# The Value of Open Source in the Cloud Era

Survey Finds Open Source
Opens Doors to Greater
Opportunity for Developers

Andy Oram

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by Andy Oram

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Executive Summary

Two significant shifts characterize computing in the past two decades: the widespread use of free and open source software (OSS), and migration to the cloud. In the age of the cloud, open source is maintaining and perhaps even increasing its influence.

In the fall of 2020, IBM, in collaboration with O'Reilly Media, sponsored a survey about open source and the cloud, to which roughly 3,440 professional developers and managers responded. They showed strong support for open source and for skills in several open source technologies. Here are some of the key findings of the survey:

- Nearly all respondents use OSS in some aspect of their operations, often deploying it widely.

- OSS was rated equal to or better than proprietary software by 94% of respondents.

- When choosing cloud providers, 70% of respondents prefer one based on open source.

- Respondents associate open source technologies with higher wages, more job opportunities, and more professional opportunities.

- Linux, containers, and databases were the most important technologies to know, being rated higher than knowledge of proprietary cloud offerings, and 95% of developers considered Linux important to their career.

- When hiring, 87% of hiring managers considered knowledge of open source an important factor. Additionally, 67% thought that experience with open source provides greater long-term value than experience with the technologies of specific vendors.

- 54% of respondents said that learning cloud computing skills specific to a single cloud provider limits their professional growth.

- The survey shows that 65% and 69% of respondents, respectively, either agree completely or agree somewhat that contributions to open source projects impress potential employers and result in better professional opportunities.

- Respondents embraced OSS for the guarantees it offers against vendor lock-in.

- Respondents signaled that open source lowers costs and allows both development and bug fixing to proceed faster.

- The marked importance of open source tools, in terms of career opportunities and positive developer experiences, supports a trend toward multicloud or hybrid cloud deployments.

Software architects and developers should be aware of both trending open source technologies and cloud offerings. Over the long term, skills in the most fundamental open source tools and libraries will provide major benefits to both professionals and organizations.

Introduction

Two significant shifts characterize computing in the past two decades: the widespread use of free and open source software (OSS), and migration to the cloud. The relationship between these trends is complex and deserves close attention. Developers need to understand the growing value of OSS in the cloud era. Mastering open source tools and programming libraries will make them valuable, even as this software is increasingly deployed on third-party cloud offerings.

The centerpiece of this report is a survey of roughly 3,440 professionals in software development, conducted by O'Reilly Media in collaboration with IBM. The respondents came from a variety of software disciplines and included managers as well as individual contributors. The survey reveals the strong loyalty shown by computer professionals to free and OSS, motivated by the real career benefits they see. Some of their answers may surprise you.

Before we dig into the results of the survey, let's first set a foundation by exploring the continued draw of open source in the cloud era.

The Appeal of Open Source in the Cloud Era

In an age of fast, reliable internet connections, the triumph of the cloud seems irresistible. For vendors, it allows rapid updates and bug fixes, plus a degree of customer lock-in (which, we'll see in this report, is why developers value open source even more). At client companies, moving to the cloud relieves system administrators of tedious tasks and moves some security into the hands of experts hired by the vendors. For end users, software as a service (SaaS) means instant access to a cornucopia of software as well as opportunities to make connections and collaborate with other end users. Because mobile devices have relatively small storage and computing resources, the cloud becomes even more important as a backend for their capabilities.

Open source continues to thrive in the age of the cloud, staunchly supported by millions of developers and others. Let's take a moment to see why.

First, OSS makes the cloud possible. Cloud computing relies on huge, ever-growing data centers, whose administrators don't want to deal

with licensing and the administrative costs that go along with it. Linux is particularly crucial, and nearly all data centers now run on Linux kernels, with Linux being a common platform uniting clouds in a hybrid cloud environment. Many of these companies also contribute to further development of the kernel.

The Cloud Native Computing Foundation (CNCF) drives innovation to help the cloud run on OSS and to support OSS far into the future. This foundation is an incubator for important cloud technologies, all under open licenses. The corporate member list is testimony to its stability and significance: not only are the major cloud vendors among CNCF's platinum sponsors, but you find major SaaS providers such as Salesforce and eBay, hardware manufacturers such as Intel and NEC, a global reach (Huawei, Fujitsu, Alibaba Cloud, etc.), and of course the major providers of OSS (Red Hat, Canonical, etc.). A job board, certification program, and speakers bureau complement the CNCF's central activities.

Second, the benefits of open source development apply just as much to cloud vendors as to others. Although Google will never open its ranking algorithm, nor will Facebook open its method for promoting articles, they do open up large amounts of other software they use behind the scenes. The support for open source has been identified as a "closed core" model.

Third, many developers who have released free software make a living by offering that software in the cloud. Wordpress.com and Drupal on Acquia are familiar examples.

Finally, open source may soften the common concerns aired today about privacy, control, and abuse in large data centers, because open source tools provide a bit of transparency into what's happening in those data centers.

Open source and the cloud are intertwined in the development of some software innovations, particularly software related to nonrelational databases and machine learning:

1. Innovations often start in academic settings or corporate research labs. At first, each group of researchers code up their own implementations of research ideas. Then libraries or utilities are released embodying the ideas under open source licenses.

2. Over time, the OSS gets refined, emerging as robust, scalable, production-ready products on which businesses can be built.

3. Cloud vendors start to offer the most popular of these products, compelled to stay on the cutting edge in order to attract customers. New waves of customers who don't want the overhead of managing the tools choose to use the cloud versions.

4. Cloud vendors then develop their own proprietary offerings that they promote as more efficient or powerful alternatives to the popular tools.

Vendors offer proprietary tools, or proprietary frameworks for open-source tools, going to great lengths to demonstrate advantages in functionality or performance with their versions. All platform-as-a-service offerings are basically vendor-native, but promise convenience and reduced administrative work. Yet, a substantial number of customers avoid the proprietary offerings and stick to the open source ones, even as they lease systems in the cloud. We'll look at possible reasons for this next.

