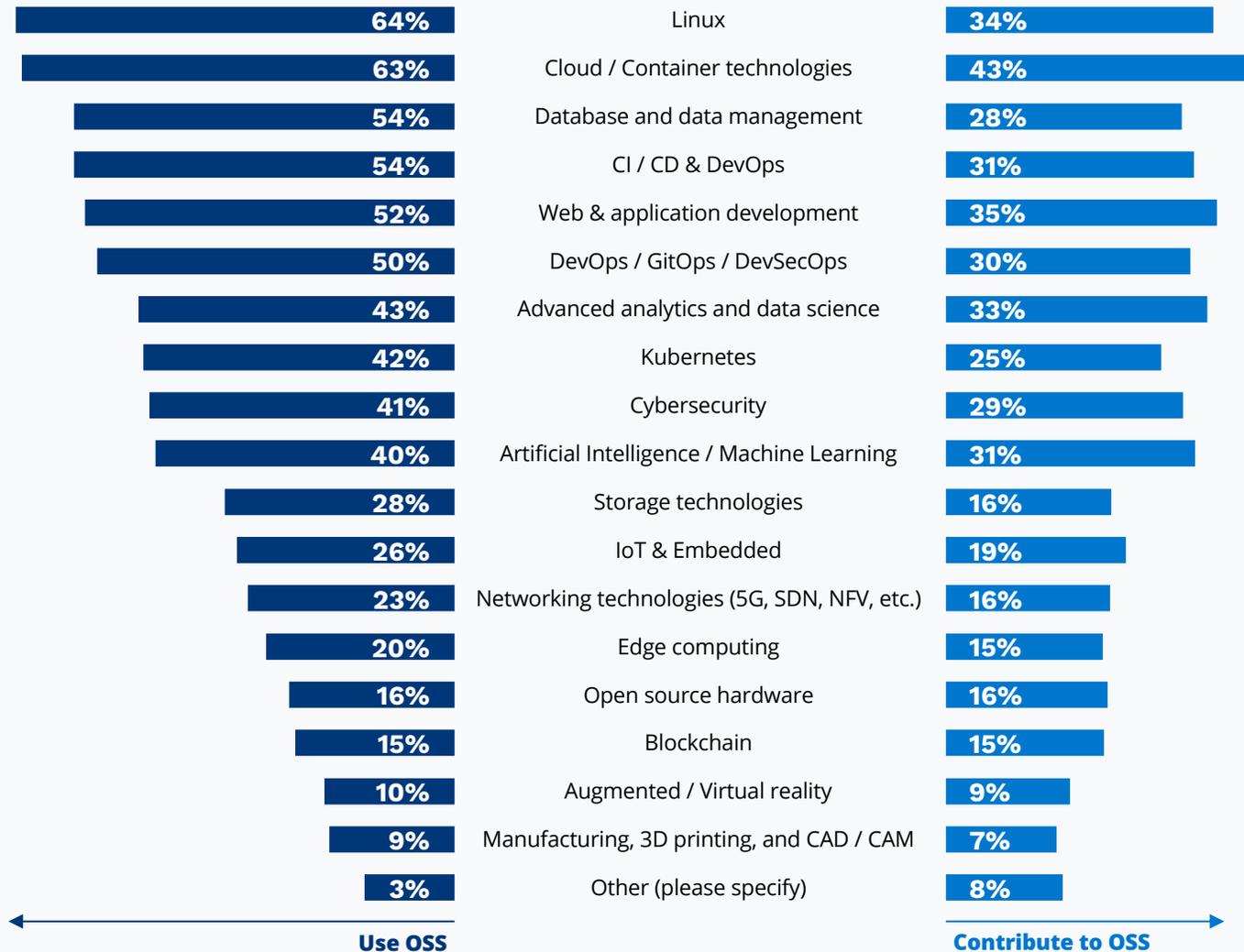
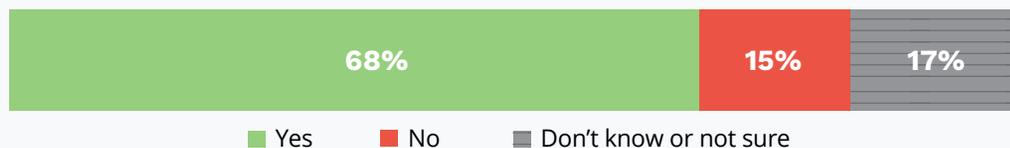


FIGURE 6

68% of respondents believe that open source is more secure than closed software

Do you believe that OSS is more secure than closed source software? (select one)

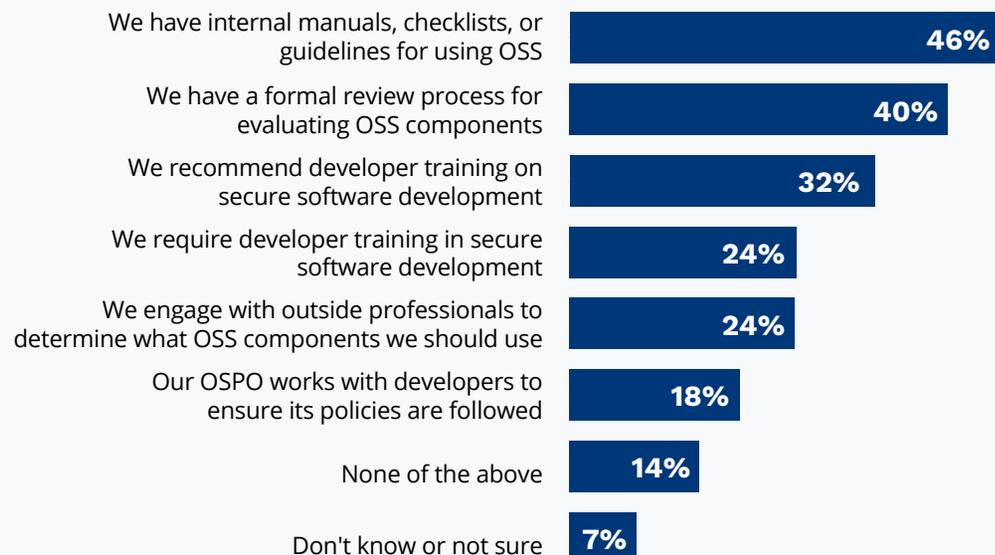


Source: 2023 World of Open Source: Global Spotlight Survey, Q21, Sample Size = 711)

FIGURE 7

46% of organizations have internal manuals, checklists, or guidelines for using OSS

What practices does your organization follow regarding the use of OSS? (select all that apply)



Source: 2023 World of Open Source: Global Spotlight Survey, Q14, Sample Size = 702, Total Mentions = 1,434

Responsibility in open source use and contribution

Thorough inspection of code is not common, even though security concerns abound

The data highlights a significant perception within organizations regarding the security of OSS versus closed-source alternatives. Figure 6 shows that most respondents, 68%, believe that OSS is more secure. However, when looking further into the security question, the picture is not as clear.

Despite the prevailing belief that OSS is more secure than closed source software, Table A1 in the Appendix shows a substantial 42% of respondents expressed concerns about the security of OSS components when prompted to agree or disagree with factors limiting OSS use in their organization. This suggests that while there is a perception that open source is secure overall, organizations may still harbor doubts about specific components or projects.

According to Figure 7, having internal manuals, checklists, or guidelines for the use of OSS (46%) and a formal review process for OSS components (40%) are common ways that organizations seek to mitigate the risk that comes when preparing to use an OSS component. Furthermore, only 24% (a minority of organizations) require development training in secure software practices, potentially leaving software development teams without the necessary skills to effectively mitigate security risks in open source projects. Addressing these disparities between perception and practice, as well as enhancing training initiatives, may be crucial for organizations aiming to harness the full potential of open source while ensuring security and compliance.

Figure 8 shows that when organizations are in the process of evaluating whether to incorporate an OSS component, it's evident that they employ various strategies to gauge the component's suitability. Primary actions include the assessment of proxies that may or may not be efficient indicators of the component's overall health and reliability. Examining the activity level within the project community is a common practice (50%), as it provides insights into the vitality of the project. Additionally, organizations rely on factors such as repository ratings and package download statistics to gauge the quality of the project (42%), while the frequency of releases (39%) helps in assessing the level of maintenance and support.

