Containers in the enterprise
Rapid enterprise adoption continues

Results from research conducted in 2020
by IBM Market Development & Insights
ABOUT THE RESEARCH

During March 2020, the IBM Market Development & Insights team conducted multipart outreach to individuals in leading IT and development roles across North America. Through hundreds of telephone interviews and responses to a blinded, in-depth online survey, current users and nonusers were asked about their initial expectations and real-world experiences with containers and container orchestration solutions. The research offers a fresh perspective on the opportunities, challenges and lessons learned from implementing containerized applications.
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Why containerization is taking off

The idea for containerization of applications has been around for decades, but recently, adoption has been steadily gaining momentum as evolving container technology intersects the growing imperative for organizations to modernize their operations and infrastructure. Increasingly, they’re moving to cloud-native development and hybrid, multicloud computing environments for greater flexibility and speed to market.

Applications that are built as microservices and deployed in containers orchestrated using technologies such as Kubernetes offer that critical flexibility and speed. The portability enabled by containers—packaging code, configuration files, libraries and any dependencies into a lightweight, platform-agnostic executable software bundle—is ideal for these modern environments.

MORE RESEARCH: BIGGER PICTURE, BIGGER BENEFITS

Containers and container orchestration are key technologies in a modern hybrid multicloud infrastructure that is already delivering outsized value for customers compared to a single-cloud, single vendor approach. Read the report.
Containers are becoming a business imperative

Survey results overview
Today, around half of all businesses have containerized at least a portion of their applications. In this research, users share their experiences, offering insight into how their own companies are employing containers and container orchestration solutions successfully, and what they plan for the near future. They discuss where their challenges lie and how they can be overcome. In addition, current nonusers explain their concerns with container technologies, detailing their remaining barriers to adoption.

What emerges is that containerization is considered a highly effective approach to application development and deployment for many types of workloads. More than ever, it’s an approach whose time has come.

Among current users of containers:
- More than 75 percent report improved application quality, faster responses to changes in the marketplace and faster time to market.
- 61 percent use a container orchestration solution—and another 30 percent plan to.
- Open source distributions and hosted managed solutions are the most commonly used orchestration platforms by far.
How containers are being used

An important strategic tool

Although survey respondents reported diverse current use cases for containers, most fell into three basic areas: migrating current applications to the cloud; updating existing applications; and developing new, industry-specific applications. Regardless of the application, users recognize the value of containerizing applications, including third-party applications.

Respondents rated the following as important or very important:

- **Containerization of internal applications**: 79%
- **Containerization of third-party applications**: 76%

See Figure 1 for complete data.

Developers and developer executives in particular, as compared to IT executives, found containerization to be very important.

See Figure 1 for complete data.
How many containers are being used per application?

Multicontainer applications are commonplace, with the number of containers typically used per application reported as:

- **11–100+**: 31%
- **2–10**: 57%
- **1**: 11%

Large enterprises showed greater propensity for using more containers in a typical application as compared to midmarket businesses. The percentage of organizations using 11 or more containers in a typical application were reported to be:

- **Large enterprises**: 37%
- **Midmarket businesses**: 20%

See Figure 2 for complete data.
Near-future plans
A significant number of new applications have been built using containers in the past two years by current users—who also plan to containerize a large portion of their existing applications over the years. Only a third of nonusers have the same plan for their existing applications.

61% used containers for half or more of their new application in the past two years.

64% will containerize half or more of their existing applications.

33% will containerize half or more of their existing applications.

Both current users and those planning to adopt a containerization approach cite key benefits they expect from the approach:

- **Portability and reliability** as applications are shifted between computing environments
- **Efficiency and time to market** in building, deploying and scaling applications
- **Simplifying development operations**, including enabling scalability and streamlining quality assurance

See Figure 3 for complete data.
Containers are delivering real-world business benefits

Although containerization may not be the best approach for every application or workload, organizations that containerize do experience real benefits across industries and geographies.

78% Improved application quality/reduced defects
78% Faster response to changes in our market segment
76% Faster time to market
74% Improved employee productivity
74% Higher customer satisfaction
73% Better security of company/customer data
73% Reduced application downtime
72% Better governance and risk management
70% Greater levels of innovation

See Figure 4 for complete data.

KEY TAKEAWAYS

IT executives and application development professionals who currently use a containerization approach express confidence that containers provide a range of quantifiable business benefits.
Identifying challenges

Adopting a containerization approach is delivering powerful, real-world benefits to users, but it’s not without challenges. We asked current users and those who expect their organization to adopt containerization within the next 12 months about barriers to adoption or expansion of containerization.

