



FEATURE

Open for business

How open source software is turbocharging digital transformation

Bill Briggs, Stefan Kircher, and Mike Bechtel

Traditional software remains foundational to IT systems everywhere. But open source software can create positive disruption—engaging both customers and employees—by encouraging collaboration and productivity.

ITHOUT THE RIGHT enterprise technologies in place, even the bestplanned software strategy can miss the mark. For this reason, a growing number of IT leaders are adding open source software (OSS) to their transformation toolkits. In a recent Red Hat survey, 69 percent of IT leaders said that enterprise OSS was either "very important" or "extremely important" to their organization's overall enterprise software strategy.¹

Make no mistake, the ever-expanding palette of vendor solutions on the market today remains an indispensable resource for enterprise-scale digital transformation. But there are compelling reasons to explore OSS's possibilities as well. For example, OSS in emerging technology domains often includes work contributed by highly creative developers with hard-to-find expertise. By exploring OSS projects for artificial intelligence (AI), blockchain, or other trending technologies, companies that lack in-house experts can better understand what the future holds for these disruptive tools.

Moreover, CIOs are realizing that when coders can engage with domain experts and contribute their own work to an OSS ecosystem, job satisfaction and creativity often grow, along with engineering discipline, product quality, and efficiency. As any software engineer knows, the ability to take established and tested code from an existing library, rather than having to create it from scratch, can shrink development timelines significantly.

These findings spotlight OSS's formidable promise. But they also make clear that open source is not an all-or-nothing proposition. IT leaders should think of OSS as a potentially valuable complement to their broader ecosystem, vendor, or partner strategy. They should also determine when its use is businesscase-justified. Overall, a judicious embrace of OSS can bring compelling benefits to a firm's strategy, processes, and people.

An emerging technology 30 years in the making

Unlike many innovations currently being developed within OSS domains, the open source model is not new. It traces its democratic roots to the mid-1990s, when the number of developers connecting via the internet began growing, a phenomenon that spawned an entirely new *kind* of collaboration and productivity. The open source idea was revolutionary: Complete strangers, committed to the same good-faith cause, pooled their energies to equal or exceed the work of paid experts.

In its early days, OSS was the bailiwick of "geeks" whose idealistic approach to software development favored a distributed, all-volunteer community over individual software firms' centralized authority. Today, their most notable creation, the Linux operating system, powers 80 percent of the Web.²

By the mid-2000s, the open source mindset had begun to go mainstream. Terms such as *Web 2.0* and *crowdsourcing* gained currency, opening the peer production movement up to "creators" as well as coders. By the end of the decade, consumerfacing websites had given way to Web *platforms*—utilities that enabled the crowd to create, connect, and consume at an unimaginable scale. Facebook (2004), Reddit (2005), and Spotify (2006) were all mechanisms for communitygenerated content and discovery. As of 2018, seven of the top 10 US websites were crowd-powered platforms.³ In each of these instances, open source offered a low-cost way to kick-start innovation. Any organization's development team can use open source to quickly prototype innovative ideas, experiment with trending technologies, and build on these trends. Whether the technology is machine learning (ML), blockchain, or virtual reality, open source provides components, libraries, and frameworks that together form a tremendous reuse pool of software for fueling and shaping new ideas.

And OSS is indeed fueling new ideas.

Opensourcecompass.io, a recent joint research effort from Deloitte and Datawheel, analyzes the trajectory of open source development of emerging technologies. Data from Open Source Compass (see figure 1) shows that the number of open source projects grew at a staggering average compound rate of 79 percent between 2008 and 2018.

Four compelling reasons to "open up"

In startups with limited resources and established enterprises with complex IT ecosystems alike, the ability to change open source code and customize it to one's needs is invaluable. But there are other OSS possibilities as well. How can the technology's availability elevate the next phase of your enterprise software strategy?