The most appealing benefit of free and open software may be the assurance that developers won't be locked in to a single vendor. More enterprises are also turning to multicloud or hybrid (on-premises plus public cloud) strategies, a trend that the vendors recognize and to which they are adapting. Companies choosing multicloud or hybrid systems cannot rely on proprietary tools from a single vendor but instead must run standard software everywhere —and OSS best meets these requirements. Even though there's no doubt that many proprietary offerings are wonderful, feature-rich, and high-performing, developers are learning the risks of relying on one vendor. Consider the following:

- The vendor may impose steep price hikes.

- The vendor may remove a key feature that a client depends on because the vendor doesn't want to support it anymore.

- The vendor may go out of business or may radically change its business model and abandon its former clients.

- The vendor may enter the niche in which the client is working, becoming a direct competitor and abusing its position to put the client at a disadvantage.

- Bugs or bizarre performance problems may crop up in the features the client depends on.
- The client may have trouble finding job candidates with expertise in the proprietary product.

The last point is particularly relevant to potential employees. Developers tend to focus their career-building efforts on popular open source products, either as students or when upgrading their skills in their spare time. The developers feel more confident in finding a job with skills in open source tools than with skills in a proprietary tool.

For instance, anyone interested in scalable programming or microservices—which are central to modern development—needs to learn Kubernetes. Google developed Kubernetes and released it as free software. This allowed Kubernetes to achieve nearly overwhelming dominance in its area. A proprietary tool from Google is less likely to lead to such widespread expertise or to drive job offers.

This section has laid out several observations to explain the popularity of OSS. Is there evidence, though, to support its assertions? The Linux Professional Institute, whose very existence is based on the premise that learning open source skills increases job prospects, lists some statistics demonstrating the career benefits. A *2020 Open Source Jobs Report* from the Linux Foundation reports two key findings that reinforce the survey results in this report:

- 93% of hiring managers report difficulty finding sufficient talent with open source skills, up from 87% in 2018.
- Hiring managers report knowledge of open source cloud technologies has the most significant impact, with 70% being more likely to hire a pro with these skills, up from 66% in 2018.

Let's now turn to the results of the O'Reilly Media survey "The Value of Open Source in the Cloud Era" to learn how professionals currently view open source tools and technologies in relation to their career prospects as well as to cloud vendors.

Survey Results

Before we present an analysis of the survey results, a quick note about respondent demographics. The roughly 3,440 respondents to the survey spanned many job categories. Slightly less than a third (1,123) identified as software developers or software engineers. Reported job categories also included software architect, DevOps engineer, and engineering manager. Responses were consistent across industries and across company size, so we can trust that they represent common attitudes.

Knowing OSS Provides a Career Boost
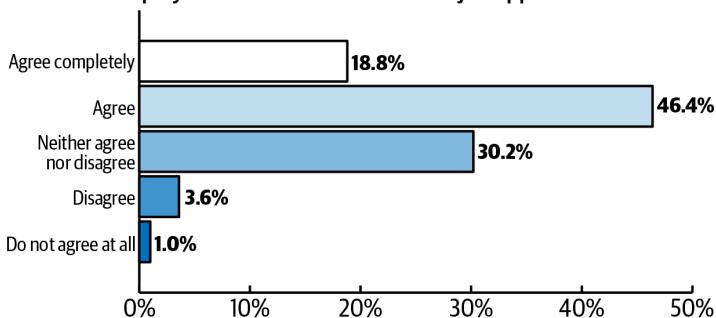
Some of the strongest findings in the responses concerned the value of learning open source technologies. In particular, two-thirds of respondents agreed that open source experience provides greater value than specific vendors' technologies. Respondents were enthusiastic in affirming that open source leads to better job opportunities and to unspecified "professional opportunities."

Knowing open source products also provides value to careers, as demonstrated by the more than 65% of respondents who agree that contributions to open source projects impress potential employers and often result in better job opportunities.
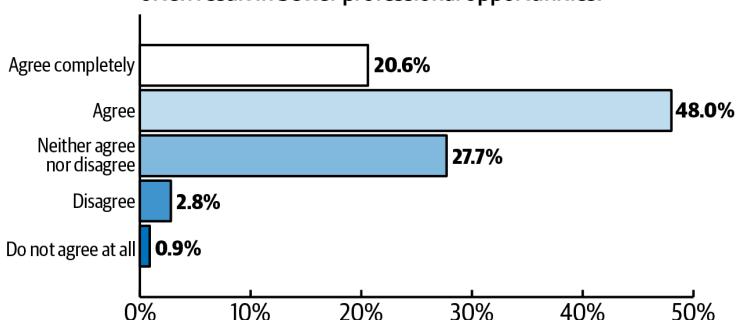
In general, support for open source was even stronger among hiring managers than among other participants in the survey. On many of the questions, the hiring managers showed significantly stronger observations in favor of open source: they often rated it more important, indicating that skills in those tools played a role in hiring, and were more likely to say it fit well into organizations. In short, hiring managers were consistently more supportive of open source tools than other respondents.

We can assume that these strong views among hiring managers guide both hiring policy and technical choices within their organizations, so their enthusiasm for the open source technologies is worth special note. Some of the statistically significant differences between the hiring managers and other respondents will be included as we move through the statistics.
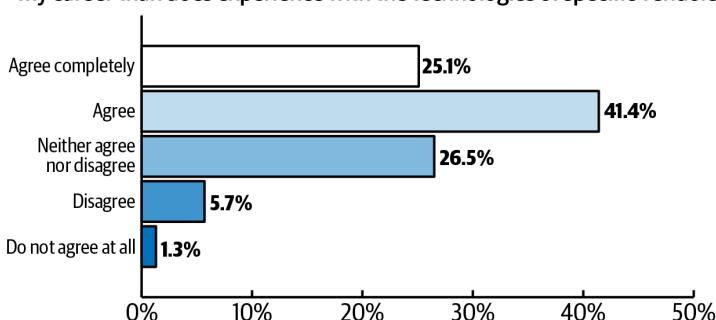
Contributions to open source projects impress potential employers and often result in better job opportunities.

