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Thought Leadership Paper  
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# Accelerate Your Path To Innovation With Containers

Open Source Is Driving Faster Adoption Of  
Container Platforms For More Enterprise Apps

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# Executive Summary

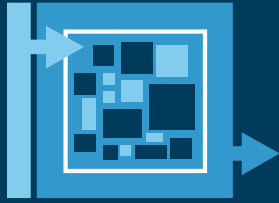
In August 2017, Red Hat commissioned Forrester Consulting to evaluate the current state and challenges of container usage and to assess what has changed since 2015.

Our 2015 study revealed that firms were just figuring out how to adopt containers and understand their impact on operations. Over the last three years, container adoption has increased dramatically, as have enterprise skill levels and sophistication. A global IT delivery director at a consulting firm summarized his company's approach: "Any app that *can* be containerized, *should* be containerized."

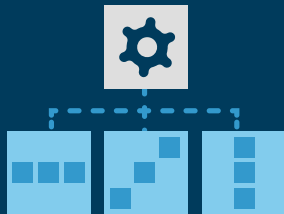
Fifty percent of the IT and software development engineers we surveyed are using containers and advanced container management tools today. As adoption has increased, users are now actively adjusting their processes, supporting technologies, and skill sets. To explore further, Forrester conducted an online survey of 200 respondents and five telephone interviews with IT and development decision makers who have direct container experience.

## KEY FINDINGS

- › **Container adoption is now mainstream and continues to grow.** Of the firms using containers today, 58% have two or more years of experience using containers and orchestration/platform software. Those surveyed currently have an average of 32% of containerized apps running in production — and they expect that percentage to increase in the next two years. Customer-facing apps have benefited most from containers to date, while the use of containers for internet-of-things (IoT) apps will grow in the coming year.
- › **Containers drive the need for hybrid cloud infrastructures.** Not every workload or company is ready or suited for public cloud today, and many companies start using containers on-premises to build skills before or alongside development in the public cloud. As firms become more skilled in using containers on-premises, they augment their in-house development and production environments with external cloud container platforms, creating the need for hybrid, multicloud container solutions.<sup>1</sup>
- › **As container adoption has grown, the requirements have become more sophisticated.** In 2015, companies were learning how to use containers. Today, they are more comfortable with containers and are looking for solutions that are easy to deploy, flexible, and secure, and support configuration management and continuous integration/continuous deliver (CI/CD) processes. Container benefits improved scalability and application quality to faster application startup.
- › **Container innovations are accelerated by open source.** Open source platforms and tools have amplified the rise of containers. Most firms prefer open source for everything from web application stacks to development tools. An "open source first" strategy allows firms to better collaborate and innovate, and open source can lower lock-in, increase agility, and drive change in the way that technology projects are designed, delivered, and governed.<sup>2</sup>



Fifty percent of respondents who use containers also use advanced container orchestration tools today.



Sixty percent plan to use containers and advanced container orchestration tools in one year.

# From Experimental To Established: Companies Have Embraced Containers

The age of the customer forces businesses to deliver compelling new products and services faster — and deliver them to customers via seamless digital experiences. Containers have made it possible for application delivery professionals to create these winning digital customer experiences. Containers are proven to help developers build and release code faster and experiment more often; they also help operations push fixes and changes through to production more frequently.<sup>3</sup>

In surveying 200 IT and development decision makers, we found that:

- › **Container and orchestration/platform usage is now widespread.** Containers have many uses — from simplifying configuration to server consolidation. Fifty-eight percent of the organizations surveyed have been using containers for two or more years; 54% have been using orchestration/platform software for the same amount of time (see Figure 1). Of the industries surveyed, government and technology organizations have been using containers the longest; most have been using containers or orchestration platforms for at least three years.

