Containers: Real Adoption And Use Cases In 2017

Application Container Usage Is On the Rise As Companies Seek To Improve Efficiency And Agility

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Executive Summary

Given the efficiencies and ease-of-use, interest in containers is extremely high.

However, critics condemn its fundamental security architecture and lack of maturity while others believe that its usage is limited to testing and development, non-production workloads.

As excited as forward-looking developers have been to incorporate containers into their application development and deployment strategies, enterprises have been equally conservative in their adoption. Until recently, concerns over security and technology immaturity have mostly relegated containerization to test/dev environments, with very little use in production. Now, in 2017, almost all major cloud providers offer their services in containers, and the container management technology marketplace is exploding. As organizations push to increase their application agility and efficiency, containerization is growing into production environments and facilitating new application transformation efforts.

Containerization is an operating system-level virtualization method that simplifies application deployment and requires fewer resources than virtual machines. Containers bundle applications with the software libraries that they depend on, allowing developers to create "build once, run anywhere" code making applications very portable. Containers do not require a hypervisor, rather they isolate application resources in a small package that can be rapidly scaled dynamically based on usage. Futhermore, containers are very often a foundational component in new "Devops" based application development and delivery processes.

In January 2017, Dell EMC, Intel, and Red Hat commissioned Forrester Consulting to evaluate how enterprises are currently using containers and what challenges and benefits they are experiencing. Forrester tested the hypothesis that containers are being rapidly adopted by the developer community but often limited to test/dev Linux-based workloads. To evaluate this trend, Forrester surveyed 195 manager-level and above IT decision makers at North American and European enterprises that have adopted containers.

KEY FINDINGS

› **Containers are used to modernize existing apps and create new cloud-native ones.** Containers are indeed exploding in popularity, and companies are using them outside of testing and development environments as they gain trust in this rapidly developing technology. Containers are viewed by IT decision makers as critical to cloud, DevOps, and will help solve application portability challenges.

› **Application transformation is still in its infancy.** Despite their efforts to increase agility and effi ciency, many companies are slow to re their monolithic legacy applications to make them more modular. Adoption of microservices is lagging compared with adoption of containers, and this may impede the realization of the benefi ts of container adoption. While expressing concerns about security of containers today, as decision makers gain experience and trust in the security of containerized microservices a significant uplift in the deployment of mission-critical applications in anticipated.

› **Organizations are realizing the benefits of containers.** Those that have adopted containers were driven to do so with expectations of secure, fast, and portable infrastructure that increases developerefficiency and creates a consistent deployment process. These companies report that they have actually experienced each of these benefits and more.

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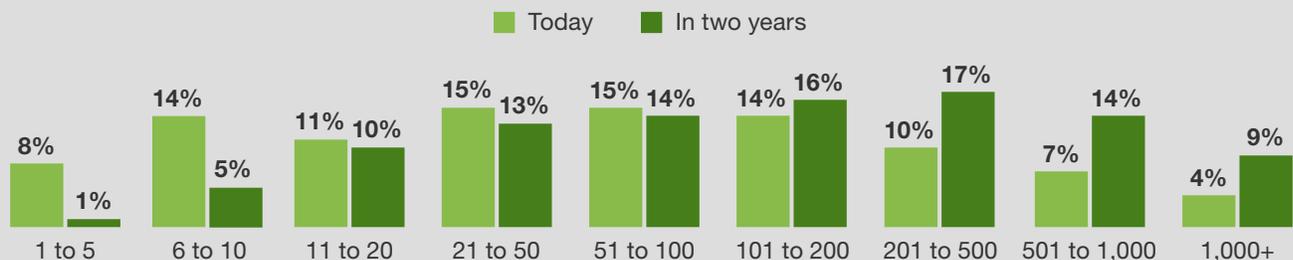# Containers Are Breaking Out Of The Test/Dev Environment