It is worth noting that most developers understandably opt for these proxies instead of conducting time-consuming direct inspections of the source code. However, even less time-intensive approaches such as automated tools are not yet commonplace in this evaluation process, with only 36% of organizations employing them. Regional variations also exist, with 41% of organizations in the Americas using automated tools, compared to 30% in Europe

and 39% in the Asia-Pacific region (Table A2). Furthermore, 30% of organizations still rely on manual reviews or inspections of the source code, suggesting that in-depth methods also persist (Figure 8). It's noteworthy that 10% of organizations in the sample do not conduct any formal review of the component at all, potentially posing risks in terms of quality and security. Considering these findings, it becomes apparent that there is room for improvement in adopting more automated and efficient evaluation tools and practices, which can help organizations streamline their OSS component assessments and ensure the fulfillment of both quality and security standards.

The open source community is encouraging secure consumption of OSS components. The Open Source Security Foundation ([OpenSSF](#)) released a working group proclamation, the [Open Source Consumption Manifesto](#), which states:

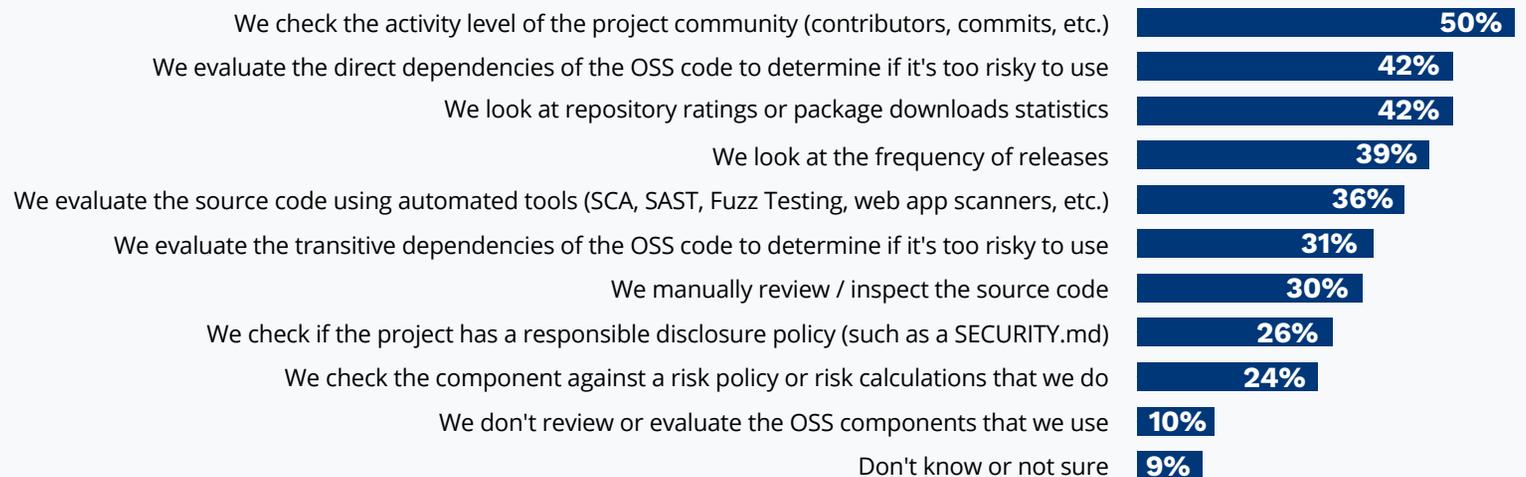
"As consumers of open source, we are responsible for the open source we use, how we consume it, and how we manage the risk associated with that consumption."

FIGURE 8

Organizations tend to use proxies to evaluate new OSS components instead of more thorough inspection

Source: 2023 World of Open Source: Global Spotlight Survey, Q15, Sample Size = 702, Total Mentions = 2,383

What actions does your organization usually take before using a new OSS component? (select all that apply)



Responsibility for OSS lies with users but also with contributors. It is essential that both parties establish and maintain policies to ensure responsible usage and contribution. Next, we examine the steps followed when organizations contribute to OSS projects.

More steps are followed for contributions when OSPO or other OSS initiatives are present

Ensuring the continued vitality of OSS projects relies on responsible contributions, where the code contributed upstream meets high standards of quality, security, and ongoing maintenance. Contributions to OSS encompass a wide range of activities. Contribution is not limited solely to code submissions; it also encompasses actions such as opening issues and answering queries, contributing to documentation, and providing non-code assets, such as design elements (Table A3).

Figure 9 illustrates the distinction between structured and unstructured approaches to contribution. We distinguish the steps taken for contribution based on whether an organization has an OSPO or a clear and visible open source strategy in

place. Organizations with a well-defined OSPO or clear strategy demonstrate a more systematic approach to contributing code, as evidenced by their engagement across all the steps outlined in the survey.

One of the most prevalent actions is peer code review, with a substantial 70% of organizations with an OSPO conducting it. This percentage drops to 48% for organizations without an OSPO. Organizations with an OSPO are also more than twice as likely to engage in security and vulnerability testing. Figure 9 reveals that 47% of organizations provide component documentation, and this figure decreases further to 22% for organizations without an OSPO. Particularly noteworthy is the “Don’t know or not sure” response, which is significantly higher among organizations lacking an OSPO, highlighting a sixfold higher uncertainty among respondents regarding the steps involved in contributing to the OSS code.

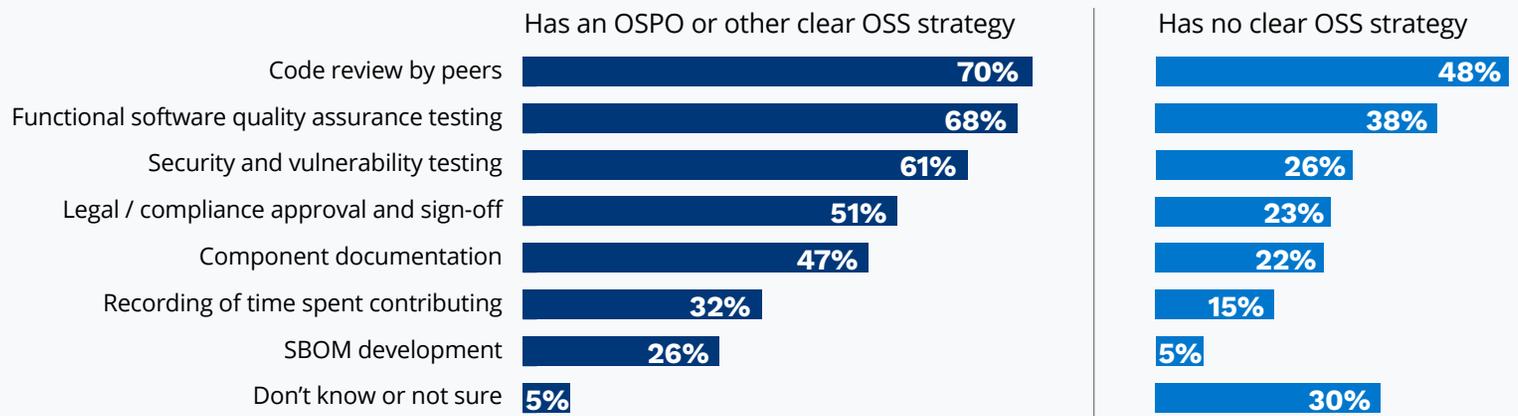
These insights underscore the advantages of structured approaches to OSS contribution, demonstrating their effectiveness in ensuring code quality, security, and project sustainability, while also highlighting potential areas for improvement in organizations with less formalized strategies.