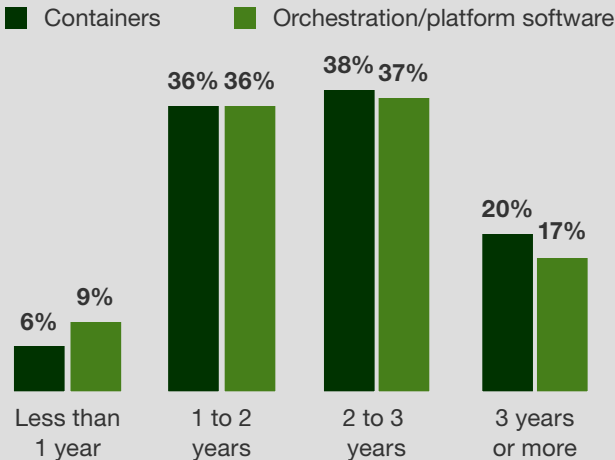
“Companies are feeling pressured by their peers, so they are moving onto technologies like containers, which are enabling ‘ready-to-earn’ or ‘go-to-market’ strategies as soon as possible.”

*Global IT delivery director at a consulting firm*

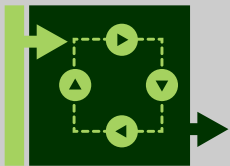


**Figure 1: Container Usage Continues To Grow**

“How much of your organization’s containers are built and run in the following IT environments?”



Base: 200 IT/development decision makers  
 Source: A commissioned study conducted by Forrester Consulting on behalf of Red Hat, November 2017



Fifty-eight percent of firms have been using container platform/orchestration software for more than two years.

- › **Successful organizations match container application candidates with the right app and business needs.** Containers are at the heart of faster, more efficient, and higher-quality software delivery — when matched with the right app. Firms have been able to speed up their average app release cycle annually to quarterly, and they expect to go to monthly or even weekly in the next two years. A software architect at an Italian government agency shared that his agency is building its first container application from scratch, and it is important for the team to get it right, so he’s starting with new apps and new processes. The firm is changing the way it develops software with a new DevOps toolchain; his goal is to increase software delivery speed. This government agency sees the value of investing in containers to develop new critical applications.
- › **Not just for test and development and not just for new apps: Container use cases expand as skills grow.** Fifty-six percent of teams using containers rate themselves considerably to completely skilled, an increase from 2015 (see Figure 2). As skills increase, those teams use containers beyond development and testing, and for both new and existing apps. Containers are now widely used from developer laptops to production, and their use will grow over the next two years. Currently, 43% of the projects for which containers are used are new, but in two years, the number of projects that are a mix of both existing and new is expected to increase to 48% as seen in Figure 2.

The last three years have proven that containers are a key supporting technology for Agile and DevOps methodologies. It has been a productive time for firms as they improve their container skills and reap the benefits across their software portfolios and software delivery life cycle. Firms now use containers for their most business-critical apps and have stepped up release frequencies.

In all, 44% of companies use containers to improve DevOps and CI/CD processes (the most popular initial use case). Another 44% inventoried their applications to find those best suited for containers (and their chosen container platform) today, to get started with the best candidate. As use cases have expanded, release frequencies have sped up significantly. Two years ago, the average release frequency was about twice a year (every 5.7 months); today, it’s 3.8 months; two years from now, companies expect to speed up to 2.6 months, better than quarterly. The long-term goal? Increase to monthly or even weekly.

“Anything that needs the elasticity and flexibility that containers provide in terms of how the workloads increase or decrease throughout the year is a good candidate for containerization. We are analyzing what other apps to move to containers now.”

*Infrastructure director at a Latin American financial institute*



**Figure 2**

**Skill Sets Have Increased Over The Last Three Years Of Container Usage**

“How skilled is your team in the use of containers?”

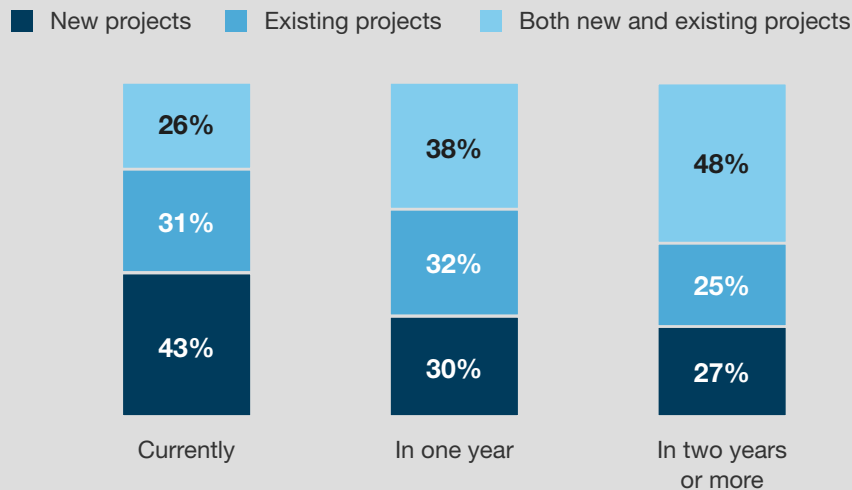


Base: 171 IT/development decision makers  
 Source: A commissioned study conducted by Forrester Consulting on behalf of Red Hat, January 2015