**KEY TAKEAWAYS**

Many of the challenges—both real and perceived—revolve around the need for new talent acquisition and thoughtfully implemented container orchestration technologies.
Container orchestration solutions

Operating hundreds or thousands of containers across a distributed system can quickly become untenable without an orchestration solution that automates and schedules tasks such as deployment, management, scaling and networking throughout the application lifecycle.

Container orchestration platforms such as Kubernetes, an open source project that has become one of today’s most popular platforms, handle these essential responsibilities. The research shows that, although containers are well understood by most respondents, far fewer felt confident that they understood fully what a container management or orchestration platform is.

Interestingly, a greater percentage of respondents reported being highly familiar with orchestration platforms when presented with brand names:

- 56% are highly familiar with containers.
- 26% are highly familiar with container orchestration platforms.
- 31% are highly familiar with Kubernetes.
- 36% are highly familiar with Red Hat® OpenShift®.

See Figure 6 for complete data.

KEY TAKEAWAYS

With only around a quarter of respondents expressing a high degree of familiarity, there is confusion in the marketplace about the role and function of orchestration platforms.
Adoption by solution type

Although developer and IT professionals may not have great familiarity with container orchestration platforms, they are in use in organizations that have adopted a containerization approach.

See Figure 7 for complete data.

Job role plays a part:

70% of developers and developer executives report using an orchestration solution.

48% of IT professionals say the same.

See Figure 7 for complete data.

As does the size of the organization:

66% of large enterprises report using an orchestration solution.

51% of midsize businesses say the same.

See Figure 7 for complete data.
Several types of container management or orchestration solution strategies are popular. More than one type of approach may be used by the organization:

- Hosted, completely managed: 70%
- Open source distribution built internally: 63%
- Vendor distribution with value-added software: 38%
- Vendor distribution without value-added software: 25%
- Unsure or don't know: 1%

See Figure 7 for complete data.

Orchestration isn't always needed
More than half of respondents report that they don't always use container orchestration platforms for their containerized applications. Asked how often they used containers without orchestration, here's what they said:

- Almost always use without: 8%
- Use without most of the time: 12%
- Occasionally use without: 34%
- Rarely use without: 31%
- Never use without: 15%

See Figure 8 for complete data.
There were a number of reasons given for not using an orchestration platform for certain containerized applications, largely centering around issues of scalability and complexity. Respondents were asked when they were most likely to use containers without orchestration (multiple answers possible):

- 36%: Scalability is not an issue.
- 33%: The application will not be deployed in multiple environments.
- 30%: The application’s resource utilization is relatively small.

See Figure 8 for complete data.

**KEY TAKEAWAYS**

- Using open source code to “build our own” was the most common response when users were asked about the orchestration platform they were employing.
- Users who adopted external orchestration solutions named “hosted, completely managed solutions” as the most popular approach.
Container orchestration solutions are delivering business value

Most users of container orchestration solutions are experiencing tangible, quantifiable benefits. Respondents called out nearly 20 benefits as important or highly important (4 or 5 on the 1–5 scale), with most centering around issues of security, productivity, portability, cost and reliability. The top 10 reasons given were:

- **86%** Provides robust security
- **85%** Increases productivity
- **81%** Is easily portable and vendor agnostic
- **81%** Minimizes human error
- **81%** Delivers cost savings by optimizing resource usage
- **80%** Reduces the risk of application downtime with rolling deployments and automated rollbacks
- **79%** Auto-scales to fit the needs of particular applications, incoming traffic and load
- **79%** Reduces the risk of downtime through self-monitoring/self-healing capabilities
- **79%** Supports hybrid cloud environments
- **78%** Provides a consistent UI and experience across clouds in a multicloud environment

See Figure 9 for complete data.
Barriers to the usage of container orchestration solutions

Several barriers to adoption or increased usage of container orchestration solutions were identified. However, in most cases, fewer than half of the respondents reported them to be a significant issue. We asked those surveyed whether they agreed with the following statements:

- It can be difficult to assess, enhance and manage container security. 42%
- It’s overkill for most of our needs. 44%
- Adoption is cumbersome and requires too much time and effort. 45%
- They are very complex and can reduce productivity and release cycles. 46%
- Managed orchestrators are more expensive than bring your own (BYO). 47%
- Third-party orchestrators increase risk of vendor lock-in. 52%
- Finding talent is difficult and expensive. 58%

See Figure 10 for complete data.