FIGURE 9

Organizations with an OSPO or other clear OSS strategy are more likely to follow a rigorous approach when contributing code

Source: 2023 World of Open Source: Global Spotlight Survey, Q23 by Q11, Sample Size = 288, Total Mentions = 875 (Filtered for organizations contributing code Q25)

What steps are followed for contributing OSS code in your organization? (select all that apply)



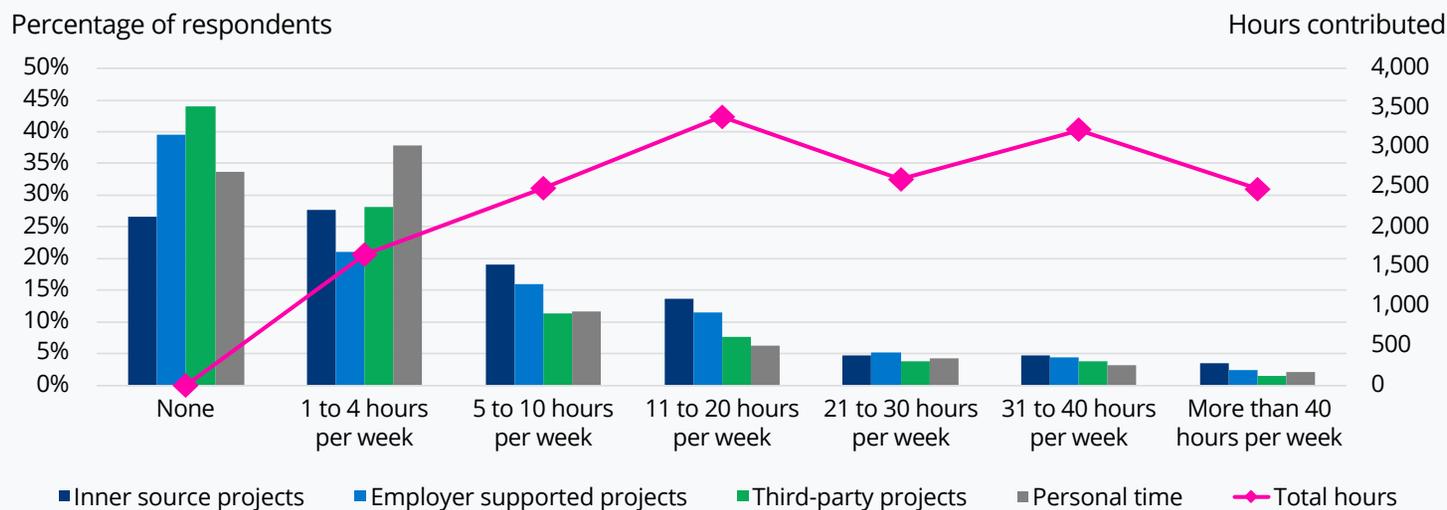
All contributions are important, no matter the time spent

Figure 10 provides valuable insight into the allocation of developer time across different types of projects and their contributions. We aimed to understand the time developers spend contributing at work to inner source projects, employer-supported projects, and third-party projects. But we also asked how much time they spend contributing in their personal time. As shown by the heights of the bar charts across the different amounts of time spent contributing, most developers in the survey spend none to four hours per week on contributing. Notably, inner source projects receive the most significant portion of developers' contribution hours. Conversely, third-party projects receive comparatively less attention, with employees dedicating fewer hours to these external initiatives.

It is essential to highlight the diversity in the time commitment across the board. Developers' contributions can range widely, from devoting just one to four hours per week to contributing more than 40 hours per week. The line in Figure 10 illustrates that the cumulative effect of many developers who undertake frequent, small contributions over time, such as 5 to 10 hours per week closely matches the total hours contributed in a more concentrated 21 to 30 hours per week assignment. This implies that even developers with limited time can make a meaningful impact through consistent contributions. This shows that open source talent is being leveraged in various types of job functions and is not limited to full-time assignments.

FIGURE 10

Time spent on contribution can range from none to more than 40 hours per week



Source: 2023 World of Open Source: Global Spotlight Survey, Q30-33, Sample Size = 604-637

Value proposition of open source use and contribution

Clear economic and business values are linked to open source use

Our survey results further confirm that using open source brings economic and business value. In 69% of cases (as depicted in Figure 11), the benefits of open source exceeded the associated costs, demonstrating the positive impact it has on various aspects of business operations. Notably, the distribution of these benefits varies across regions, with Europe reporting higher percentages

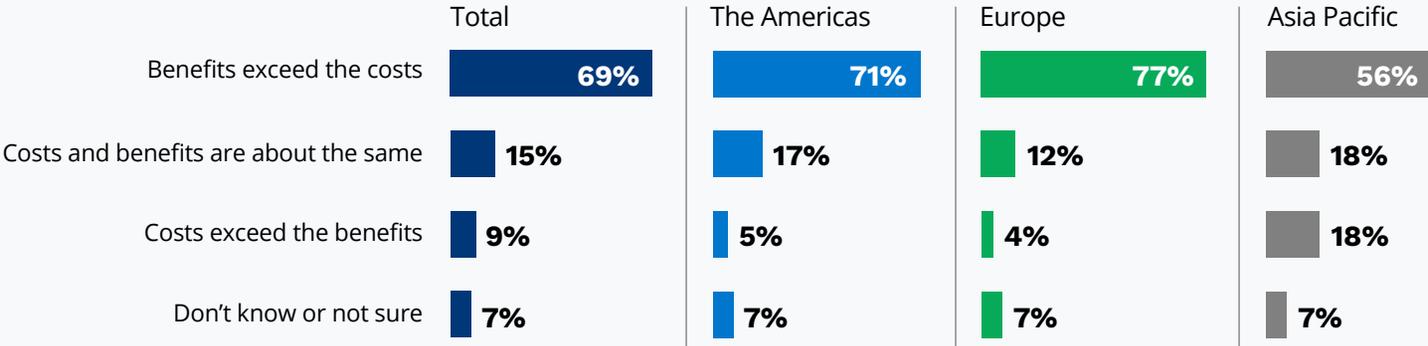
of positive outcomes (77%), while the Asia-Pacific region registers slightly lower figures (56%). A preliminary analysis paper on quantifying the economic value of open source gives further insight into how benefits exceed the costs of open source use. For instance, the paper shows that the benefit-cost ratio of open source has been improving in the past five years.²

Figure 12 presents an overview of the perceived advantages that OSS usage brings to organizations. Foremost among these

2 Henry Chesbrough, "Measuring the Economic Value of Open Source: A Survey and a Preliminary Analysis," foreword by Irving Wladawsky-Berger, The Linux Foundation, March 2023.

FIGURE 11
OSS benefits exceed the costs for most organizations

Which of the following statements best characterizes your organization's use of OSS? (select one)
segmented by In what country or region does your organization have its headquarters? (select one)



Source: 2023 World of Open Source: Global Spotlight Survey, Q42 by Q5, Sample Size = 599