Base: 200 IT/development decision makers  
 Note: Percentages may not total 100 because of rounding.  
 Source: A commissioned study conducted by Forrester Consulting on behalf of Red Hat, November 2017

**Firms Plan To Use Containers Increasingly For A Combination Of New And Existing Projects In The Next Two Years**

“For what types of projects do you currently use containers/plan to use containers? How do you anticipate this will change in the future?”



Base: 196 IT/development decision makers  
 Source: A commissioned study conducted by Forrester Consulting on behalf of Red Hat, November 2017

# Faster, Please: Overcoming Container Challenges Is Now Priority One

As container usage increases, IT and development decision makers must overcome more sophisticated organizational speed bumps and technical challenges. In 2015, security was the top container challenge identified; it remains among the top challenges still in 2017. Fewer firms are concerned about the performance of containers in production today; in fact, production use is expected to increase quickly over the next two years.

Top container challenges identified in 2017 include the following:

- › **Performance and security continue to top the list of concerns.** Thirty-one percent of respondents listed performance as their top container challenge, followed closely by security, but they expect these concerns to decline. Security and performance were among the top three challenges in 2015, and in 2017, they are joined by scalability (see Figure 3). Without the proper development security operational controls (DevSecOps), developers can knowingly or unknowingly include vulnerable libraries or allow uncontrolled access to production containers. Keep in mind that containers are not just small virtual machines; they are runtime environments and code, so they cannot be treated the same way. The way they are built, maintained, updated, and released is different and needs a fresh look from developers.<sup>4</sup>

“Our container deployment environment is all on-premises today — it’s all in our own data centers. With a command or two, it’s up and running. That’s important for us, especially looking at the broader scale at which we expect to deploy containers.”

*Senior technology manager at a global telecommunications firm*

Fifty-six percent of teams using containers consider themselves considerably to completely skilled.

“We looked at our applications based on five guidelines to decide if they were good candidates for containerization. Are they supported by the container platform? Is the app stateless? Is it a single Java binary? Is it a web app? Or is it a software product we sell and want to deliver to our customers in containers?”

*Global IT delivery director at a consulting firm*



**Figure 3:** Performance And Security Remain Top Challenges



Base: 194 IT/development decision makers  
Source: A commissioned study conducted by Forrester Consulting on behalf of Red Hat, January 2015

Base: 200 IT/development decision makers  
Source: A commissioned study conducted by Forrester Consulting on behalf of Red Hat, November 2017

- › **Firms need a culture of change to succeed.** While containers help with implementation of DevOps, Agile, and CI/CD, organizational change is required as well. Multiple interviewees expressed concern with their organizations' culture and how it can slow down container adoption and value. A software architect at an Italian government agency explained: "As we move from a classical way of developing software to the DevOps way of doing the same thing, many of our employees have struggled with the change. . . . They think they cannot learn a new technology and way of working. I am surprised by how strong the resistance has been; we didn't expect it." The takeaway? Pair your container use with a customer-focused development and IT organization.<sup>5</sup>
- › **Firms rely on open source for container innovation.** Open source software and tools are at the heart of containers and container platforms. Companies should consider participating in container open source communities to reap the rewards of access to innovation and improved skills. A technology director at a software company explained: "Initially, there were lots of bugs [in container software], and we soon learned to become open source committers and provide the fixes. Additionally, if there are open source components in the technologies we use, then our platform automatically benefits as long as we continue to upgrade to the latest version. We use that to our advantage in that sense."
- › **Organizations start building and running containers on-premises, then move to the cloud.** Seventy percent of firms are building and running their container environments on-premises on virtual machines, bare-metal, vendor container platforms, or a stack they built themselves (see Figure 4). This data demonstrates the hybrid nature of infrastructure today — and the multiplatform model to dominate in the enterprise for many years to come. Firms will increasingly build and deploy containers on-premises and in public cloud platforms. One Italian software architect put it bluntly: "Our environment is completely on-prem. We are a public administration, and we are very afraid of the public cloud. We plan to move to a public cloud configuration in the coming years, but it needs to be secure." This trend is confirmed by Forrester client inquiries: Companies today strongly prefer to start modernizing software using containers on-premises, with a long-term plan to move to public cloud once their firms are comfortable with cloud security and compliance.