Agree completely	18.8%
Agree	46.4%
Neither agree nor disagree	30.2%
Disagree	3.6%
Do not agree at all	1.0%

Involvement and contributions to open source projects often result in better professional opportunities.

Agree completely	20.6%
Agree	48.0%
Neither agree nor disagree	27.7%
Disagree	2.8%
Do not agree at all	0.9%
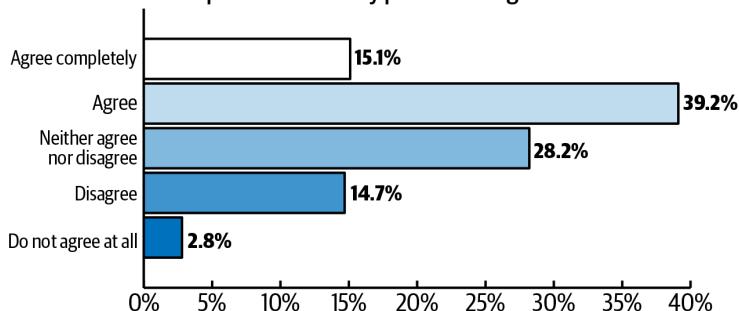
Having experience with open source provides greater long-term value for my career than does experience with the technologies of specific vendors.

Agree completely	25.1%
Agree	41.4%
Neither agree nor disagree	26.5%
Disagree	5.7%
Do not agree at all	1.3%
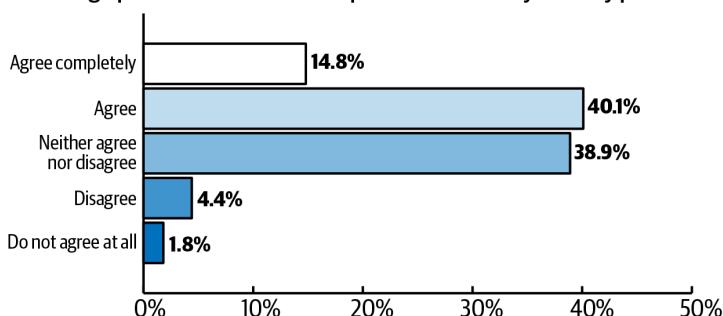
Respondents were equally lopsided in claiming that open source knowledge was good for earning respect and credibility. Reputation is crucial in open source communities, and the results of this

question reinforce the questions shown earlier on "professional opportunities" and "long-term value for my career."
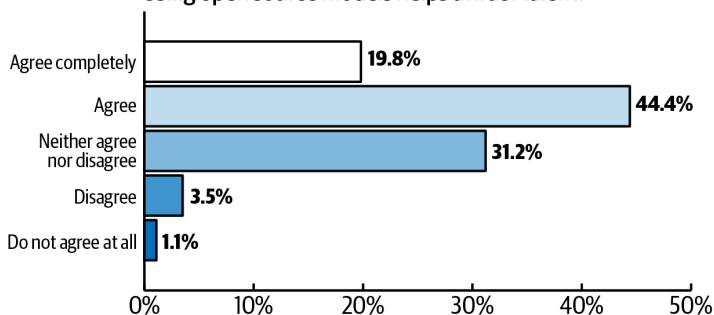
Learning cloud computing skills specific to a single cloud provider limits my professional growth.

Agree completely	15.1%
Agree	39.2%
Neither agree nor disagree	28.2%
Disagree	14.7%
Do not agree at all	2.8%

0% 5% 10% 15% 20% 25% 30% 35% 40%

Using open source increases respect and credibility with my peers.

Agree completely	14.8%
Agree	40.1%
Neither agree nor disagree	38.9%
Disagree	4.4%
Do not agree at all	1.8%

0% 10% 20% 30% 40% 50%

Using open source models helps attract talent.

Agree completely	19.8%
Agree	44.4%
Neither agree nor disagree	31.2%
Disagree	3.5%
Do not agree at all	1.1%

0% 10% 20% 30% 40% 50%
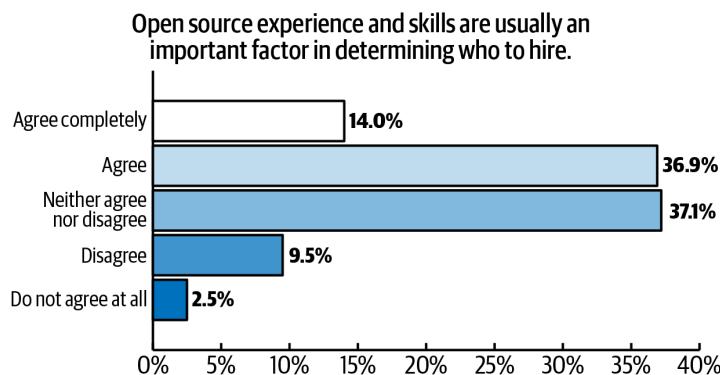
On all the questions we've looked at so far, hiring managers had significantly stronger opinions favoring open source. For instance, when asked whether "Contributions to open source projects impress potential employers and often result in better job opportunities," hiring managers were more likely to agree completely (about 22%).

Let's focus now on a key assertion of this report: that learning open source technologies is more important than learning proprietary cloud tools, in terms of career growth. This assertion was supported by a two-to-one margin of respondents: about 65% preferred to possess skills related to the underlying open source technologies (such as Linux, Kubernetes, or Istio), while about 35% preferred skills related to a specific cloud platform (i.e., IBM, AWS, Azure, or Google).

Most respondents believe that open source helps them attract talent to their companies. This observation is a natural complement to their conviction that open source skills give them greater job opportunities.

Hiring managers were more likely than others to agree completely that open source attracts talent (about 23%), a statistically significant difference, and one worth noting because the hiring managers are keenly alert to things that attract talent in tight job markets.

In a similar question, respondents thought that experience with open source would influence who they hired, but not as strongly as in the previous question.