Container use started as a way for developers to quickly code and test new applications while minimizing (or at least delaying) any focus on infrastructure configuration. But due to technology limitations and security concerns, these testing and development environments are where container usage ends for many companies. As containers gain popularity and the marketplace of management tools grows, more enterprises are expanding their use of containers to full production applications, both in the form of net-new cloud-native apps and modernized legacy software. Our study found that:

› **Container volume is growing.** Containers have exploded in popularity as organizations recognize benefits to both time and resource efficiency. Sixty-three percent of enterprises using containers have over 100 deployed, and 82% expect to have more than 100 containers deployed within the next two years. In a similar vein, respondents reported that they now have an average of 165 different containerized applications, a number that they project will rise by 80% in the next two years (see Figure 1).

Figure 1

"How many containerized applications are you aware of that your enterprise has deployed/will deploy . . .?"

■ Today ■ In two years

	1 to 5	6 to 10	11 to 20	21 to 50	51 to 100	101 to 200	201 to 500	501 to 1,000	1,000+
Today	8%	14%	11%	15%	15%	14%	10%	7%	4%
In two years	1%	5%	10%	13%	14%	16%	17%	14%	9%

Organizations expect that their number of containerized applications will rise by **80%** in the next two years

Base: 195 US and European manager+ IT decision makers responsible for public/private cloud decisions at enterprises that have adopted containers
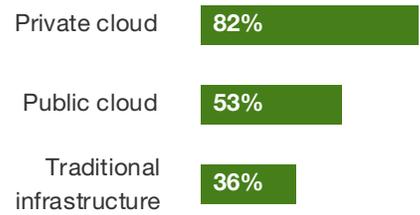(percentages may not total 100 because of rounding)
Source: A commissioned study conducted by Forrester Consulting on behalf of Dell EMC, Intel, and Red Hat, January 2017

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› **Container environments are not islands in the data center.**
Containers aren't exclusively being used in a single-cloud deployment
type. In fact, there's adoption cross-platform, with respondents
claiming container usage across private (82%), public (53%),
and traditional on-premises infrastructure (36%) (see Figure 2).
Respondents also dispel the belief that enterprises are choosing
between containers and private platform-as-a-service (PaaS)
offerings. Over half provision containers on private PaaS. Specifically,
62% of container users leverage private PaaS today. Of those that
do use private PaaS, over three-fourths (78%) are provisioning
containers to that environment today, with another 14% planning to
do so. In PaaS environments, containers are supported with pre-
assembled enterprise capabilities that are less customizable but
relatively simpler to set up and consume, thus easing the learning
curve.

› **Containers are used for an expanding variety of applications.** As
more organizations gain trust in containers, they are extending their
use beyond development and testing environments. Forty-seven
percent of respondents are using containers in production — and
those that do are rapidly increasing their number of deployments for
various application types (see Figure 3). A lot of this early production
usage serves net-new workloads, with 44% using containers for
net mobility applications and cloud-native applications. However,
this is not the limit to their production usage. Many enterprises also
use containers for traditional workloads like collaboration software,
enterprise content management (ECM), and enterprise resource
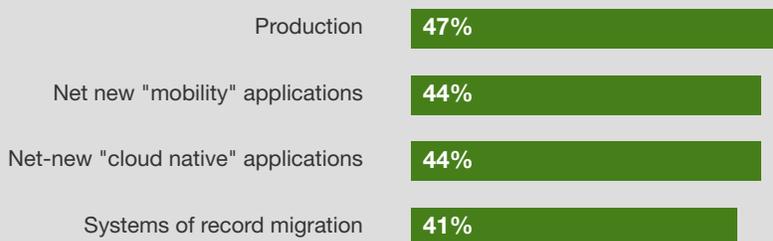planning (ERP).

Figure 2

**"On which types of platforms do
you use containers today?"**
(Select all that apply)

Private cloud	82%
Public cloud	53%
Traditional infrastructure	36%

Base: 195 US and European manager+ IT
decision makers responsible for
public/private cloud decisions at
enterprises that have adopted containers
Source: A commissioned study conducted
by Forrester Consulting on behalf of Dell
EMC, Intel, and Red Hat, January 2017

Figure 3

"For which of the following do you use containers today?"