"There is a lot of innovation happening in open source companies, compared to the traditional software companies. It gives us a lot of flexibility in terms of what to choose. Prototyping is easy, and much cheaper. There is also great production performance."

*Global IT delivery director at a consulting firm*



"This kind of deployment requires a cultural shift. It's not something training alone will fix. You need to develop a strategy where you give them training for methods but also for technologies. Then they become your partners, spreading the good word around. A lot of communication and quick support is needed. A center of excellence, a team of experts, should be there to guide them after they are trained."

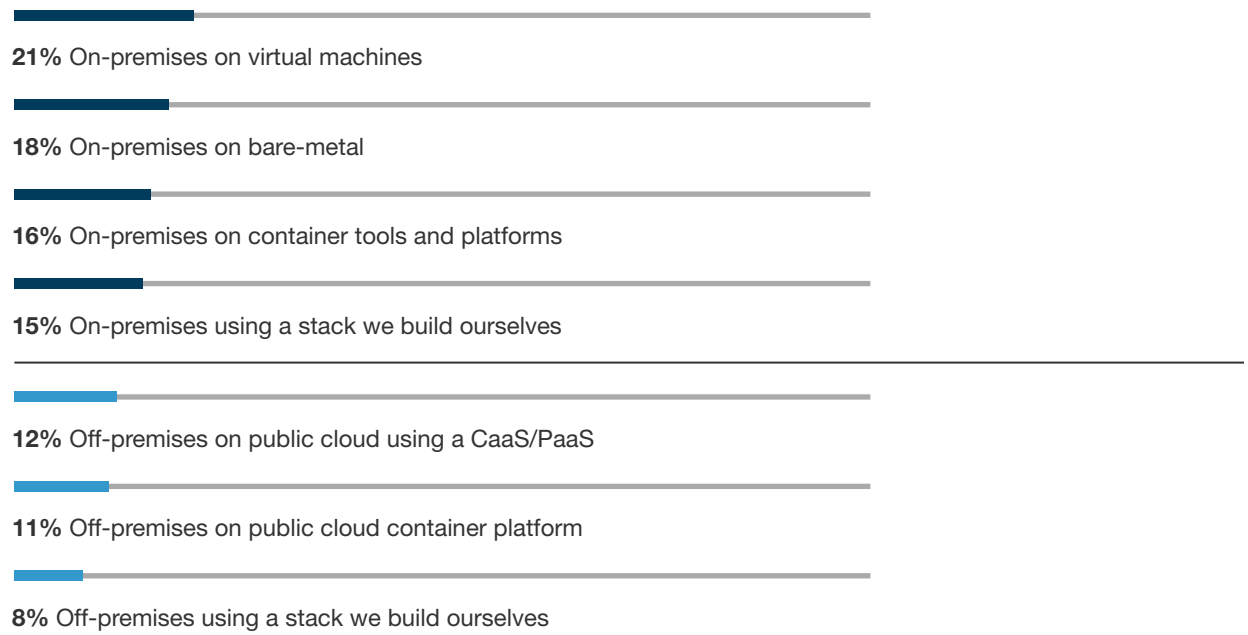
*Global IT delivery director at a consulting firm*





**Figure 4: Firms Begin With On-Premise Solutions**

“How much of your organization’s containers are built and run in the following IT environments?”



Base: 179 IT/development decision makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Red Hat, November 2017



# Containers Are Powering Innovation: Find The Right Fit At Your Firm

While containers are a natural fit for microservices and event-driven (or functions-based) app architectures, they are not the right solution for every app or use case today. One respondent told us that for high-performance computing, he needs multiple servers for one job, and slicing compute into multiple containers wasn't useful for that app.