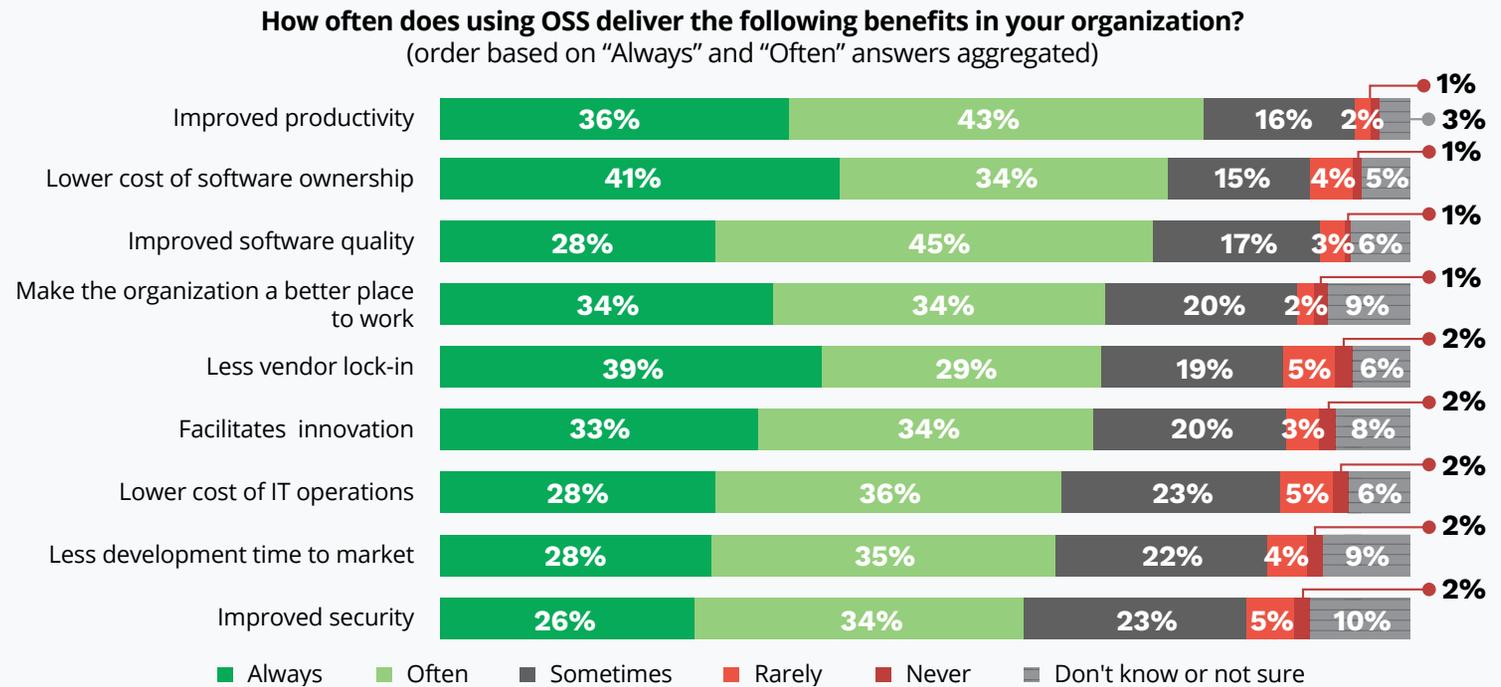
benefits are improved productivity and enhanced software quality, with a substantial 79% and 75% of organizations always or often experiencing these advantages. Furthermore, open source adoption contributes to a clear economic benefit through the reduction in software ownership costs. Less vendor lock-in is also important, which allows organizations greater flexibility and autonomy in their technology choices.

It is also worth emphasizing that OSS adoption appears to have a positive impact on the organizational environment. It enhances efficiency, reduces costs, and makes the workplace more attractive to employees, which is a crucial factor in talent retention. This multifaceted value proposition highlights the wide-ranging advantages that OSS offers to organizations, reinforcing its importance in modern business and other organizational strategies.

FIGURE 12

OSS use brings many benefits including improved productivity and software quality, and lower cost for software

Source: 2023 World of Open Source: Global Spotlight Survey, Q17, Sample Size = 702



Non-monetary benefits of contribution

The rationale behind contributing to open source projects may not always be immediately apparent to organizations, but there are numerous tangible benefits that such contributions can bring. These advantages encompass not only monetary gains but also improvements to an organization’s work environment and the broader industry landscape.

We can see the results in Figure 13. For instance, 51% of our respondents believe that contribution always or often enables the IT industry to be more innovative. Collaboration and the sharing of ideas in open source development can lead to groundbreaking advancements and novel solutions. Furthermore, 52% think that contributions always or often make their organizations a better place to work, fostering teamwork, skill development, and a sense of community among employees. Many organizations also see

contributing to open source as a moral obligation, reflecting a commitment to the principles of transparency, collaboration, and giving back to the community. Additionally, improved software quality resulting from contributions can be directly tied to economic value for organizations. High-quality software reduces maintenance costs, enhances user satisfaction, and can lead to increased revenue.

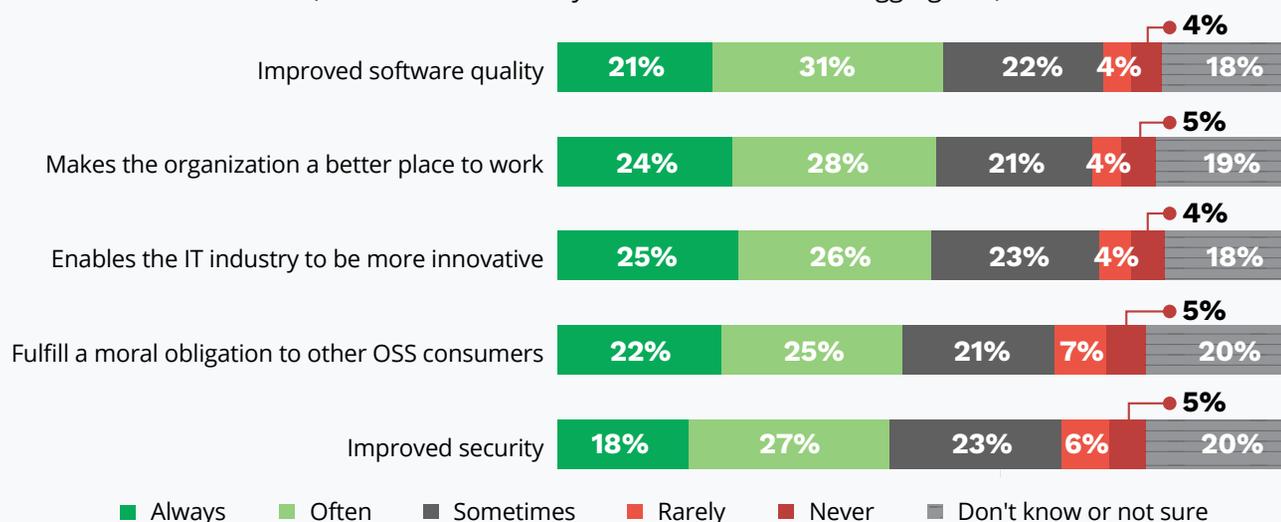
Lastly, contributions aimed at enhancing the security of open source projects are crucial for the long-term health of these projects, protecting an organization’s digital assets and reinforcing overall trust in open source solutions. These diverse benefits underscore the multifaceted advantages of open source contribution, appealing to the economic interests and the broader values of organizations, ultimately adding to the collective progress and vitality of the open source ecosystem and the technology industry as a whole.

FIGURE 13

OSS contributions always or often result in improved software quality according to 52% of respondents

Source: 2023 World of Open Source: Global Spotlight Survey, Q26, Sample Size = 604

How often do OSS contributions in your organization deliver the following benefits:
(order based on “Always” and “Often” answers aggregated)



Motivators for personal time contributions

Although our survey focused on organizations, the dedication of developers who willingly contribute to open source projects during their personal time, often without any financial compensation, may also provide important insight. Figure 14 displays the various factors that motivate these individuals when deciding whether to engage in open source contributions. Among these factors, the most significant is the pursuit of learning and personal development, as it holds great influence for 61% of respondents, and somewhat influential for 26%.