Production	47%
Net new "mobility" applications	44%
Net-new "cloud native" applications	44%
Systems of record migration	41%

Base: 195 US and European manager+ IT decision makers responsible for
public/private cloud decisions at enterprises that have adopted containers
(percentages reflect only respondents who have deployed each type of application)
Source: A commissioned study conducted by Forrester Consulting on behalf of Dell
EMC, Intel, and Red Hat, January 2017
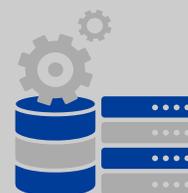
Containers are used to
deploy a range of new
and traditional
application types, with
the most popular
including internal web
business apps,
back-end management
tools, collaboration
software, ECM, and
ERP.

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› **Containers facilitate application modernization.** Older, core applications tend to be monolithic and interdependent on layers of architecture and do not fit with a DevOps strategy that values quick, agile iterations enabled by a microservice-based architecture. In order to build in new capabilities and keep their core applications technologically relevant, organizations are undergoing application modernization. Fifty-eight percent of organizations surveyed claimed that they have at least started the process of modernizing their applications, which largely includes increasing modularity and improving APIs (see Figure 5).[1] The ability to break down applications into containerized microservices greatly improves agility and implementation flexibility.

Surprisingly, fewer than half (48%) of our respondents said that they use microservices today (see Figure 4), which is a key indicator that organizations are still tentative about dramatically transforming their applications despite their stated priorities. This may also indicate that those surveyed may not yet understand the significance of the transformations in applications that are currently taking place.
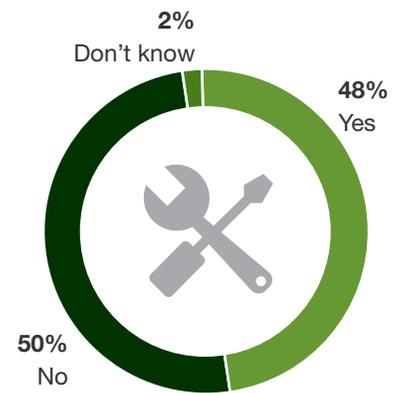
Figure 5

"What are your organization's plans when it comes to modernizing its existing applications?"
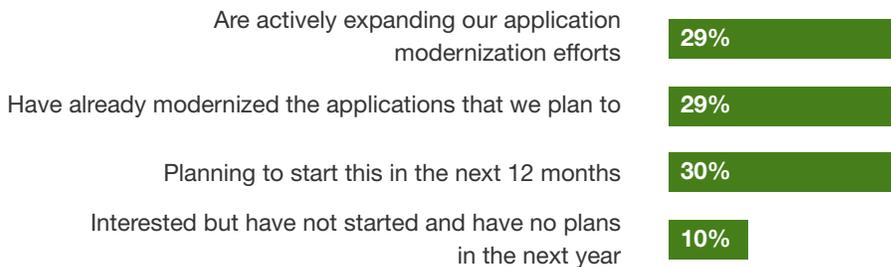
Are actively expanding our application modernization efforts	29%
Have already modernized the applications that we plan to	29%
Planning to start this in the next 12 months	30%
Interested but have not started and have no plans in the next year	10%

Organizations Are Modernizing Applications — Or Are They?