Containers are particularly well-suited for delivering highly-scalable "cloud-native" apps, and survey respondents believe they will also complement, and eventually replace, virtual machines. Containers are being used to modernize many applications and workloads, and organizations have prioritized their customer-facing apps like mobile, social, and systems of engagement as their first priority. Data-rich apps and systems of record that are part of their core business are a close second for firms enhancing apps with containers. As IT and software developers create plans for containers, they should prioritize the use cases and application architectures that will benefit most.

Survey respondents listed the following key container benefits:

- › **Containers drive up customer experience and drive down costs.** Improved software quality, quicker application startup, and faster application development have a direct impact on customer experience. Consolidation enabled by containers adds more benefits: 78% of organizations have increased their server efficiency/utilization, and another 78% have reduced their costs. Seventy-six percent of firms have found that containers make it easier to move apps between clouds and data centers, and 74% have experienced more consistency across their environments.
- › **Open source will continue to accelerate container platform innovation and benefits.** Ninety-two percent of organizations that are using containers prefer open source for development tools, configuration and deployment tools, databases, and more (see Figure 5). A global IT delivery director at a consulting firm told us that the open source usage at his organization has grown 80% in the last nine years. Open source unlocks talent and innovation, both within your company and in the larger community. Open source foundations, leading vendors, and end user companies actively contribute updates and fixes to open source container platforms. Momentum and adoption of new standards accelerate when developers build the standards into popular open source projects, making them more visible and better known.<sup>6</sup>
- › **Containers make operational challenges easier.** Larger, traditional companies are turning to container technology because of the competitive pressure to go to market faster. Containers make it easier to do so by simplifying management of app life cycles. Containers allow for greater flexibility, thanks to the ability to choose the language used and inherent container scalability. Sixty percent of decision makers agree that containers provide consistency across environments. Containers also have the potential to drive better collaboration between application and IT teams; 68% of firms considered that a top benefit.

"[Containers are] much easier to manage from the life cycle perspective. [They're] quicker to move and make decisions about each piece of functionality and release times. They give us choice of language. Each team is more independent. Different teams have used different languages."

*Technology director at a software company*



"There is a lot of innovation happening in open source companies, compared to the traditional software companies. It gives us a lot of flexibility in terms of what to choose. Prototyping is easy and much cheaper. There is also great production performance."

*Global IT delivery director at a consulting firm*



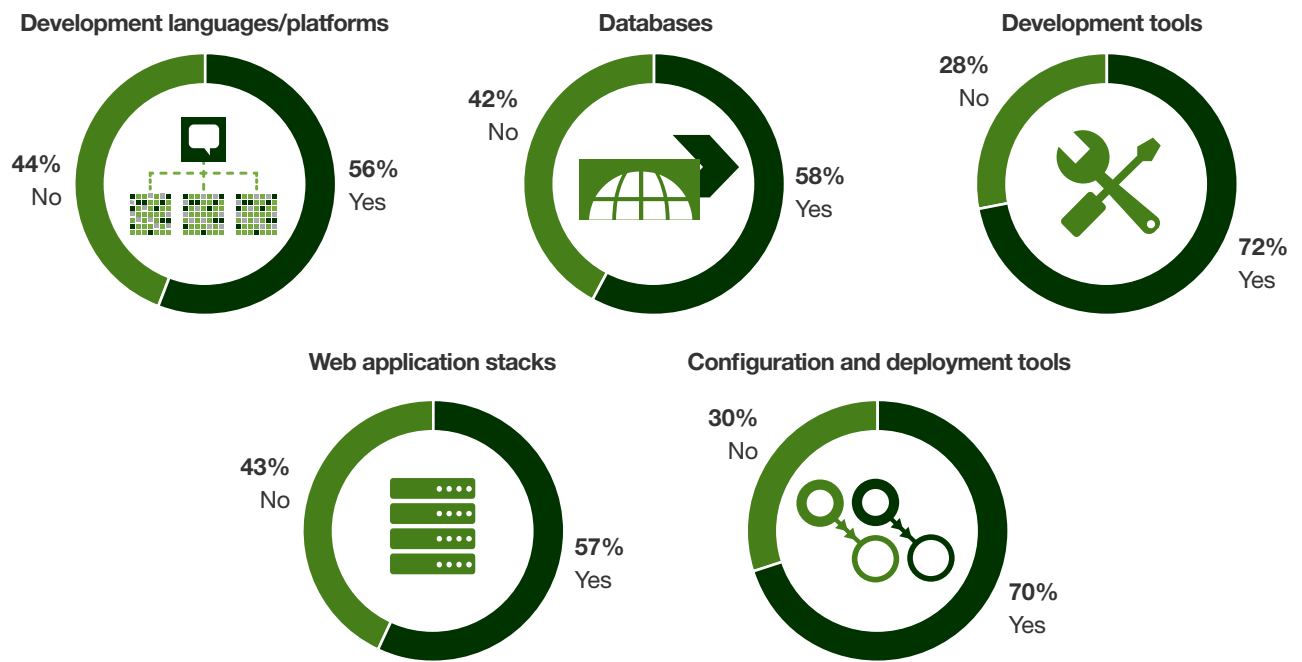
Seventy-six percent of firms have found that containers make it easier to move apps between clouds and data centers.