**KEY TAKEAWAYS**

- There is an apparent disconnect between the business benefits noted by current users of container orchestration solutions and the barriers to adoption. As a reminder, the top three business benefits identified were:
  - 86% Provides robust security
  - 85% Increases productivity
  - 81% Is easily portable and vendor agnostic

- Security, productivity and vendor lock-in remain concerns for a sizable percentage of respondents, indicating that more education around overcoming these perceived barriers may be required.

- Interestingly, cost was reported to be among the lowest barriers to adoption, with only 34 percent of respondents unsure whether the cost of deploying a container orchestration solution is worth it.
Your future will be containerized

Containers and container orchestration solutions are highly regarded by those who use them. Most respondents see them as viable long-term approaches, especially as more organizations implement a hybrid or multicloud strategy.

We asked users whether the performance of containers and orchestration solutions matched their expectations. Here’s what they said:

<table>
<thead>
<tr>
<th>CONTAINERS</th>
<th>CONTAINER MANAGEMENT/ ORCHESTRATION PLATFORMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significantly exceeded</td>
<td>31%</td>
</tr>
<tr>
<td>expectations</td>
<td></td>
</tr>
<tr>
<td>Somewhat exceeded expectations</td>
<td>31%</td>
</tr>
<tr>
<td>Met expectations</td>
<td>35%</td>
</tr>
<tr>
<td>Somewhat failed expectations</td>
<td>3%</td>
</tr>
<tr>
<td>Significantly failed expectations</td>
<td>0%</td>
</tr>
</tbody>
</table>

Not surprisingly, given these results, the future of containers looks bright for the long term. Here’s what users said:

<table>
<thead>
<tr>
<th>CONTAINERS</th>
<th>CONTAINER ORCHESTRATION SOLUTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very likely a long-term approach</td>
<td>27%</td>
</tr>
<tr>
<td>Likely a long-term approach</td>
<td>40%</td>
</tr>
<tr>
<td>Unsure</td>
<td>29%</td>
</tr>
<tr>
<td>Likely a temporary fad</td>
<td>3%</td>
</tr>
<tr>
<td>Very likely a temporary fad</td>
<td>1%</td>
</tr>
</tbody>
</table>
Role plays a part in influencing perspective as well, with more developers and developer executives than IT executives agreeing that containers offer a long-term approach:

**DEVELOPERS AND DEVELOPER EXECUTIVES**

- **CONTAINER ORCHESTRATION PLATFORMS**
  - 32% Very likely a long-term approach

- **CONTAINERS**
  - 39% Very likely a long-term approach

**IT EXECUTIVES**

- **CONTAINER ORCHESTRATION PLATFORMS**
  - 21% Very likely a long-term approach

- **CONTAINERS**
  - 22% Very likely a long-term approach
The path ahead

The research confirms that containers and container orchestration solutions have never been more relevant. Users are seeing real-world strategic and operational benefits—advantages that enable them to deliver applications faster and more reliably, with better quality and greater efficiency.

Perceived barriers to adoption remain, but those who adopted containerization have largely found that the barriers, while real, are often not as concerning as they may have appeared. Choosing the right container technologies and the right container orchestration platform can go a long way toward breaking down these barriers, enabling the organization to bring new applications to the marketplace faster, migrate legacy applications for the modern computing environment and, ultimately, seize opportunities to drive revenue.

Containers are key components of an open hybrid cloud strategy that lets you build and manage workloads across all environments. Learn more.

To get started right away with containers, sign up for an IBM Cloud account.
APPENDIX
Importance that applications are containerized

Containerization is more important for dev/dev exec than IT:
- **Internal apps**: Dev/dev exec (59%) vs. IT (40%)
- **Third-party apps**: Dev/dev exec (45%) vs. IT (35%)

*Figure 1*
Number of containers in containerized applications

- **# in a typical app**
  - 1 Container: 11%
  - 2–10 Containers: 57%
  - 11–49 Containers: 28%
  - 50–99 Containers: 2%
  - 100+ Containers: 1%

- **Maximum # in an app to date**
  - 1 Container: 4%
  - 2–10 Containers: 34%
  - 11–49 Containers: 37%
  - 50–99 Containers: 22%
  - 100+ Containers: 2%

*Figure 2*
Percentage of applications using containers

- **Current container users**
  - New apps built with containers in the past two years:
    - Less than 25%
    - 25% to 49%
    - 50% to 74%
    - 75% or more
    - Mean: 52%
  - Existing apps to be put in containers in the next two years:
    - Less than 25%
    - 25% to 49%
    - 50% to 74%
    - 75% or more
    - Mean: 56%