Evolving container technologies gained significant momentum over the past two to three years, earning popularity through adoption by many well-known cloud providers.[2] Similar to the past adoption curve of virtualization, the majority of enterprises have been conservative, allowing the container technology marketplace to develop. Now that every major public and private cloud platform has integrated container support capabilities already in place or on their road map, infrastructure and operations (I&O) teams will start to be more aggressive in their approaches to both containerization and application transformation. To do so, they must tackle the biggest container challenges, which are two-fold:

› **Security remains a key concern.** The biggest issue with a "build once, run everywhere" application is the pervasive concern that an infected kernel can affect many containers, as opposed to virtual machines, which are fully isolated from each other. Security is always an expected concern with developing technologies, and it unsurprisingly ranks as the biggest roadblock to container deployment, followed by data management concerns (see Figure 6). Cloud platform providers are at work addressing this challenge as they improve their overall security features, including cloud workload security management and bring-your-own-keys (BYOK) encryption schemes. Cloud security gateways (CSGs) will also come of age to better monitor external traffic for public cloud container usage.[3] I&O teams are taking precautions such as backing up container data (44%), performing regular security audits (43%), and restricting file permissions (39%). Our study found that many organizations sacrifice efficiency for security by running containers on top of VMs. Fifty-four percent of IT pros use hypervisors as part of their current container management strategy, presumably to provide improved security for containers via isolation provided by VMs.

54% of container users provision containers on top of hypervisors today.

Figure 6

"What were the biggest roadblocks/challenges that you experienced when deploying container technology?"
(Select all that apply)

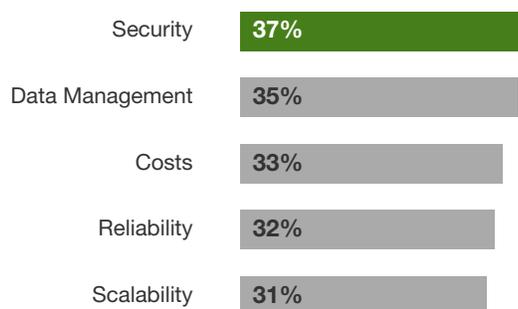|	
Security	37%
Data Management	35%
Costs	33%
Reliability	32%
Scalability	31%

Base: 195 US and European manager+ IT decision makers responsible for public/private cloud decisions at enterprises that have adopted containers

Source: A commissioned study conducted by Forrester Consulting on behalf of Dell EMC, Intel, and Red Hat, January 2017

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› **Microservices are still in the "cool concept" category rather than an organizational imperative.** Microservices and containers should go hand in hand, yet many microservices strategies lag behind. Only 48% of organizations using containers also leverage a microservices-based architecture. Forrester measured sentiment across containers and microservices to see if respondents felt differently about one versus the other. Our sentiment analysis found that while most respondents perceive many virtues of microservices — citing that they are a key open source technology (23%), really easy to use (22%) and the hypervisor replacement for new workloads (23%) — 24% still consider microservices to be "a cool concept, but future unknown" (see Figure 7). These results are highly alarming given that a microservices architecture — which involves breaking down bulky applications into packaged chunks — is a critical component of moving containers to production environments. The 24% of decision makers who foresee a brighter future and more positive outlook for containers than they do microservices-based architectures may be further behind in their application modernization efforts than they readily admit.

Figure 7

"Which sentiments describe your organization's stance on microservices?" (Select all that apply)

Cool concept, but future unknown	**24%**
A key open source technology to use	**23%**
Will solve application portability challenges	**23%**
The hypervisor replacement for our new workloads	**23%**
A way to minimize software licensing fees	**22%**
Really easy to use	**22%**
A key component of our DevOps strategy	**19%**

24% still consider microservices to be "a cool concept, but future unknown

Base: 195 US and European manager+ IT decision makers responsible for public/private cloud decisions at enterprises that have adopted containers
Source: A commissioned study conducted by Forrester Consulting on behalf of Dell EMC, Intel, and Red Hat, January 2017

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Containerization Will Grow As Organizations Seek To Improve Efficiency And Scalability

As speed and efficiency both become increasingly paramount, the time for being cautious about containers is coming to an end. Containers offer the potential to help contain hypervisor licensing costs. At a fraction of the size of a VM and with libraries and dependencies bundled in, containers have too much to offer both in terms of simplicity for developers and higher server efficiency and scalability for technology managers. Our study found that IT departments are already getting real results that align to the promised benefits of containerization