OSS IS AN ONRAMP TO THE FUTURE

Established organizations are beginning to explore how trending technologies such as AI and blockchain can play a part in addressing their customers' needs. A dip into these domains quickly reveals that open source languages, tools, and platforms can be powerful accelerants and, in some cases, even table stakes for attaining competency.

Consider TensorFlow, a machine learning platform originally developed in 2011 by a handful of internal researchers at Google. Released four years later under the Apache 2.0 open source license, TensorFlow has since exploded in popularity.⁴ By 2016, more than 1,500 code repositories on GitHub only five of them from Google—mentioned TensorFlow.⁵ By 2018, more than 3,500 individual developers around the globe had made roughly 43,000 contributions to the project.⁶

FIGURE 1

Cumulative number of OSS projects created, 2008–2018



Data from Deloitte's Open Source Compass site analyzing projects with more than 10 watchers across 15 emerging technology domains

Source: Open Source Compass.

Open Source Compass data on TensorFlow (see figure 2) shows steady growth in number of developers contributing to TensorFlow projects.

The size and diversity of the developer base, while certainly eye-opening, are not necessarily the headline here. Rather, it's the clientele. Airbnb is using TensorFlow's ML capabilities to classify property listing images and detect household objects at scale, helping to improve the guest experience.⁷ PayPal is using its deep learning libraries to recognize, and get ahead of, complex fraud patterns.⁸ And beyond tech companies, established global enterprises such as Coca-Cola, Airbus, and GE Healthcare are leveraging TensorFlow to jump-start the delivery of their next-generation business capabilities.⁹

Key takeaway: At first glance, emerging technologies such as machine learning or AR/VR can feel so fast-moving as to be unattainable given your organization's current tools, techniques, and talent. Recognize that open source software can provide an accessible on-ramp to your desired future state. And while you may not, for instance, have machine learning gurus on your team, you may have a cadre of C++ and Python engineers looking for a new challenge. Open source projects such as TensorFlow can provide that gateway.

FIGURE 2

TensorFlow contributors, Q2 2013 to Q1 2019





Source: Open Source Compass, opensourcecompass.io.

4.36K

457

1.88K

825

ONTRIBUTORS

KERAS

CAFFE

PYTORCH

OSS IS A TALENT BEACON

While the benefits of leveraging OSS in the enterprise are becoming clearer, the benefits of engaging with the broader OSS community are less often discussed.

Participating in an open source community can provide junior developers an opportunity to read code written by more experienced colleagues in their field or even by highly creative pioneers who are driving their domains forward. This kind of access can serve as a master class in complex systems and the engineering techniques used to build them. Likewise, by engaging with their peers in an OSS community, more experienced developers particularly those in enterprise IT leadership positions—can continuously freshen their skills, while keeping their finger on the pulse of the latest technologies, programming languages, and tools. This information, in turn, can inform their own recruiting, retention, and training programs.

Full "digital citizenship" in the OSS community expects developers to contribute code as well as consume it. Today, many companies are consuming more than they're contributing back to the open source world. There are different ways to approach this. IBM, for instance, has a rule about how many lines of code employees may take out relative to how many lines they put in.10 Beyond skill development and professional growth opportunities that open source offers code writers, firms are realizing that the ability to contribute to the OSS ecosystem strikes a chord with a generation of millennials who intrinsically value giving something back to the wider world. Anecdotally, we hear how some companies that have encouraged on-staff developers to share their own work in OSS projects have seen a welcome uptick in retention rates among coders.

Key takeaway: On the issue of employee training, leadership coach Peter Baeklund famously told the following joke: "A CFO asks a CEO, 'What happens if we invest in developing our people and then they

leave us?' The CEO responds: 'What happens if we don't and they stay?'"¹¹ Encouraging participation in—both consumption of and contribution to—the broader OSS community can be a meaningful means of attracting, engaging, and developing your next generation of technologists.