Open source experience and skills are usually an important factor in determining who to hire.

|	
Agree completely	14.0%
Agree	36.9%
Neither agree nor disagree	37.1%
Disagree	9.5%
Do not agree at all	2.5%
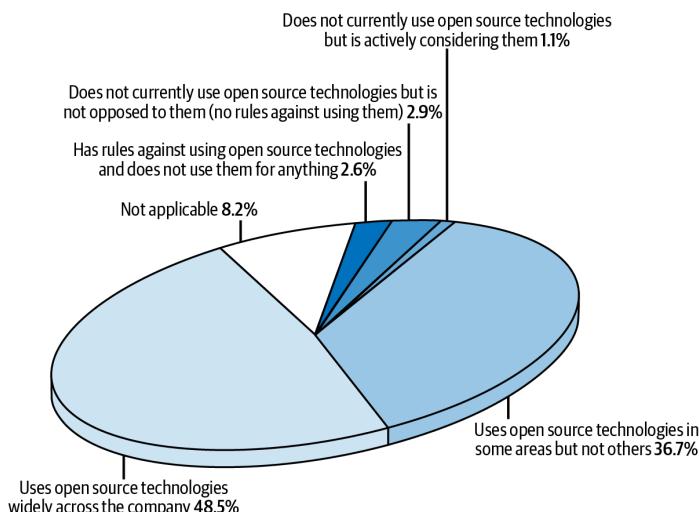
On this question of job opportunities, it's worth paying special attention to the views of hiring managers, because they make the ultimate decisions about who takes a job role in the organization. These managers were significantly more likely to agree (about 39%) and to agree completely (about 17%) that open source experience and skills were usually important factors in determining who to hire. Their support for the power of open source is reinforced in a question aimed directly at them. Just about 52% said that an applicant's knowledge of open source weigh into their hiring decisions, whereas only about 8% said it did not. (The other roughly 40% said the question was not applicable.)

Sections that follow will look at the forces behind these strong endorsements for open source technologies.

Companies Have Skin in the Game

The respondents indicated that their opinions around the value of open source were not based on abstractions or hearsay. Rather, they indicated their companies are actively using free and OSS in their operations. Almost half of them use it "widely," and hiring managers were much more likely to say they use open source widely (about 59%).

Which of the following best describes your company's approach toward open source technologies?

Does not currently use open source technologies but is actively considering them **1.1%**

Does not currently use open source technologies but is not opposed to them (no rules against using them) **2.9%**

Has rules against using open source technologies and does not use them for anything **2.6%**

Not applicable **8.2%**

Uses open source technologies in some areas but not others **36.7%**

Uses open source technologies widely across the company **48.5%**

Furthermore, half of the companies go the extra mile and contribute back to OSS. Because many of the respondents are developers, we'll assume they are referring to actual code check-ins when they say "contribute," but the responses are impressive even if they refer to monetary contributions or other types. It has been understood in the open source community for some time that a large percentage of contributions come from programmers paid by companies. In this survey, more than a quarter of companies contribute at least once a year—a finding that is consistent across industries and different company sizes.
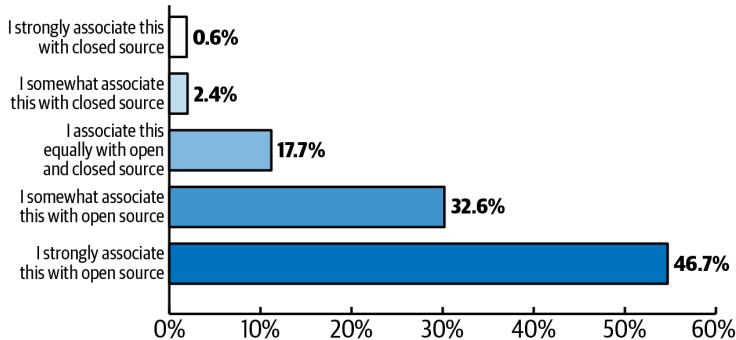
Why Respondents Like Open Source

Aside from career impact, respondents indicated that they harbor a strong intrinsic preference for free and OSS. When asked to rate "developer satisfaction," nearly 63% said OSS is better, whereas just about 3% said proprietary software is better. (The other 34% rated them equal.) In addition, respondents overwhelmingly prefer to work with an open source-based cloud platform (70%) rather than a proprietary one (7%).
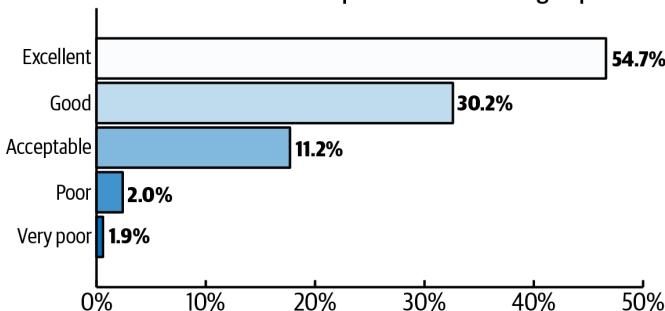
But why? Respondents largely praised the choice and flexibility offered by open source. They reacted especially positively to the suggestion that open source minimizes vendor lock-in, a question that came up twice in the survey.

Additionally, about 79% of respondents thought that open software offered more "technology flexibility" than proprietary software.
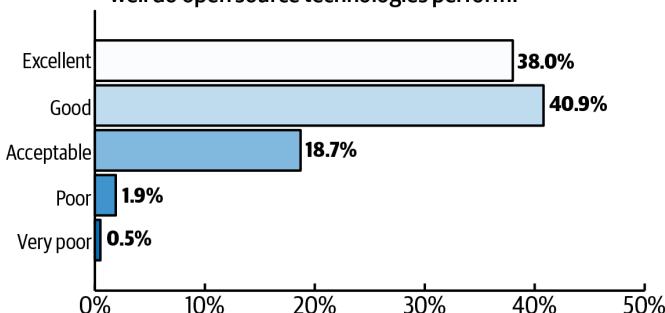
Less vendor lock-in: more associated with open source or proprietary software?