Another crucial individual factor is the desire to improve career opportunities through open source contributions. However, it is essential to recognize that collective factors also play a pivotal

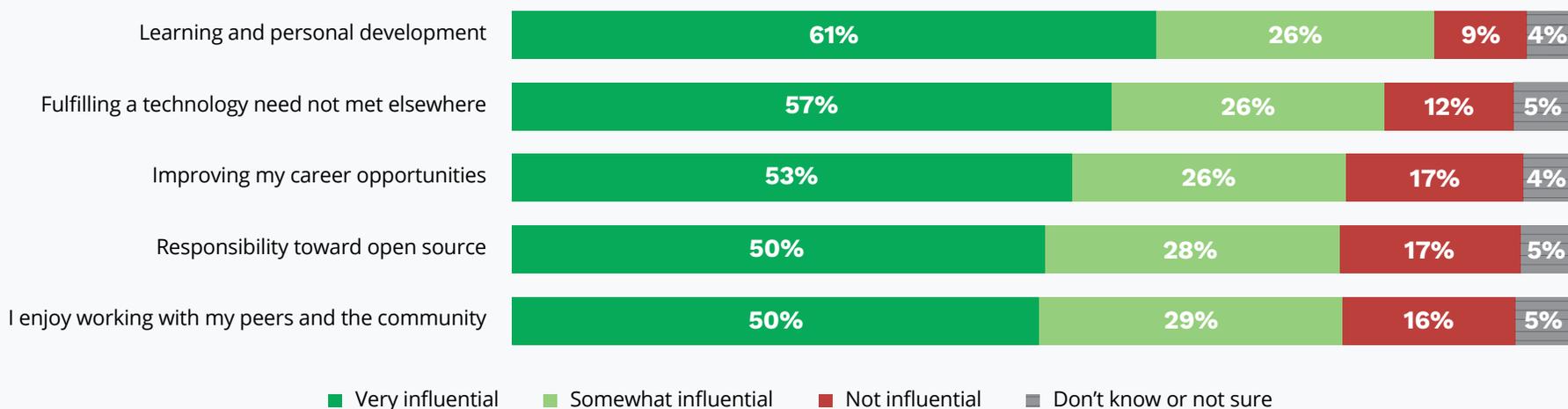
role. For example, the need to address technological gaps not met elsewhere in the industry is a motivating factor for many contributors. A strong sense of community and belonging within the open source ecosystem is evident in respondents' motivations, as 50% of respondents indicated that the enjoyment they derive from collaborating with their peers and actively participating in the community is a very influential motivator.

Additionally, respondents feel a sense of responsibility toward the open source movement itself, viewing their contributions as a way to give back and support the broader community. This blend of individual and collective motivations illustrates the diverse reasons why developers choose to contribute their personal time and expertise to open source initiatives.

FIGURE 14

People contribute in their personal time due to various reasons, be it for individual or collective benefit

How influential are the following factors when considering whether or not to contribute your personal time to open source projects?



Source: 2023 World of Open Source: Global Spotlight Survey, Q34, Sample Size = 637

Improving open source sustainability

A clear lack of return on investment is not the only inhibiting factor for open source contributions in organizations

When we consider strategies to improve OSS sustainability, particularly in the context of open source contributions, it becomes vital to identify and address the barriers organizations face. Figure 15 shows that the most prominent issue hindering organizations from contributing is not the expected lack of a clear return on investment. Instead, 43% of organizations cite legal and licensing concerns, coupled with a fear of leaking IP (43%), as significant obstacles. This highlights the importance of navigating the legal landscape when engaging in open source initiatives.

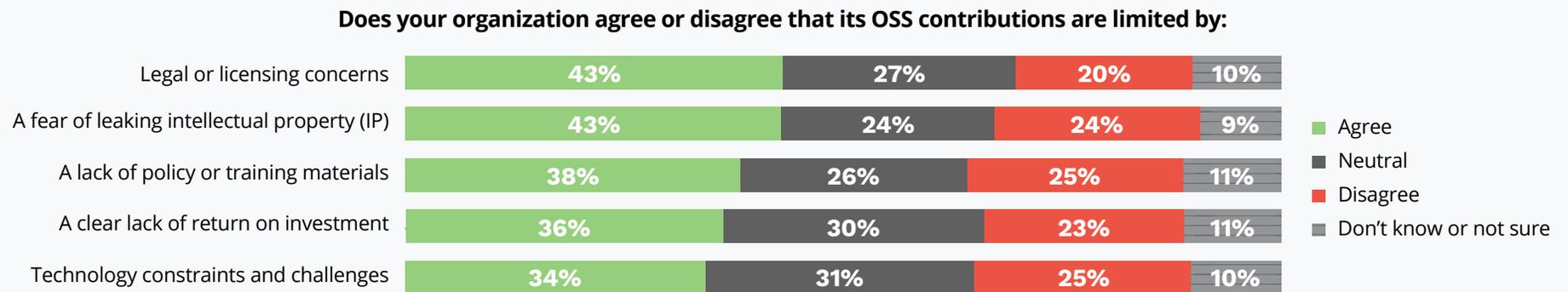
Moreover, 38% of organizations identify a lack of policy or training materials as a challenge, emphasizing the need for well-defined

guidelines and educational resources to facilitate contributions effectively. While 36% of respondents consider a clear lack of monetary return on investment a barrier, 23% disagree with this statement. This suggests that a significant number of organizations do not view the absence of direct financial gains as an important obstacle to their contributions.

Respondents also mention technology constraints and challenges (as illustrated in Figure 15) as another hindrance. These may encompass technical limitations or difficulties in integrating open source contributions into their existing technology stack. Understanding and addressing these diverse barriers can pave the way for increased open source contributions from organizations, ultimately promoting sustainability and innovation within the open source ecosystem.

FIGURE 15

Top concerns about contributions include legal, licensing and leaking IP issues



Source: World of Open Source: Global Spotlight Survey, Q28, Sample Size = 604

Allocating employee time should be a priority to increase contributions

When we shift the perspective and inquire about the areas deserving of resources or investment to foster increased open source contributions, several clear solution paths emerge (Figure 16). Foremost among these is the allocation of employee time for open source contributions, which ranks as the top priority at 65%. Providing the necessary time and resources enables employees to actively engage in open source projects, enhancing their contributions. Financial support for open source projects is another critical avenue for boosting contributions (63%). By allocating funds, organizations can help sustain and advance the projects they rely on, reinforcing their commitment to the open source community.

Building on the earlier discussion of legal and licensing concerns, addressing these issues is crucial. A significant 55% of respondents

agree that tackling licensing concerns would significantly increase contributions. This underscores the importance of legal clarity in encouraging organizations to engage more actively in open source initiatives. Additionally, providing clearer and more accessible policies for employees regarding open source contributions is essential. Many organizations currently lack well-defined open source contribution policies (Figure 4), which can act as a deterrent. Clarity in this area empowers employees to participate confidently.

Educating the organization on the value of OSS is important (62%). While survey respondents recognize the high value associated with open source, it's essential to ensure that this understanding permeates throughout the organization. When management and other stakeholders grasp the significance of open source contributions, they are more likely to support and invest in these initiatives, preserving the roles of open source contributors within the company.

FIGURE 16

Employee time for contributions and funding are the most popular areas respondents feel need investment

Source: World of Open Source: Global Spotlight Survey, Q29, Sample Size = 637

How much would OSS contributions change if your organization invested in the following actions:

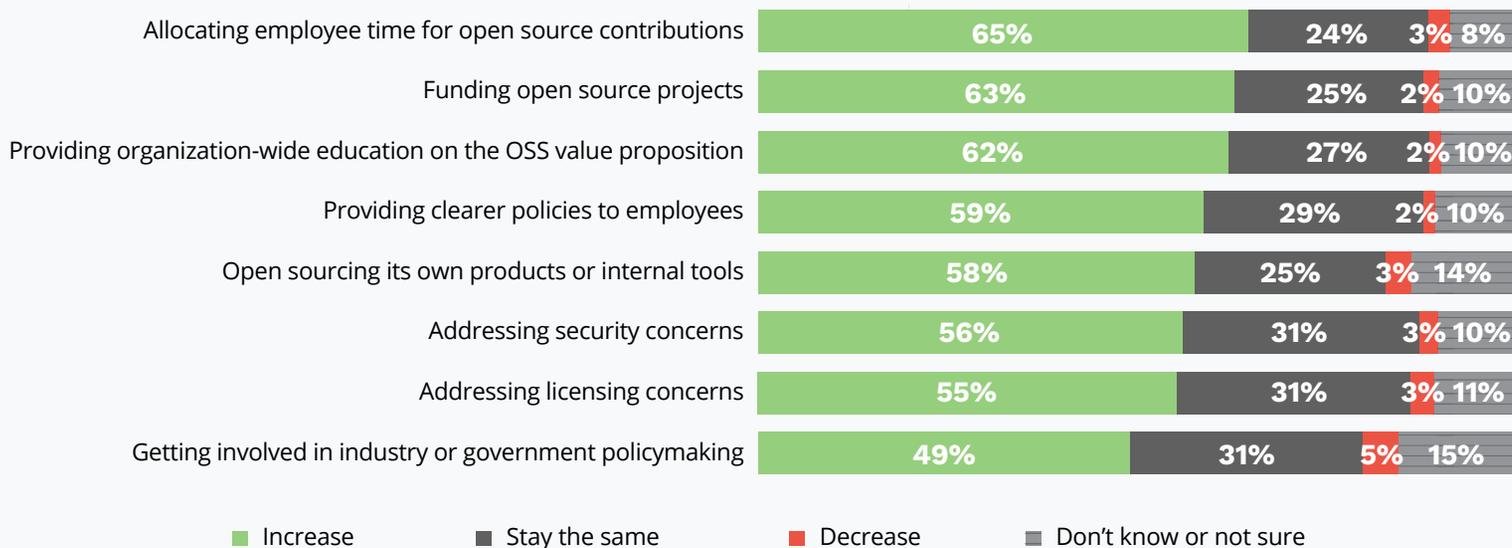
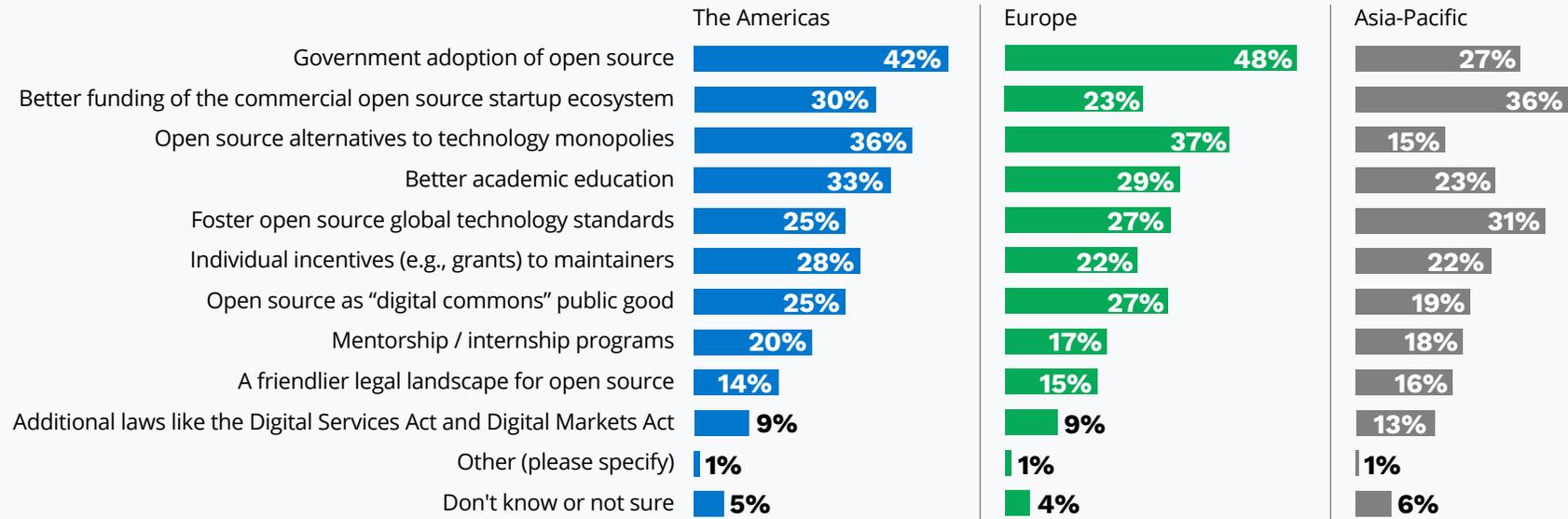


FIGURE 17

Government adoption of open source is leading area for further investment

In which areas do you think there should be further investment in open source across your geographic region? (select between one and three responses) segmented by **In what country or region does your organization have its headquarters?** (select one) (order based on worldwide average)



Source: 2023 World of Open Source: Global Spotlight Survey, Q41 by Q5, Sample Size = 599, Total Mentions = 1,507

Priorities in investment differ in some regions

Figure 17 reveals regional disparities in the priorities for investment and advancement within the open source landscape. In the Americas and Europe, respondents highlight the unique role that governments play in driving open source adoption, with 42% and 48% respectively selecting this option as a top priority. Following closely behind is the pursuit of open source alternatives to technology monopolies, emphasizing the need for increased competition and choice in these regions. Furthermore, respondents from these areas believe that improving academic education related to open source technologies is another essential investment area.

Conversely, in the Asia-Pacific region, the priorities differ. The leading choice here is better funding for the commercial open source startup ecosystem (36%), reflecting the importance of nurturing entrepreneurship and innovation in open source businesses. Fostering open source global technology standards ranks as the second priority (31%), highlighting the role of this region in setting and promoting industry-wide standards. Government adoption of open source emerges as the third priority.

These regional variations emphasize the diverse needs and opportunities within the open source landscape, suggesting that tailored strategies and investments may be necessary to promote open source adoption and sustainability effectively in each region.

AI / ML and other technologies that factor into future OSS use

As part of our research on sustainability, we asked organizations which open source technologies are most valuable to the future of their industry. The intent was to identify and initiate discussions on how best to support these technology areas. Figure 18 indicates that five technology areas warrant discussion. These include AI / ML (36%), cloud and container technologies (30%), the Linux kernel (28%), cybersecurity (25%), and advanced analytics and data science (24%).

AI / ML is now showing up frequently as a key issue in LF Research surveys. AI / ML factors heavily into organizational hiring plans, is a high-growth technology area, and is an area targeted by

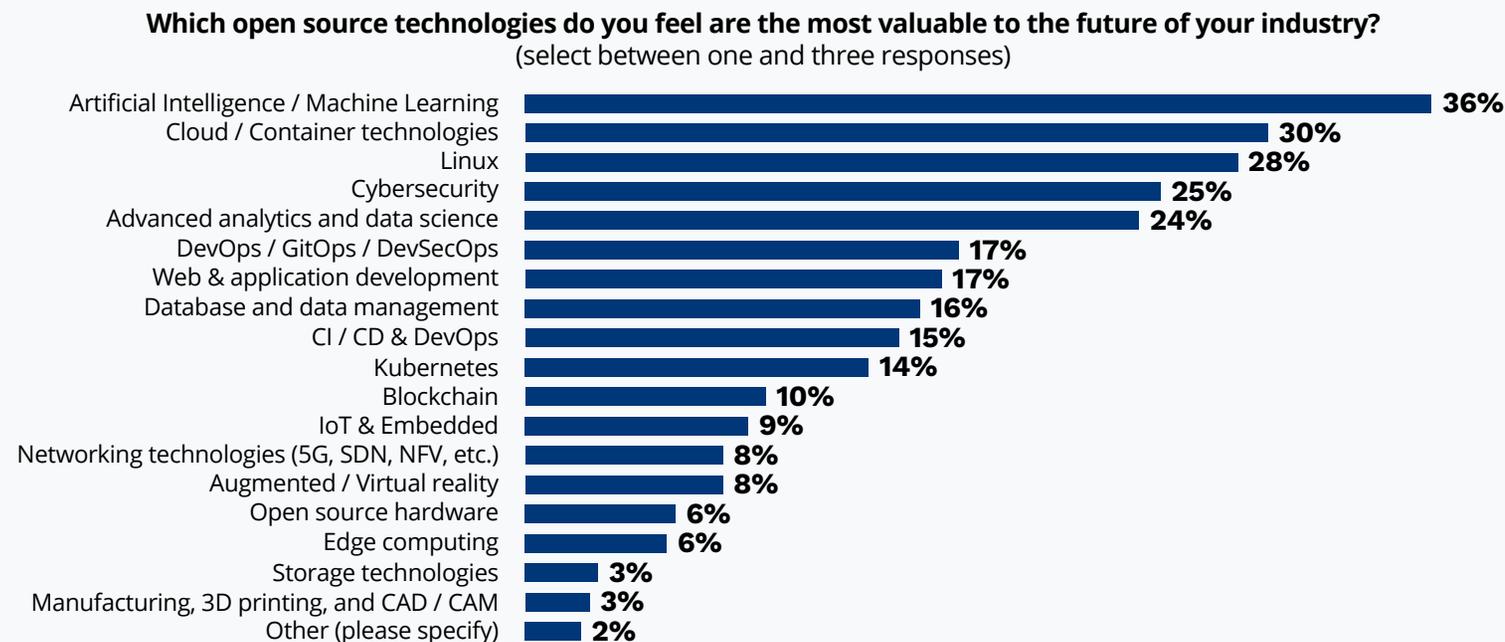
organizations for OSS development.³ The OSS challenge with AI / ML is determining how exactly the community can add value. Stay tuned for an upcoming research report on the state of open source in generative AI later in 2023.