- **Nonusers**
  - Existing apps to be put in containers in the next two years:
    - Less than 25%
    - 25% to 49%
    - 50% to 74%
    - 75% or more
    - Mean: 36%

*Figure 3*
Business benefits experienced from adopting containers
(% rating 4 or 5 in degree of experiencing benefit on 1–5 scale)

<table>
<thead>
<tr>
<th>Benefit</th>
<th>2017 (%)</th>
<th>Increase since 2017 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved app quality/reduced defects</td>
<td>51%</td>
<td>+28% 78%</td>
</tr>
<tr>
<td>Faster response to changes in our market segment</td>
<td>49%</td>
<td>+29% 78%</td>
</tr>
<tr>
<td>Faster time to market</td>
<td>45%</td>
<td>+31% 76%</td>
</tr>
<tr>
<td>Improved employee productivity</td>
<td>48%</td>
<td>+26% 74%</td>
</tr>
<tr>
<td>Higher customer satisfaction</td>
<td>32%</td>
<td>+41% 74%</td>
</tr>
<tr>
<td>Better security of company/customer data</td>
<td>39%</td>
<td>+34% 73%</td>
</tr>
<tr>
<td>Reduced app downtime</td>
<td>49%</td>
<td>+24% 73%</td>
</tr>
<tr>
<td>Better governance and risk management</td>
<td>42%</td>
<td>+30% 72%</td>
</tr>
<tr>
<td>Greater levels of innovation</td>
<td>48%</td>
<td>+22% 70%</td>
</tr>
<tr>
<td>Greater ability to expand into new market segments</td>
<td>39%</td>
<td>+28% 67%</td>
</tr>
<tr>
<td>Lower costs</td>
<td>37%</td>
<td>+29% 65%</td>
</tr>
<tr>
<td>Higher rates of customer retention/engagement</td>
<td>27%</td>
<td>+36% 63%</td>
</tr>
<tr>
<td>Higher sales/revenues</td>
<td>34%</td>
<td>+27% 60%</td>
</tr>
<tr>
<td>Reduced vendor lock-in</td>
<td>31%</td>
<td>+26% 57%</td>
</tr>
</tbody>
</table>

Figure 4
### Challenges to adoption or expansion of container use

(\% rating 4 or 5 in degree of experiencing benefit on 1–5 scale)

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient internal expertise in container development and management</td>
<td>53%</td>
</tr>
<tr>
<td>They can be complex (i.e., the learning curve for containers is high)</td>
<td>53%</td>
</tr>
<tr>
<td>Challenges in redesigning existing on-premises enterprise applications for containers</td>
<td>50%</td>
</tr>
<tr>
<td>Immaturity of internal, homegrown tools for container development and management</td>
<td>50%</td>
</tr>
<tr>
<td>Uncertainty regarding the time and costs involved in container projects</td>
<td>45%</td>
</tr>
<tr>
<td>Not enough advocates/evangelists in our organization</td>
<td>44%</td>
</tr>
<tr>
<td>No clear way to assess ROI or track benefits concretely</td>
<td>44%</td>
</tr>
<tr>
<td>Difficulty predicting container performance undermining confidence in meeting SLAs</td>
<td>44%</td>
</tr>
<tr>
<td>Difficulty cataloging, curating and managing containers as they proliferate across our environment</td>
<td>43%</td>
</tr>
<tr>
<td>Difficulty managing, sharing and securing data across containers</td>
<td>43%</td>
</tr>
<tr>
<td>Uncertainty about stability and performance of containers developed with open source tools</td>
<td>40%</td>
</tr>
<tr>
<td>Lack of enterprise-grade security capabilities</td>
<td>40%</td>
</tr>
<tr>
<td>Skepticism among senior/influential IT executives</td>
<td>40%</td>
</tr>
<tr>
<td>Skepticism among senior/influential business executives</td>
<td>40%</td>
</tr>
<tr>
<td>Lack of use cases that demonstrate value of containers for our industry/businesses like ours</td>
<td>39%</td>
</tr>
<tr>
<td>We often don’t see a need for containers</td>
<td>37%</td>
</tr>
<tr>
<td>Difficulty moving containerized applications from dev/test into production</td>
<td>34%</td>
</tr>
<tr>
<td>Inability to control relationship between microservices that comprise a container and underlying...</td>
<td>33%</td>
</tr>
<tr>
<td>Difficulty using containers in cloud environments</td>
<td>33%</td>
</tr>
</tbody>
</table>

*Figure 5*
Level of familiarity

![Bar chart showing the level of familiarity for container technology and container management or orchestration solutions.](image)

- **Container technology**
  - 56% familiar
  - 38% moderately familiar
  - 6% little or no familiarity

- **Container management or orchestration solutions**
  - 26% highly familiar
  - 40% moderately familiar
  - 17% little or no familiarity

Familiarity is higher for specific products such as Kubernetes (31% highly familiar) or OpenShift (36%).