I strongly associate this with closed source	0.6%
I somewhat associate this with closed source	2.4%
I associate this equally with open and closed source	17.7%
I somewhat associate this with open source	32.6%
I strongly associate this with open source	46.7%

Minimizes vendor lock-in: how well do open source technologies perform?

Excellent	54.7%
Good	30.2%
Acceptable	11.2%
Poor	2.0%
Very poor	1.9%
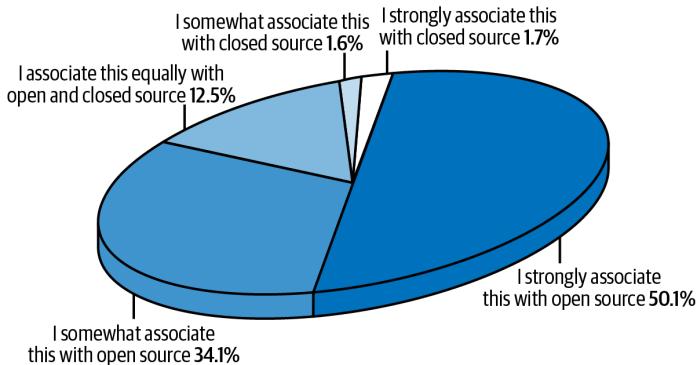
Enables choice of deployment platforms: how well do open source technologies perform?

Excellent	38.0%
Good	40.9%
Acceptable	18.7%
Poor	1.9%
Very poor	0.5%
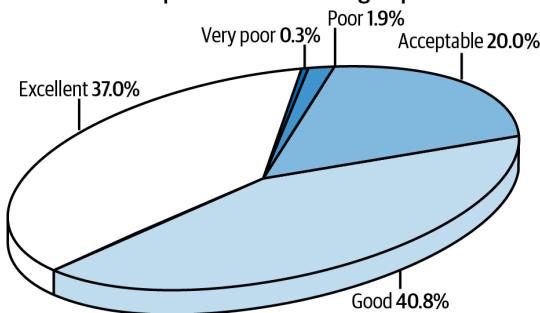
As one might expect, respondents also thought open source lowered costs. Those questions regarding speed of development and bug fixes sit under this category, because speed presumably affects the company's bottom line.
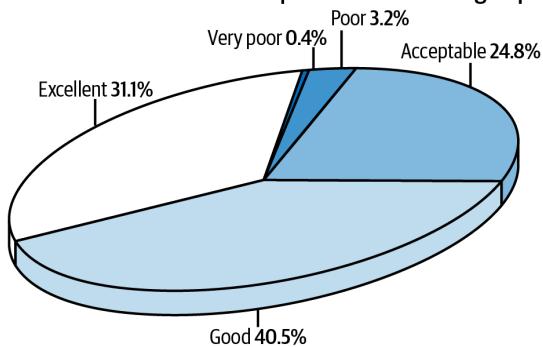
Association with lower cost: open and closed source software

I somewhat associate this with closed source **1.6%**

I strongly associate this with closed source **1.7%**

I associate this equally with open and closed source **12.5%**

I strongly associate this with open source **50.1%**

I somewhat associate this with open source **34.1%**
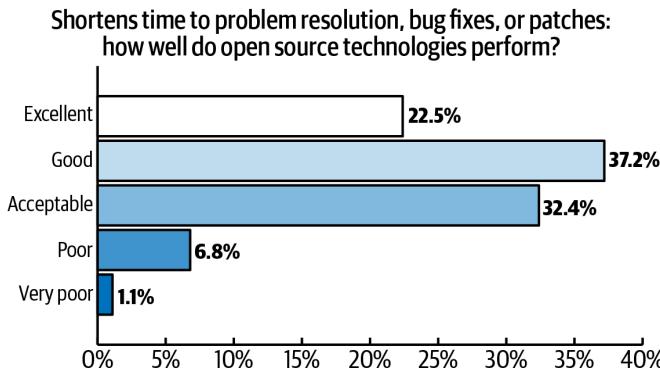
Meets our objectives while minimizing costs: how well do open source technologies perform?

Very poor **0.3%**

Poor **1.9%**

Acceptable **20.0%**

Excellent **37.0%**

Good **40.8%**

Shortens time to value: how well do open source technologies perform?

Very poor **0.4%**

Poor **3.2%**

Acceptable **24.8%**

Excellent **31.1%**

Good **40.5%**

Shortens time to problem resolution, bug fixes, or patches: how well do open source technologies perform?

Rating	Percentage
Excellent	22.5%
Good	37.2%
Acceptable	32.4%
Poor	6.8%
Very poor	1.1%