Cloud and container technologies continue to be a strong focal point for LF activities judging by the lengthy list of CNCF incubating and graduated projects and the high levels of interest and participation in these projects. The Linux operating system has been and will continue to be a key foundational element of LF guidance and support. Cybersecurity rises in importance as a technology area that the OpenSSF gives plenty of attention to. Finally, advanced analytics and data science have become a top five technology warranting greater OSS attention - most likely from the pull through being driven by AI / ML.

³ Jason Perlow and Stephen Hendrick, "2023 State of Tech Talent Report," foreword by Clyde Seepersad, The Linux Foundation, May 2023.

FIGURE 18
AI/ML factors prominently into future organizational plans

Source: 2023 World of Open Source Global Spotlight Survey, Q38, Sample Size = 584, Total Mentions = 1,611 (DKNS excluded)



Conclusions and actionable insights

The current state of OSS use and contribution

To conclude, the open source landscape is marked by the persistence of asymmetrical use and contribution policies, which reflect the various attitudes and strategies of organizations, characterizes the open source landscape. Additionally, disparities exist in the gaps between open source technology use and contribution, underscoring the need for more comprehensive strategies. Regarding open source use, some organizations may lag in implementing best practices for safe usage. When it comes to contributions, there is room for improvement in terms of testing and documentation when code is being pushed upstream. While it's evident that organizations perceive value in contributions, it's noteworthy that this value encompasses both non-monetary benefits and those tied to economic gains. This multifaceted value proposition underscores the diverse motivations for contributing to open source projects. However, contributing to open source is not without its challenges. These barriers extend beyond a simple lack of monetary return and encompass a range of factors, including legal concerns, organizational policies, and resource constraints. The open source ecosystem is dynamic and diverse, characterized by a complex interplay of policies, practices, motivations, and challenges.

OSPOs can help organizations navigate the open source landscape

Establishing an OSPO is an excellent way to formalize and structure an organization's open source efforts. OSPOs can provide clear policies and guidelines to employees, fostering a culture of responsible open source engagement. They can also address legal

and licensing concerns, ensuring compliance with open source licenses. OSPOs can play a pivotal role in increasing an organization's contributions to open source projects. By providing clear policies, resources, and support, OSPOs empower employees to contribute confidently. Organizations need not navigate the open source landscape alone. Resources such as those offered by the [TODO Group](#) may be invaluable. They provide guidance on setting up and managing OSPOs, including best practices and case studies. Such a strategy ensures that organizations follow the necessary steps and fosters a culture of collaboration, compliance, and contribution, ultimately benefiting both the organization and the broader open source community.

Government adoption of open source

Government adoption of open source could help encourage international collaboration on software projects. When multiple governments adopt the same open source solutions, it promotes standardization and compatibility, making it easier for organizations worldwide to work together. Government funding provides financial support for open source and signals its importance, encouraging other organizations and entities to invest in open source development. It could help build a more robust open source ecosystem by addressing the financial challenges that many projects face. Government adoption of open source can create a ripple effect by increasing the prominence of open source solutions in the market, attracting funding, and encouraging collaborative efforts that advance the open source ecosystem. Further insights into how the public sector is playing and should be playing a role in open source advancement specifically in Europe,

can be found in the Linux Foundation's '[The European Public Sector Open Source Opportunity](#)' report.⁴

Allocating employee time and funding open source projects should be priority solution paths

Although monetary factors are not the number one motivator for contributors to work on OSS⁵, the sustainability of the open source ecosystem will ultimately rely on whether open source projects can continue without their developers burning out and/or quitting. The financial factor may not be the first that attracts developers to the work but might be the most important factor driving them away from projects if lacking. In the survey results, we have seen that most open source developers think that contributions would increase if organizations allowed employees to contribute during working hours. In terms of directly funding open source projects or contributors, there are various ways to donate, sponsor, and help the work of maintainers.⁶

Methodology

Survey screening involves the use of four variables to validate the respondent. The respondent needed to answer all the demographic questions.

- The respondent had to be at least somewhat familiar with how their organization uses and contributes to open source software.

That being said, to ensure the vitality of projects and avoid unnecessary competition among open source developers, it is best to give open source project communities autonomy over the funding provided. At the same time, open source communities should maintain transparency around the level of corporate involvement and funding in the interest of safeguarding community interests.⁷ Autonomy and transparency fosters human-centered open source technological innovation, which companies ultimately rely on.

While acknowledging that economic headwinds are at play that divert attention from these efforts, we hope this report serves as evidence that the open source ecosystem is deserving of a special focus in resources and investment. If you are interested in further discussions around open source innovation as a potential lever for economic recovery, read our [report](#) on the key takeaways on the topic. Thank you for reading through and being part of the conversation.

- The respondent needed to self-identify as a real person willing to share their OSS experience and perceptions.
- The respondent needed to be able to speak for themselves and the department, organization, or industry they are working for.
- The respondent could not be "unemployed and not currently looking for work," a full-time student, or retired.

4 Cailean Osborne, Mirko Boehm, and Ana Jimenez Santamaria, "The European Public Sector Open Source Opportunity: Challenges and Recommendations for Europe's Open Source Future," foreword by Gabriele Columbro, The Linux Foundation, September 2023.

5 Frank Nagle et al., "Report on the 2020 FOSS Contributor Survey", The Linux Foundation & The Laboratory for Innovation Science at Harvard, December 2020.

6 Ashwin Ramaswami, "Open Source Maintainers: What They Need and How to Support Them." The Linux Foundation, 2023 www.linuxfoundation.org/blog/open-source-maintainers-what-they-need-and-how-to-support-them?a.

7 Cailean Osborne, "Open Source Innovation as a Potential Lever for Economic Recovery: Insights from a Linux Foundation Challenge Session at the 9th World Open Innovation Conference," foreword by Henry Chesbrough, The Linux Foundation, March 2023

A total of 2,165 candidates started the survey. There were 1,249 candidates that we disqualified due to the screening criteria outlined above, and 916 answered a significant number of survey questions or completed all of them. The margin of error for this sample size was $\pm 2.7\%$ at a 90% confidence level. We stratified the data collection by company size and organization type. We also designed the stratification to allow segmentation by these variables and other variables correlated with these.

Although respondents needed to answer nearly all questions in the survey, there were times when the respondent was unable to answer one because it was outside the scope of their role or experience. For this reason, we added a “Don’t know or not sure” (DKNS) response to the list of responses for nearly all questions. However, this creates a variety of analytical challenges.

One approach was to treat a DKNS just like any other response so that the percentage of respondents that answered the DKNS is known. The advantage of this approach is that reports fact the exact distribution of data collected. The challenge with this approach is that it can distort the distribution of valid responses, i.e., responses where respondents could answer the question.

Some of the analyses in this report exclude DKNS responses. This is because we can classify the missing data as either missing at random or missing completely at random. Excluding DKNS data from a question does not change the distribution of data (counts) for the other responses, but it does change the size of the denominator used to calculate the percent of responses across the remaining responses. This has the effect of proportionally increasing the percentage values of the remaining responses. Where we have elected to exclude DKNS data, the footnote for the figure includes the phrase “DKNS responses excluded.”

The percentage values in this report may not total exactly 100% due to rounding.

Survey design

The 2023 World of Open Source: Global Spotlight Survey comprised 43 questions, including the themes of open source use, contribution, value, and sustainability. For information about access to the 2023 World of Open Source: Global Spotlight project and survey instrument, see the Data.World access heading at the end of this section.