OSS CAN BE A TROJAN HORSE FOR ENGINEERING DISCIPLINE

Many open source projects focus on programming frameworks. From the early model–view– controller days of Apache Struts to today's collection of Java Spring, Ruby on Rails, Django, AngularJS, and Vert.x, these frameworks are born out of necessity. For larger projects, the open source community needs structure and enforcement of good practices—for example, separation of concerns, isolation, and abstraction. Frameworks serve these purposes and drive efficiencies and consistency. Organizations of all sizes can leverage them to harvest the very same benefits.

In this context, standardization of operability and interoperability (for example, JSON or XML) represents another major benefit. Open source is driving open standards that need implementation, while open standards encourage broader adoption of loosely coupled systems using contract-based interfaces and APIs.

Key takeaway: If every company today is a technology company, bolstering engineering and architecture should be high on priority lists. Instead of inventing standards and frameworks, OSS can provide a foundation—embodying best practices and accelerating efforts to stand up modern development capabilities.

OSS OFFERS A WAY TO IMPROVE YOUR "-ILITIES"

Yes, OSS can provide access to trending technology domains. And sure, talented developers are clamoring to be part of it all. But one question remains: Can IT departments count on OSS software being any good?

Technology architects have long referred to a system's overall performance profile in terms of its *-ilities*: scalability, availability, reliability, and more.¹² Upon close inspection, OSS can, in fact, check many of the same *-ility* boxes as proprietary software. And add a few more to the mix. For example, software engineers typically prize *utility*. They champion efficiency and, by extension, look to avoid

duplicative work. To wit, many developers appreciate OSS because access to extant libraries can reduce their time spent reinventing wheels. A meaningful percentage of your organization's custom code is likely less-than-strategic plumbing or glueware. All things being equal, your developers likely prefer to import selections from a well-worn OSS library than build them from scratch.

As an example of how an OSS library can drive efficiency, consider the emergence of RStudio's

FROM THE TRENCHES: TURNING JOBS INTO HOBBIES

Over the course of Frank Nazzaro's career in technology, he has covered a lot of "open" ground, from experimenting with Linux and Pine in the early 1990s to working with Kubernetes today. Though he has always recognized OSS as a valuable resource for innovation and operations, he now also sees it as a powerful tool for building and maintaining morale among IT talent. In his current role as CTO and acting CIO of the Federal Home Loan Mortgage Corp. (Freddie Mac), Nazzaro has with his own team seen how being able to take software from the OSS ecosystem—and share their own in return—has helped boost job satisfaction and sparked creativity.

Nazzaro began exploring open source's broader enterprise potential several years ago while working for a different company. "We deployed two technology tracks," he says. "The first was conservative and followed traditional methods. In the second, a small team began experimenting with OSS with the goal of developing more in-house skills and evolving products over time." Today, Freddie Mac uses a similar model as it transforms its IT ecosystem from on-premises to cloud-based. The organization calls its two tech tracks the *brown field*, which includes legacy systems and tactics, and the *gold field*, which features new tools, services, and applications being developed, in part, using OSS.

Nazzaro says that over the last decade, the OSS ecosystem has grown and matured to become an invaluable repository of "glueware"—all the things developers must do to make varied systems work together seamlessly within a technology stack. "There's a lot of ingenuity and social capital that comes from gluing technologies together. It's great that everyone can now share that IP with others throughout the marketplace. It's good for companies, but also for developers."

He encourages OSS contributions "because it gives developers the ability to create and contribute things outside their areas of responsibility," he continues. "In a way, it turns their jobs into hobbies and vice versa. It also provides opportunities for internal developers with specific roles to contribute to projects in other areas. All of this has had a positive impact on employee retention."

Nazzaro adds that contributing also gives IT talent access to experts in the OSS community—and a way to showcase their own expertise among their peers. "People want to work with good technologists," he says. "When we announced a Kubernetes project recently, several individuals from outside Freddie Mac inquired within minutes about joining our team, which was remarkable."