Regarding speed of development, just over 50% of respondents found open source better than proprietary, and another 40% found them equal.
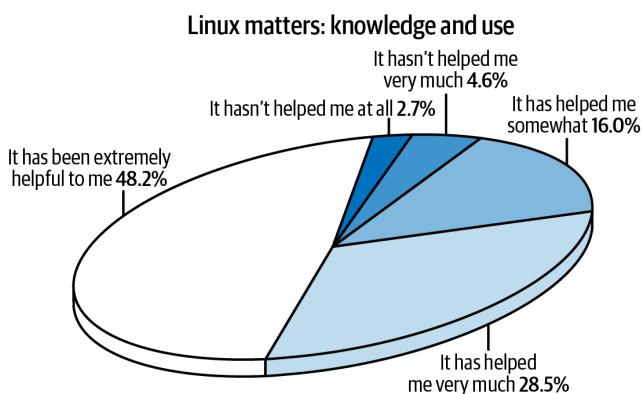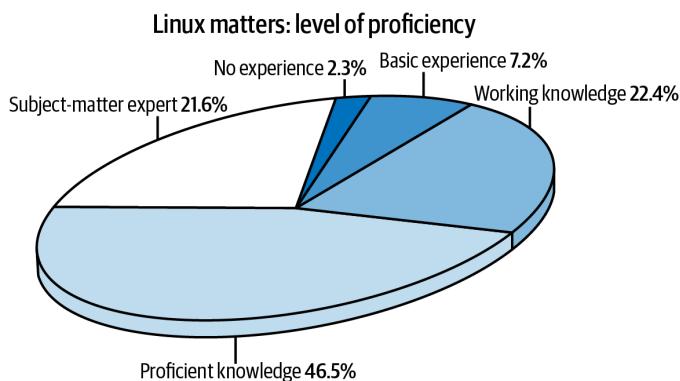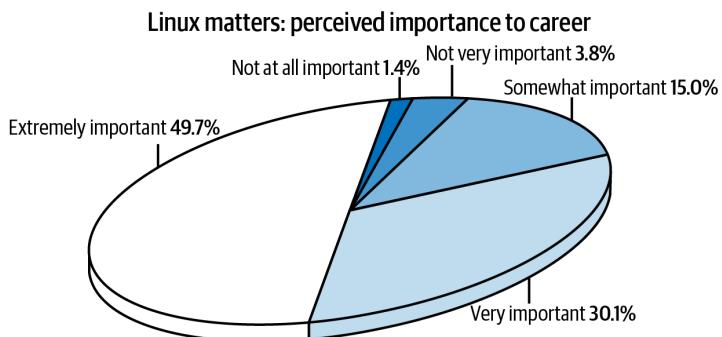
Open source also received endorsements for security and innovation. A large percentage of respondents believe open source quality to be better than proprietary software. Half considered them equal in quality—which in itself is an impressive advance over the indifference and dismissive attitude most companies had toward OSS in the 1990s.

Respondents had a noticeable preference for open source in areas of functionality, performance, and stability.

The Impact of Skills with Specific Open Source Tools Is Varied

Across industries and company sizes, respondents agreed that skills in certain specific open source tools were important but were divided on the impact of others.
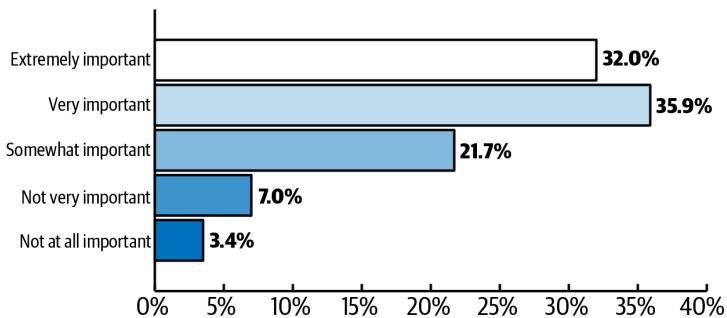
Linux towered above other technologies in importance—in fact, 95% of respondents called it "somewhat" to "very" important. They also indicated that they possessed the skills they called critical. Linux was rated particularly high in importance by respondents in the telecom industry, one of the few times when a particular industry differed from others in the survey.

Linux matters: perceived importance to career

Not at all important **1.4%**

Not very important **3.8%**

Somewhat important **15.0%**

Extremely important **49.7%**

Very important **30.1%**

Linux matters: level of proficiency

No experience **2.3%**

Basic experience **7.2%**

Working knowledge **22.4%**

Subject-matter expert **21.6%**

Proficient knowledge **46.5%**

Linux matters: knowledge and use

It hasn't helped me very much **4.6%**

It hasn't helped me at all **2.7%**

It has helped me somewhat **16.0%**

It has been extremely helpful to me **48.2%**

It has helped me very much **28.5%**

The importance of other open source tools received weaker responses. Containers rank fairly high, followed by Kubernetes. (It's not clear how the respondents saw the relationship between these two questions, because, of course, Kubernetes is the leading tool for managing containers.) For both containers and Kubernetes, respondents indicated the technology helped them in their career—more so in the case of containers, which were rated more important in the first place.

What's interesting is that respondents' self-reported expertise does not match the importance they assign to these skills. Perhaps there is just a time lag between the desire to obtain skills and the actual achievement. Alternatively, respondents may have trouble finding educational outlets. Computer science courses concentrate on general knowledge rather than current technologies, which is entirely appropriate. Many other learning organizations, including O'Reilly Media and IBM, are trying to fill the gap by offering instruction on the latest tools.
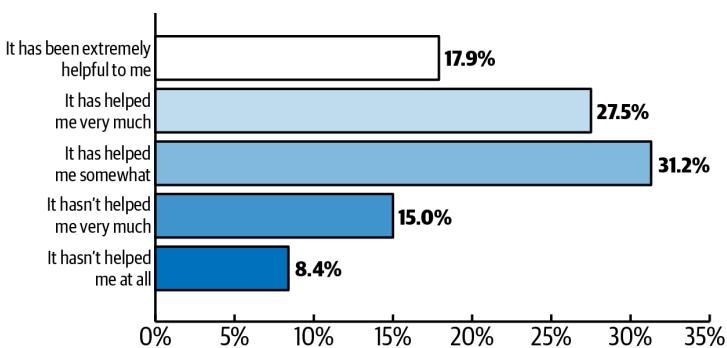
Containers matter: perceived importance to career

Category	Value
Extremely important	32.0%
Very important	35.9%
Somewhat important	21.7%
Not very important	7.0%
Not at all important	3.4%

(x-axis: 0% 5% 10% 15% 20% 25% 30% 35% 40%)
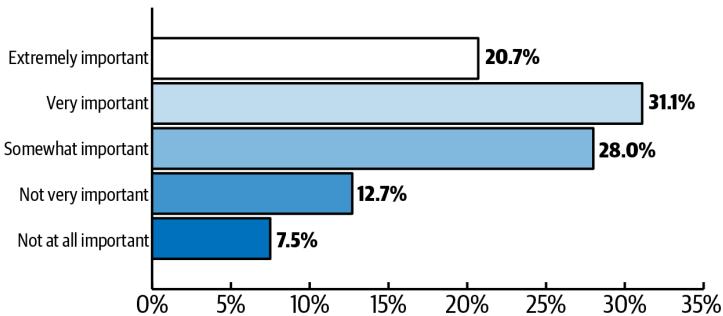
Containers matter: level of proficiency