› **Scalability, developer efficiency, and application modernization.** Despite security concerns by some, others cited security as a key driver of containerization, along with other well-known benefits such as lower costs and increased speed, portability, and developer efficiency. When we inquired about the extent to which organizations have actually experienced those benefits, we found that 75% have moderately or significantly experienced increased speed, 67% increased security, 73% developed a more consistent deployment process, and 66% increased developer efficiency, among other benefits (see Figure 8). The contradiction of security as both a top concern and a stated benefit may be that containers are viewed as less isolated than virtual machines but more isolated than running applications on their own. Decision makers use various tactics to maximize the security of their containerized applications, including utilizing name spaces (which limit the ability for malware to identify other containers), running containers on top of hypervisors, and utilizing automation to keep their kernels and host systems up to date with the latest security packages.

› **Support for critical DevOps, cloud, and agile software development initiatives.** Modern service delivery entails using technology to engage customers, and to achieve this, organizations must break down silos to connect developers with business stakeholders. DevOps, cloud, and agile software development are all key IT initiatives designed to reduce friction and increase speed, portability, and communication between developers, operations teams, and other parts of the business. Our sentiment analysis showed that this is where containers really shine. The most popular stance on containers among our respondents is that they are a key component of their company's DevOps strategy, in addition to being tightly tied to their private cloud story and a key component of their move to Agile (see Figure 9).

› **Reduced costs.** Containers are a full magnitude smaller than full virtual machines, which contain full guest operating systems and are therefore usually three to five times as large. Furthermore, they support iterative development approaches, as they are quicker to test and do not require infrastructure configuration. Forrester has found instances of organizations with heavy container use that have reduced their number of servers by as much as 80% and that anticipate 70% savings on dev/test costs and upwards of 40% on savings in production.[4]

Automated self-service is a high or critical priority for **84% of organizations.**

Figure 8

"To what extent have you actually experienced the following benefits from your adoption of container technology?"

■ Significantly ■ Moderately ■ Slightly ■ Not at all

	Significantly	Moderately	Slightly	Not at all
Increased speed	32%	43%	16%	7%
Security	33%	34%	25%	6%
Consistent deployment process	24%	49%	20%	5%
Increased developer efficiency	24%	42%	28%	5%
Increased portability	23%	46%	23%	6%
Simplified packaging	23%	43%	26%	6%
Enabled applications to run on multiple cloud platforms	23%	45%	22%	6%
Reduced costs outside hypervisor costs	21%	41%	31%	6%
Eliminated future hypervisor licensing costs	24%	37%	26%	9%
Eliminated existing hypervisor licensing costs	20%	41%	29%	8%
Reduced vendor lock-in	19%	41%	29%	8%
Supported microservices architectures	19%	41%	27%	9%

The contradiction of security as both a top concern and a stated benefit may be that containers are viewed as less isolated than virtual machines but more isolated than running applications on their own.

Base: 195 US and European manager+ IT decision makers responsible for public/private cloud decisions at enterprises that have adopted containers
Source: A commissioned study conducted by Forrester Consulting on behalf of Dell EMC, Intel, and Red Hat, January 2017

Figure 9

Which sentiments describe your organization's stance on containers?" (Select up to five sentiments)

A key component of our DevOps strategy	32%
Tightly tied to our private cloud story	29%
A key component of our move to Agile	24%
Will solve application portability challenges	24%
Tightly tied to our public cloud story	24%
A way to minimize software licensing fees	22%
The hypervisor replacement for our existing workloads	22%

Base: 195 US and European manager+ IT decision makers responsible for public/private cloud decisions at enterprises that have adopted containers
Source: A commissioned study conducted by Forrester Consulting on behalf of Dell EMC, Intel, and Red Hat, January 2017

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Key Recommendations

Enterprises across industries recognize containers as a solution to help meet the ever-increasing demand for rapid application development. In order to deliver against your DevOps and application modernization agenda, you must break applications into smaller, more workable pieces that maximize speed, agility, and efficiency.