*Figure 6*
Use container management/orchestration solution?
(% selecting among container users)

- Yes: 61%
- No, plan to: 32%
- Don’t know - 1%

Devs/dev execs (70%) more likely to report using than IT (48%)
Large enterprises (66%) more likely to use than midmarket (51%)

Type of container orchestration solution used
(% selecting among container users)

- Hosted, completely solutions: 70%
- Open source distribution built internally: 63%
- Vendor distribution with value-added software: 38%
- Vendor distribution without value-added software: 25%
- Not sure/don’t know: 1%

Figure 7
Use of containers without orchestration solution

Almost always use without: 8%
Use without most of the time: 34%
Occasionally use without: 31%
Rarely use without: 15%
Never use without: 15%

Most likely to use without orchestration solution when:

- Scalability is not an issue: 36%
- App not deployed in multiple environments: 33%
- App includes relatively few containers: 33%
- App’s resource utilization is relatively small: 30%
- App has a narrow range of users: 27%
- App will not be deployed in cloud: 26%
- Other: 1%

Figure 8
Benefits motivating container management/orchestration solution use  
(% rating 4 or 5 in importance on 1–5 scale)

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides robust security</td>
<td>86%</td>
</tr>
<tr>
<td>Increases productivity</td>
<td>85%</td>
</tr>
<tr>
<td>Easily portable and vendor agnostic</td>
<td>81%</td>
</tr>
<tr>
<td>Minimizes human error</td>
<td>81%</td>
</tr>
<tr>
<td>Delivers cost savings by optimizing resource usage</td>
<td>81%</td>
</tr>
<tr>
<td>Reduces the risk of app downtime with rolling deployments and automated rollbacks</td>
<td>80%</td>
</tr>
<tr>
<td>Ability to auto-scale to fit the needs of particular apps, incoming traffic and load</td>
<td>79%</td>
</tr>
<tr>
<td>Reduces the risk of app downtime through self-monitoring/self-healing capabilities</td>
<td>79%</td>
</tr>
<tr>
<td>Supports hybrid cloud environments</td>
<td>79%</td>
</tr>
<tr>
<td>Provides a consistent UI and experience across clouds in a multicloud environment</td>
<td>78%</td>
</tr>
<tr>
<td>Provides a control version of our infrastructure</td>
<td>78%</td>
</tr>
<tr>
<td>Supports Kubernetes</td>
<td>78%</td>
</tr>
<tr>
<td>Likely to be a future-proof solution</td>
<td>78%</td>
</tr>
<tr>
<td>Supports Docker containers</td>
<td>77%</td>
</tr>
<tr>
<td>Can run on our on-premises infrastructure</td>
<td>77%</td>
</tr>
<tr>
<td>Creates better collaboration among team members</td>
<td>76%</td>
</tr>
<tr>
<td>Allows us to install our “standard” orchestration stack across environments</td>
<td>76%</td>
</tr>
<tr>
<td>Helps developers write code as microservices</td>
<td>75%</td>
</tr>
<tr>
<td>Is easier to learn and use than other solutions</td>
<td>73%</td>
</tr>
<tr>
<td>Helps to attract talent</td>
<td>64%</td>
</tr>
<tr>
<td>Supports Apache Mesos Containers</td>
<td>52%</td>
</tr>
</tbody>
</table>

Figure 9
Challenges to usage of container orchestration platforms

(\% agreeing)

- Finding talent is difficult and expensive: 58\%
- Third-party orchestrators increase risk of vendor lock-in: 52\%
- Managed orchestrators are more expensive than BYO: 47\%
- Very complex and can reduce productivity and release cycles: 46\%
- Adoption is cumbersome, requires too much time and effort: 45\%
- An overkill for most of our needs: 44\%
- Difficult to assess, enhance or manage container security: 42\%
- No high availability build-in mode by default: 38\%
- The cost to run orchestrators is not worth it: 34\%

Figure 10