Category	Value
Subject-matter expert	6.5%
Proficient knowledge	24.3%
Working knowledge	32.5%
Basic experience	25.8%
No experience	10.9%

(x-axis: 0% 5% 10% 15% 20% 25% 30% 35%)
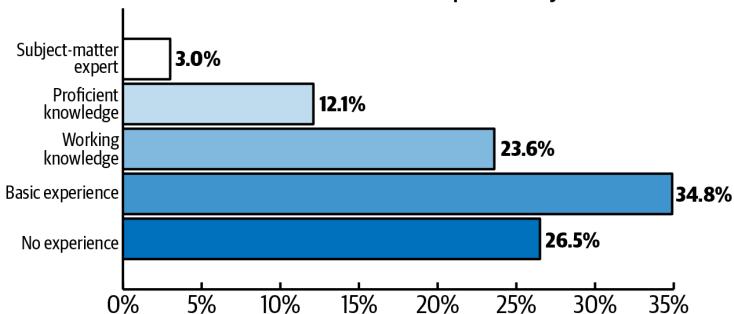
Containers matter: knowledge and use

Category	Value
It has been extremely helpful to me	17.9%
It has helped me very much	27.5%
It has helped me somewhat	31.2%
It hasn't helped me very much	15.0%
It hasn't helped me at all	8.4%

(x-axis: 0% 5% 10% 15% 20% 25% 30% 35%)
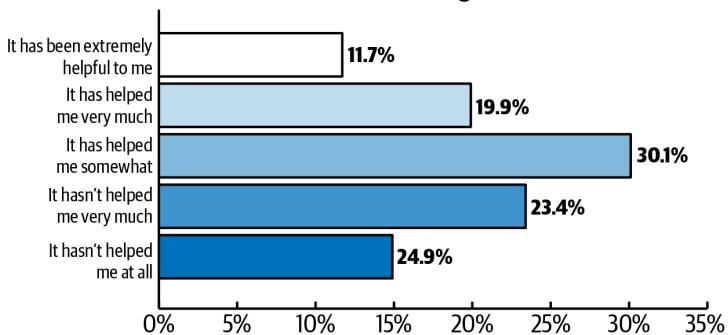
Kubernetes matters: perceived importance to career

Category	Percentage
Extremely important	20.7%
Very important	31.1%
Somewhat important	28.0%
Not very important	12.7%
Not at all important	7.5%

Kubernetes matters: level of proficiency

Category	Percentage
Subject-matter expert	3.0%
Proficient knowledge	12.1%
Working knowledge	23.6%
Basic experience	34.8%
No experience	26.5%
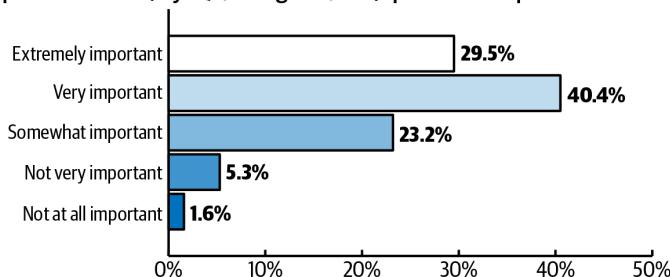
Kubernetes matters: knowledge and use

Category	Percentage
It has been extremely helpful to me	11.7%
It has helped me very much	19.9%
It has helped me somewhat	30.1%
It hasn't helped me very much	23.4%
It hasn't helped me at all	24.9%
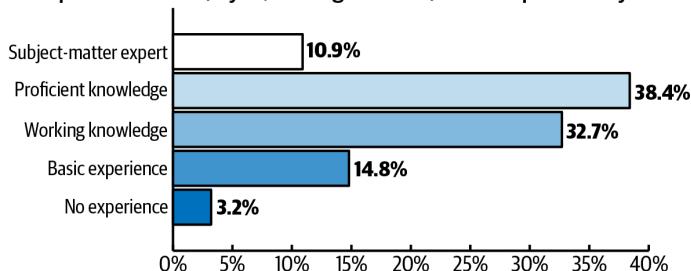
Respondents rated open source databases as important, and their skills matched their high assessment.
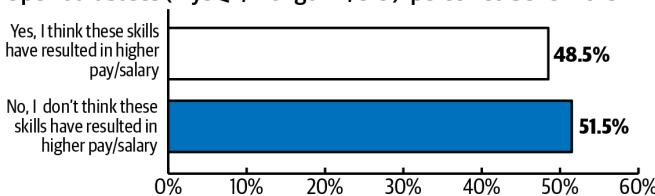
Open databases (MySQL, MongoDB, etc.): perceived importance to career

|	
Extremely important	29.5%
Very important	40.4%
Somewhat important	23.2%
Not very important	5.3%
Not at all important	1.6%

0%　10%　20%　30%　40%　50%
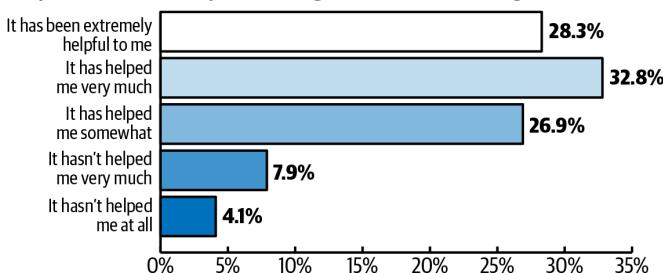
Open databases (MySQL, MongoDB, etc.): level of proficiency

Subject-matter expert	10.9%
Proficient knowledge	38.4%
Working knowledge	32.7%
Basic experience	14.8%
No experience	3.2%