Forester's in-depth survey of IT decision makers using containers yielded several important recommendations:

Accelerate your microservices strategy. Although container users claim to be modernizing applications, the apparent lack of interest and adoption of microservices architectures with containers is problematic. This indicates that much of current container usage fails to fully embrace and take advantage of high-scaling environments typical of containers and cloud services. It is critical to accelerate your adoption of microservices with containers if you are to realize the full value of your containerization efforts.

Start using containers in production. With organizations delivering ever higher volumes and varieties of business- and customer-facing applications, DevOps initiatives are paramount. The container technology marketplace has matured to a point where the majority of organizations now feel confident using containers in production environments, and the rest need to follow suit. Those still lagging behind will ultimately find their businesses at a competitive disadvantage as their peers capitalize on their new development capabilities.
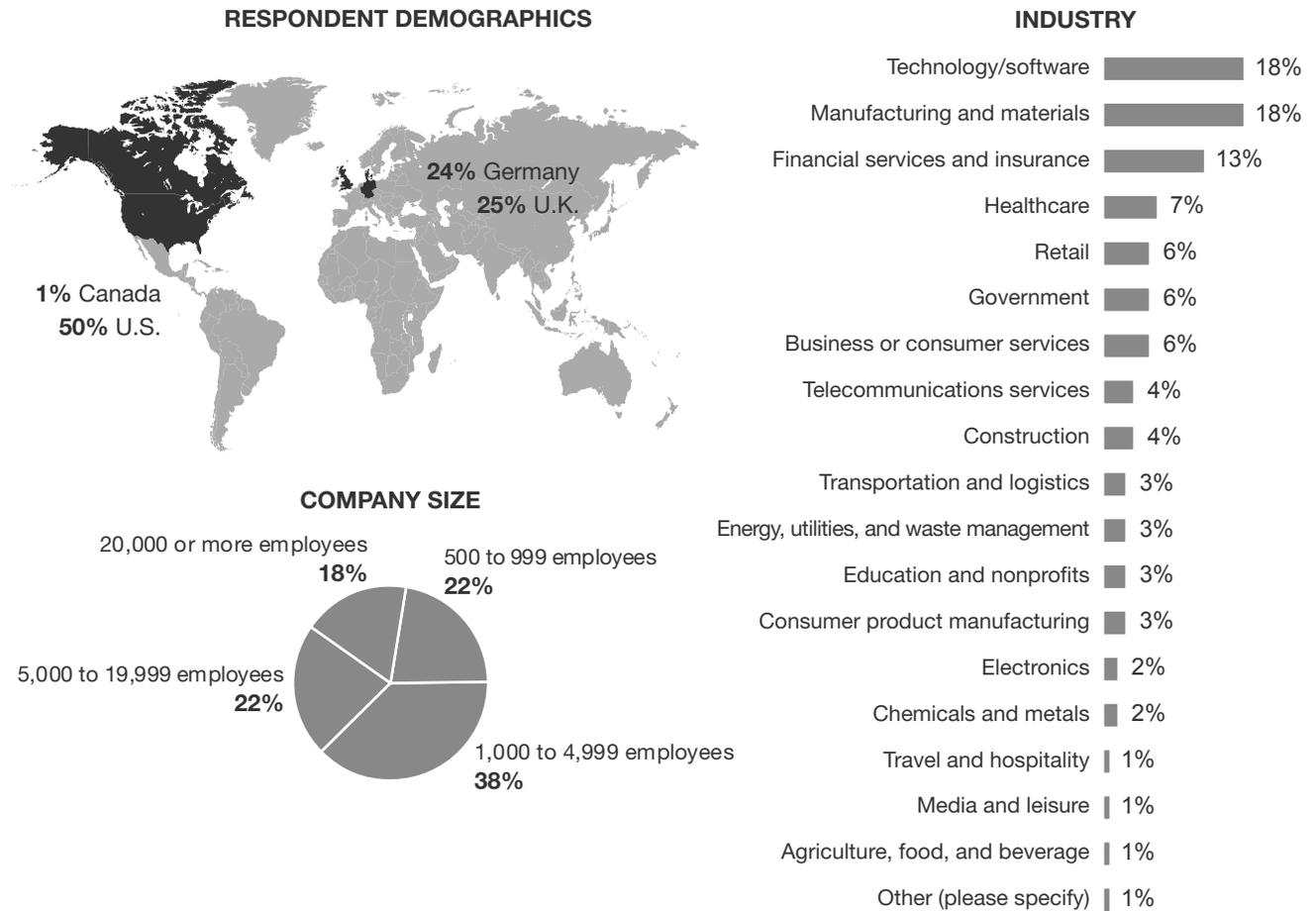
Build an application modernization road map. While net-new applications are a no-brainer with containers, core systems are a different beast. Retooling and migrating an application is an expensive proposition and may not provide obvious value when it comes to systems-of-record apps that do not require frequent updates. Forrester recommends taking an app-by-app approach, beginning your modernization efforts with apps that are easier to work with and that will provide the most value. When assessing each app for containerization (and ultimately for cloud migration), consider the value versus cost, the migration approach, and the right team (internal or outsourced) to get the job done.[5]