OSS is one of the tools in Freddie Mac's digital transformation toolkit that can help IT talent approach their work in new ways. Indeed, it has helped them create a community culture that, Nazzaro says, supports more creative problem-solving. "Traditionally, the staff would provide me with a list of the things they were concerned about. But they are more empowered now, so I can approach potential problems differently. I say to my team, Tell me all the things we have to do to make this work.' This completely changes the way people design and look at problems."

FIGURE 3

Dplyr contributors, Q4 2012 to Q1 2019

The number of contributors to the original dplyr package (dark line), versus the number of contributors to dplyr after it became part of the Tidyverse ecosystem (lighter line)



Source: Open Source Compass, opensourcecompass.io.

Tidyverse, an ecosystem of widely used data analysis and cleaning applications for the R programming language. Tidyverse's progenitor is dplyr, an R library created by New Zealand statistician Hadley Wickham. This early library proved so popular that Wickham, who is now the chief scientist for OSS vendor RStudio, developed a centralized ecosystem that allowed other users to build their own libraries on top of existing libraries. Today, that ecosystem, Tidyverse, consolidates numerous open source R packages and capabilities in one location. In short, Tidyverse offers growing numbers of R language developers "one-stop OSS shopping."¹⁴ As any experienced architect will tell you, however, faster doesn't necessarily mean better, which leads us to the question of OSS quality and security. Sure, 3,500 volunteers can coauthor a Wikipedia entry *about* enterprise software, but can they be trusted to develop said software? Test it? Support it? Secure it? The answer is yes. A sufficiently large army of motivated volunteers, working transparently toward a common goal, can often equal or outperform a single expert.

/ dplyr 🔴 tid

Of course, developers are not the only stakeholders here. Compliance and risk teams require auditability. Here, too, OSS shines brightly because it makes source code open to all for inspection.

Key takeaway: Software developer and OSS advocate Eric S. Raymond famously said, "Given

enough eyeballs, all bugs are shallow."¹⁵ Recognizing the pithy nature of his quip, he more formally explains: "Given a large enough beta-tester and codeveloper base, almost every problem will be discovered quickly, and the fix obvious to someone."

FROM THE TRENCHES: THOMSON REUTERS' INSIDE JOB

Each day, mass media and information company Thomson Reuters delivers business intelligence, technology solutions, and human expertise to professional markets in more than 100 countries. One way that it meets evolving customer demand while keeping its global operations integrated is by building enterprise-scale software solutions in-house—solutions that in many cases leverage open source software. According to Sejal Amin, the firm's CTO for tax professionals and head of corporate technology, OSS is present throughout the IT ecosystem. "Open source offers access to core portions of today's major programming languages. We use open source building blocks regularly in our development, operational tooling, and data services."

While OSS has become a valuable component in Thomson Reuters' digital strategy, perhaps its greatest impact thus far has come from an internal OSS community that the company now operates. "Over the past few years, we've created an open source library of front-end software components that follow Thomson Reuters' branding and product approaches," Amin says. "It's a consumable toolkit that anyone at Thomson Reuters wanting to follow this branding can use."

In fact, Amin says, leaders now *expect* developers to use the tools, which they are doing in a big way. While working to build many of the company's tax and accounting applications during the last three years, developers consumed and contributed library components that were brand- and product-compliant. These components, in turn, are now being extended to the company's broader portfolio. "The tax and accounting apps were created with Angular, AngularJS, and Bootstrap, so they have close ties to other development projects in the organization using the same OS frameworks," Amin says. "Being able to share them internally has been great."

Meanwhile, the company continues to leverage external OSS ecosystems. "We are also pulling domain-standard offerings that are licensed under an open source model," Amin says. "The now-normal mode of consuming SaaS means sourcing components from industry leaders. This is just one of the ways we make regular use of open source building blocks."

Amin says that overall, consuming OSS—and, when possible, sharing IP in return—has afforded Thomson Reuters the opportunity to leverage and contribute to offerings that have seen widespread adoption. But she notes that this opportunity goes hand in hand with persistent risks involving software maturity, licensing implications, and broader adoption. Some industry-standard components may use open source code that, in turn, uses other open source code. "These kinds of dependencies can introduce challenges for adoptions or impact your overall security posture," Amin says.