› **Automation combined with container platforms multiplies value.**

Organizations are combining enhanced automation with container use to realize benefits sooner and drive additional value. From automated container deployment to infrastructure provisioning and storage to network configuration, firms are using container platforms as automation engines. We found that companies that have adopted comprehensive container orchestration, continuous integration and deployment tools, and automated security and authentication, among others, are realizing container benefits sooner. They enjoy easier deployments, operational efficiency and flexibility, and fully automated rollouts and rollbacks.

**Figure 5: Ninety-Two Percent Of Firms Using Containers Prefer Open Source**

“Companies surveyed prefer open source for . . .”



Base: 197 IT/development decision makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Red Hat, November 2017

# Key Recommendations

Containers are poised to power more digital transformation than virtualization did 15 years ago. Why? Because they not only provide IT operational efficiencies and infrastructure savings, but they help developers turn terrific ideas into winning software faster. While containers are already providing a broad range of critical benefits (even more since we last surveyed the market in 2015), they are not the right solution for every use case or workload. To maximize container benefits, companies need to adopt agile and continuous software delivery processes and apply relentless automation to container operations. Forrester's in-depth survey of IT and development leaders about containers yielded several important recommendations:



**Adopt a container platform strategy, not just a product.** Your container strategy should start with your software development and customer objectives. Match container platform services with your development skills and processes, then identify the best combination of platform services to help you achieve your digital transformation goals faster. Make open source components a linchpin of your platforms strategy to ensure you get the benefits of participating in the active, innovative open source container, orchestration, and operating system ecosystems.



**Don't limit container efforts to just for dev and test: Container use is now widespread.** Now that more than half of developers and IT leaders consider themselves highly skilled with containers, the exploration phase is over. Production deployments at scale will drive the next phase of container adoption, and companies have started using containers to modernize customer-facing mobile and social apps, data-rich apps, and even core business systems. Take stock of your app portfolio today to identify those apps and workloads best suited for containers.



**Refocus container IT operations on speed and automation.** Containers are best suited today for projects that demand continuous integration and delivery, automated provisioning and orchestration, and elastic scaling. But these cloud-native apps demand cloud-native operations. Look for container platforms that simplify performance and security management, scalability, data and storage management, and day two operations.



**Identify your container-based transformation leaders and start training.** Build a small team responsible for sourcing and operating container platforms. Seed this team with architects, IT operations, and developers, and fund immersive training programs to make sure these new leaders learn together, fail together, and prove together the value of the container platforms you use.