Data.World access

LF Research makes each of its empirical project datasets available on Data.World. Included in this dataset are the survey instrument, raw survey data, screening and filtering criteria, and frequency charts for each question in the survey. LF research datasets, including this project, can be found at data.world/thelinuxfoundation.

About this study

This study is based on a web survey conducted by the LF and its partners in 2023 from April to June. The survey’s goal was to provide a global perspective on the state of open source. In the following, we present the study methodology and the demographics of the respondents. From a research perspective, it was important to eliminate any perception of sample bias and ensure high data quality. We handled the elimination of sample bias by sourcing our usable sample from the LF membership, partner communities, social media, and a third-party panel provider. We addressed data quality through extensive pre-screening, screening criteria, and data quality checks to ensure that respondents had sufficient open source familiarity and professional experience to answer questions accurately on behalf of the organization they worked for.

We collected survey data from end-user organizations, IT vendors and service providers, and nonprofit, academic or government organizations. Respondents spanned many vertical industries and companies of all sizes, and we collected data from geographies including the Americas, Europe, and Asia Pacific.

Demographics

The demographic data in Figure 19 illustrates some of the considerations that we gave to survey stratification.

The type of organization, shown in the top left-hand chart, contains the distribution of IT vendors / service providers and end-user organizations. End-user organizations are companies that use IT products and services to support their business deliverables. We also included nonprofits, foundations, academic institutions, and government agencies in the end-user category.

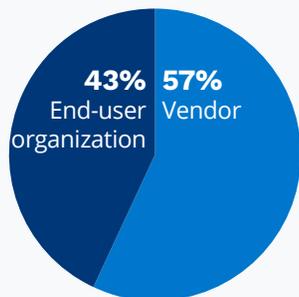
The bottom left-hand chart in Figure 19 shows company size as measured by the number of employees. We aggregated the seven categories originally presented in this question into the three categories shown here. The intention was to ensure that each of these three categories had enough responses so that, when cross tabbed, the results would be reliable.

The right-hand chart shows the role that best describes the respondent. Approximately 71% of the respondents were in technical roles.

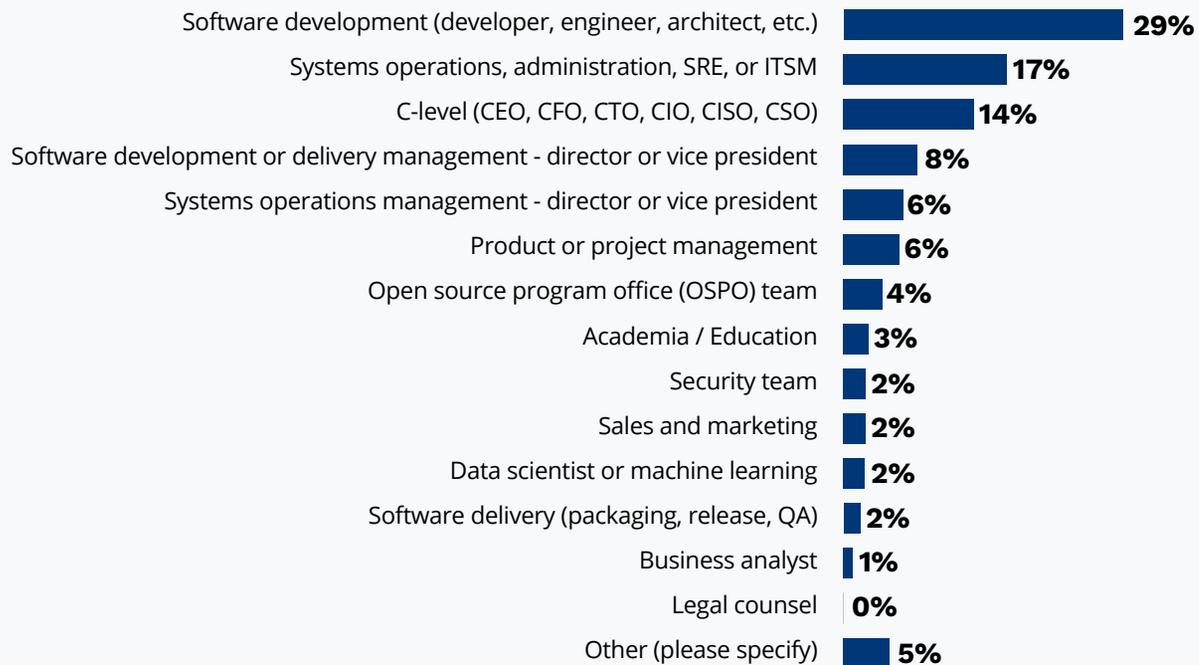
FIGURE 19

Selected Demographics from the 2023 World of Open Source: Global Spotlight Survey

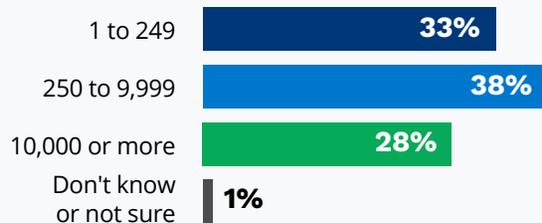
Q7: What option best describes the organization you work for? (select one)



Q6: Professionally, which role do you most closely identify with? (select one)



Q10: Please estimate how many employees your organization has worldwide? (select one)



Source: 2023 World of Open Source: Global Spotlight Survey, Sample Size = 916

Appendix

A1	Q18: Do you agree or disagree that OSS use in your organization is limited by: (select one response per row)	Agree	Neutral	Disagree	Don't know or not sure
	A lack of understanding of the non-technical value proposition	41%	23%	29%	7%
	Licensing of intellectual property (IP) concerns	45%	28%	21%	6%
	A lack of a clear policy or supporting training and guidance on how to use OSS	41%	25%	27%	6%
	External regulations or other formal restrictions	36%	31%	25%	8%
	Concerns about the quality of OSS components	38%	32%	25%	5%
	Concerns about the security of OSS components	42%	29%	22%	6%

A2	Q15: What actions does your organization usually take before using a new OSS component? (select all that apply) segmented by Q5: In what country does your organization have its headquarters? (select one)	Total	The Americas	Europe	Asia-Pacific	Other
	We check the activity level of the project community (contributors, commits, etc.)	50%	55%	54%	38%	55%
	We evaluate the direct dependencies of the OSS code to determine if it's too risky to use	42%	45%	38%	42%	48%
	We look at repository ratings or package downloads statistics	42%	45%	43%	34%	52%
	We look at the frequency of releases	39%	41%	41%	32%	43%
	We evaluate the source code using automated tools (SCA, SAST, Fuzz Testing, web app scanners, etc.)	36%	41%	30%	39%	21%
	We evaluate the transitive dependencies of the OSS code to determine if it's too risky to use	31%	37%	27%	32%	21%
	We manually review/inspect the source code	30%	32%	26%	33%	26%
	We check if the project has a responsible disclosure policy (such as a SECURITY.md)	26%	29%	24%	25%	21%
	We check the component against a risk policy or risk calculations that we do	24%	28%	24%	19%	19%
	We don't review or evaluate the OSS components that we use	10%	9%	11%	11%	14%
	Don't know or not sure	9%	10%	11%	4%	12%

A3	Q25: Has your organization made any of the following OSS contributions? (select all that apply)	
	Opened an issue on an open source project	54%
	Contributed code to an open source project	48%
	Answered queries relating to an open source project on an online community (e.g., Stack Overflow, Reddit)	46%
	Helped with open source documentation	40%
	Contributed designs, graphics, or other non-code assets	26%
	None of the above	12%
	Don't know or not sure	13%

Acknowledgments

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Founded in 2021, Linux Foundation Research explores the growing scale of open source collaboration, providing insight into emerging technology trends, best practices, and the global impact of open source projects. Through leveraging project databases and networks, and a commitment to best practices in quantitative and qualitative methodologies, Linux Foundation Research is creating the go-to library for open source insights for the benefit of organizations the world over.

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October 2023



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