To help manage such risks, Thomson Reuters takes four steps. First, it inventories all the open source software currently in use at the company and addresses licensing, maturity, dependency, and security matters. Then, it works across the business with legal, branding, and cybersecurity teams to establish a clear approach for OSS licensing usage and security. Step three involves developing a methodical training program to instruct IT talent on OSS usage guidelines. The final step, Amin says, is essential: "We work to enforce guidelines and maintain our training program."

Providing training on an ongoing basis is key. Amin says she has noticed that developers see OSS not only as a way to collaborate with their industry peers on exciting projects—"it is also a way to give something back, which is important to them." Through ongoing training, companies can help their developers participate fully in OSS environments without introducing additional risks. "In the open source world," she says, "this is what practicing digital citizenship looks like."¹⁶

Points to ponder

In the spirit of risk management and judiciousness, consider the following points as you determine the right spaces to engage with open source software.

Competitive differentiation. Harvard management guru Michael Porter argues that strategy is, in part, the art of knowing what not to do.¹⁷ For those technology capabilities at the core of your firm's strategic differentiation, it's understandable-and prudent-that you'd be reticent to depend upon, let alone share them with, anyone outside your direct control. Once you determine and designate your services as supporting versus strategic, an easy answer is to begin crowdsourcing the former (that is, embrace OSS) to free precious internal cycles for the latter. It's also worth challenging convention and evaluating whether open source could actually help drive competitive advantage in areas deemed crown jewels.18

Cultural constraints. Some corporate cultures are simply more "open to being open" than others. Consider Tesla. Long considered a technology company that happens to sell cars, Elon Musk's decision to open source the company's patent portfolio in 2014 was called at once intuitive (by software industry pundits) and unprecedented (by automotive experts).¹⁹ As you think about the benefits of using OSS in your organization, remember to first consider your mission, vision, and values. As the old saying goes: "Culture eats strategy for breakfast." Embracing open source can be part of a broader effort to modernize tech operating and delivery models, but don't underestimate the importance of (and challenge of) the required cultural shift.

Uncertain lineage. All open source projects are not created equal. Your confidence in a given project, fork, or codebase should run proportionally to its number of contributors, commits, and followers. Consider looking for a conservative lineage, and stick to a particular line. For core plumbing, there's no reason to be out on the bleeding edge.

DEGREES OF FREEDOM

Free. A simple word with many meanings.

One of the oft-repeated talk tracks in the OSS community is software activist Richard Stallman's "free speech versus free beer" concept.²⁰ Open source software is always *libre* ("free like speech") but not always *gratis* ("free like beer"). Reputable firms such as RedHat have built profitable, enduring business models around *libre* software. Despite that fact, OSS's countercultural and vaguely anticapitalist origins have historically soured technology executives on the space.

This is a missed opportunity. Technology executives would do well to recognize that *libre* OSS is, like every technology before it and any to come, simply another tool in their kit. It is appropriate for some jobs, less so for others.

OSS may not be your tool of choice for initiatives close to your strategic core, or contrary to your cultural norms. Likewise, bleeding-edge OSS projects may carry too much uncertainty and too little support for your needs.

Those caveats notwithstanding, nearly any CTO should find open source software worth considering. If your job requires a quick adaptation to fastmoving emerging tech domains? OSS frees you to do so. If your job requires a means of more effectively attracting, engaging, developing, and retaining talent? OSS frees you to do that as well. Finally, if your job calls for a solution built with utility, quality, auditability in mind, OSS can free you to do that too.

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Deloitte Consulting LLP's Open Source Compass tool delivers insights into the trajectory of open source software by visualizing trends in technology domains, projects, programming languages, and locations. It can help technology leaders as they make decisions about which technologies to invest in, where to focus innovation efforts, and where to scout for talent. To learn more about Open Source Compass and how it can elevate your technology strategy, contact the authors or go to opensourcecompass.io.



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