0%　5%　10%　15%　20%　25%　30%　35%　40%
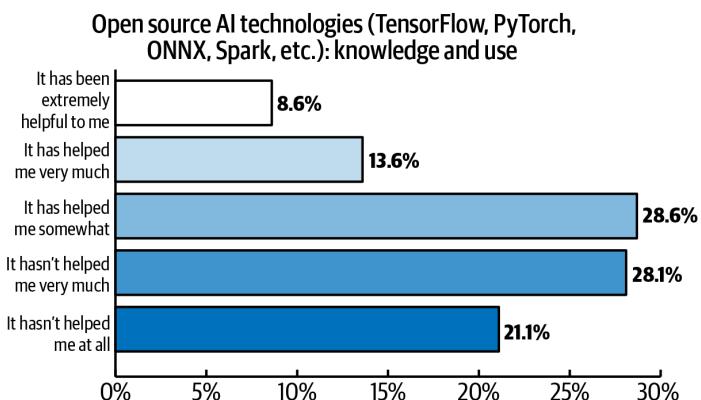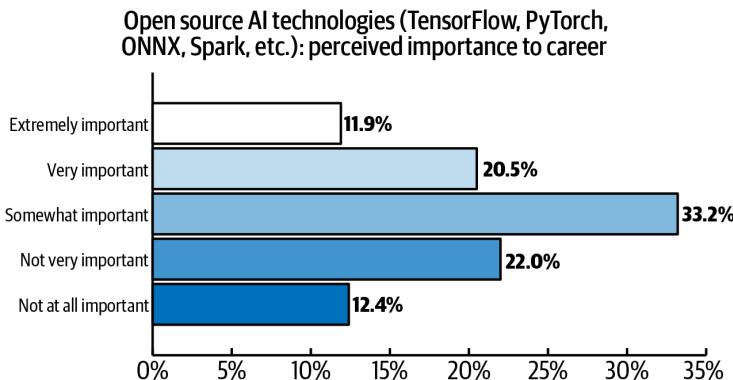
Open databases (MySQL, MongoDB, etc.): perceived benefit of skill

Yes, I think these skills have resulted in higher pay/salary	48.5%
No, I don't think these skills have resulted in higher pay/salary	51.5%

0%　10%　20%　30%　40%　50%　60%

Open databases (MySQL, MongoDB, etc.): knowledge and use

It has been extremely helpful to me	28.3%
It has helped me very much	32.8%
It has helped me somewhat	26.9%
It hasn't helped me very much	7.9%
It hasn't helped me at all	4.1%

0%　5%　10%　15%　20%　25%　30%　35%

Interestingly, AI technologies did not seem as important as the ones previously listed. But even though the respondents didn't seem enthusiastic when rating AI in the abstract, almost half affirmed that it had boosted their pay.

Open source AI technologies (TensorFlow, PyTorch, ONNX, Spark, etc.): perceived importance to career

Extremely important	11.9%
Very important	20.5%
Somewhat important	33.2%
Not very important	22.0%
Not at all important	12.4%

Open source AI technologies (TensorFlow, PyTorch, ONNX, Spark, etc.): knowledge and use

It has been extremely helpful to me	8.6%
It has helped me very much	13.6%
It has helped me somewhat	28.6%
It hasn't helped me very much	28.1%
It hasn't helped me at all	21.1%

One-third of respondents rated the importance of AI to their career as "very" or "extremely" important. But given the stunning achievements of some high-profile AI initiatives—think of the now ubiquitous voice recognition systems, for instance—the vast promise they offer, and the hype they've received, we should take a moment to ask why these technologies didn't rate even higher. Apparently, they are still at a relatively early stage of adoption. The barrier is not just the lack of expert data scientists and support staff but a willingness to

commit the entire organization to a radically data-driven strategy. The attitudes of respondents toward AI was the same across all company sizes and the industries tracked.

Hiring managers were consistently stronger in rating the importance of the technologies highlighted in this section. By statistically significant differences, the hiring managers thought that skills in Linux, containers, Kubernetes, and open databases were important and helpful to their careers. They also rated AI-related open source tools more positively than other respondents.

Conclusion

The cloud is made possible by open source. Open source is maintaining and perhaps even strengthening its hold on institutional software use and development, even as some technical and business forces encourage the use of third-party cloud services. The growing loyalty that developers and their managers display toward open source comes through in their responses to the questions in this survey.

Nearly all companies represented in the survey use OSS in some aspect of their operations, often deploying it widely and contributing back to it. Thus, real-life experience has informed the respondents' opinions about open source and its benefits to their own careers.

Most notably, respondents embraced OSS because it diminishes the potential for vendor lock-in. But they like open source for many other reasons as well. They found that it lowers costs and allows both development and bug fixing to proceed faster. To a more modest extent, some thought open source tools to be more secure and of higher quality.

Answers to several questions revealed the benefits that proficiency in open source technologies has on careers. Our survey shows that 65% and 69% of respondents, respectively, either agree completely or agree somewhat that contributions to open source projects impress potential employers and result in better professional opportunities. Respondents rated knowledge on several open source technologies—notably Linux, containers, and databases—more important than knowledge of proprietary cloud offerings. Respondents pinpointed ways in which the open source technologies

improved their careers: higher wages, more job opportunities, and professional opportunities. By the same token, respondents say that open source skills play an important role in their own hiring.

Modern software architects and developers should remain aware of both trending open source technologies and cloud offerings. Over the long term, a knowledge of the most fundamental open source tools and libraries will provide major benefits in job growth and other professional activities. As the survey shows, this insight is recognized both by developers seeking jobs and the managers who hire them.

About the Author

Andy Oram has brought to publication O'Reilly's Linux series, the groundbreaking book *Peer-to-Peer*, and the best seller *Beautiful Code*. Andy has also authored many reports on technical topics such as data lakes, web performance, and open source software. His articles have appeared in *The Economist*, *Communications of the ACM*, *Copyright World*, the *Journal of Information Technology & Politics*, *Vanguardia Dossier*, and *Internet Law and Business*. Conferences where he has presented talks include O'Reilly's Open Source Convention, FISL (Brazil), FOSDEM, DebConf, and LibrePlanet. Andy participates in the Association for Computing Machinery's policy organization, USTPC. He also writes for various websites about health IT and about issues in computing and policy.