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Appendix A: Methodology

In this study, Forrester conducted an online survey of 195 organizations in the US, Canada, Germany, and the UK to evaluate their adoption rates and attitudes toward containers. Survey participants included manager-level and above IT decision makers with responsibility for public and/or private cloud decisions at 500-plus-employee enterprises that have adopted containers. Respondents were offered a small incentive as a thank you for time spent on the survey. The study was conducted in January 2017.

Appendix B: Demographics/Data

RESPONDENT DEMOGRAPHICS

24% Germany
25% U.K.
1% Canada
50% U.S.

COMPANY SIZE

20,000 or more employees
18%

500 to 999 employees
22%

5,000 to 19,999 employees
22%

1,000 to 4,999 employees
38%

INDUSTRY

Technology/software	18%
Manufacturing and materials	18%
Financial services and insurance	13%
Healthcare	7%
Retail	6%
Government	6%
Business or consumer services	6%
Telecommunications services	4%
Construction	4%
Transportation and logistics	3%
Energy, utilities, and waste management	3%
Education and nonprofits	3%
Consumer product manufacturing	3%
Electronics	2%
Chemicals and metals	2%
Travel and hospitality	1%
Media and leisure	1%
Agriculture, food, and beverage	1%
Other (please specify)	1%

Appendix C: Supplemental Material

RELATED FORRESTER RESEARCH

"Predictions 2017: Customer-Obsessed Enterprises Launch Cloud's Second Decade," Forrester Research, Inc., November 2, 2016

"Brief: Why The CIO Must Care About Containers," Forrester Research, Inc., May 10, 2016

"Application Modernization, Service By Microservice," Forrester Research, Inc., November 20, 2015

"Brief: Why Docker Is All The Rage," Forrester Research, Inc., October 21, 2014

"Microservices Have An Important Role In The Future Of Solution Architecture," Forrester Research, Inc., July 16, 2015

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Appendix D: Endnotes

[1] Source: "Application Modernization, Service By Microservice," Forrester Research, Inc., November 20, 2015.

[2] Source: "Brief: Why Docker Is All The Rage," Forrester Research, Inc., October 21, 2014.

[3] Source: "Predictions 2017: Customer-Obsessed Enterprises Launch Cloud's Second Decade," Forrester Research, Inc., November 2, 2016.

[4] Source: "Brief: Why The CIO Must Care About Containers," Forrester Research, Inc., May 10, 2016.

[5] Source: "Your Three-Step Guide To Planning Cloud Migration," Forrester Research, Inc., May 11, 2016.

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