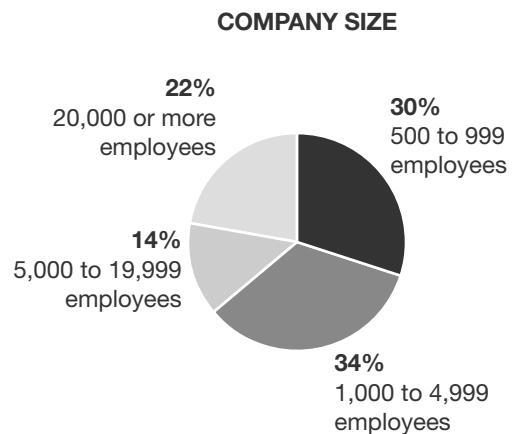
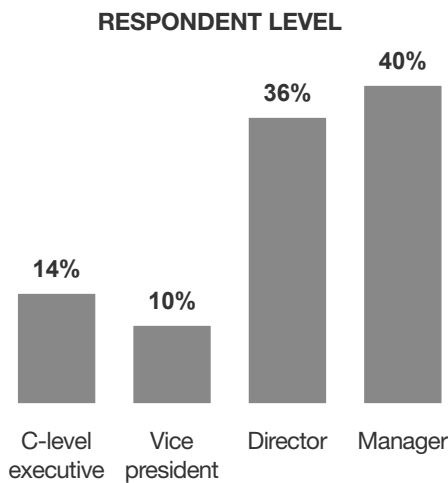
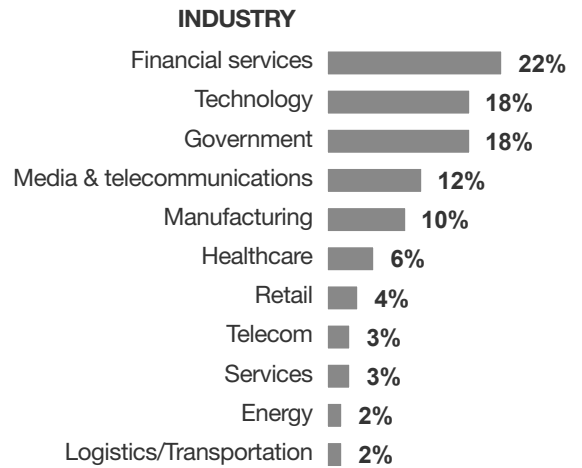
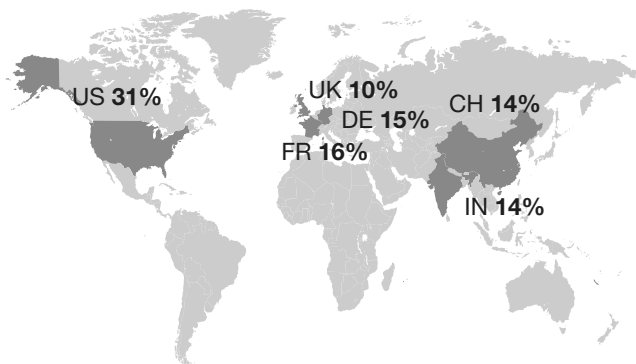


**Consider whether you need to build your platform, and where.** Today's container platforms offer packaged stacks of development tools, container runtimes, orchestration, monitoring, and operations tools. Do you have the bandwidth and skills to build your own platform from scratch? Few companies do. Explore the container platform landscape to find the best balance of integration and flexibility to meet your needs, and plan to start on-premises if your primary goal is faster software delivery.

# Appendix A: Methodology

In this study, Forrester interviewed five respondents and conducted an online survey of 200 organizations in the US, France, Germany, the UK, India, and China from a variety of industries to evaluate container adoption and usage. Survey participants included decision makers in a variety of IT and application development roles. Questions provided to the participants asked about their container usage, challenges, and expected or experienced benefits. Respondents were offered an incentive as a thank you for time spent on the survey. The study began in August 2017 and was completed in November 2017.

# Appendix B: Demographics/Data



Base: 200 IT/development decision makers

Source: A commissioned study conducted by Forrester Consulting on behalf of Red Hat, November 2017

## Appendix C: Endnotes

<sup>1</sup> Source: “Scoring Our 2017 Cloud Predictions,” Forrester Research, Inc., January 4, 2018.

<sup>2</sup> Source: “Open Source Powers Enterprise Digital Transformation,” Forrester Research, Inc., April 25, 2016.

<sup>3</sup> Source: “Designing Microservice Apps For Containers And Cloud Platforms,” Forrester Research, Inc., July 27, 2017.

<sup>4</sup> Source: “Ten Basic Steps To Secure Software Containers,” Forrester Research, Inc., April 14, 2017.

<sup>5</sup> Source: “Optimize Your Cloud Organization For Speed And Customer Delight,” Forrester Research, Inc., January 24, 2017.

<sup>6</sup> Source: “DevOps Will Drive Open Source APM,” Forrester Research, Inc., February 16, 2017.