About this paper

A Pathfinder paper navigates decision-makers through the issues surrounding a specific technology or business case, explores the business value of adoption, and recommends the range of considerations and concrete next steps in the decision-making process.

About the Author

Jay Lyman
Senior Research Analyst, Cloud Native and DevOps

Jay Lyman is a Senior Research Analyst with the Cloud Native and Applied Infrastructure & DevOps Channels at 451 Research, a part of S&P Global Market Intelligence. He covers infrastructure software, primarily hybrid and multi-cloud environments, management and orchestration, and enterprise use cases that center on the confluence of software development and IT operations known as DevOps. Jay’s analysis encompasses evolving IT operations and software release models, as well as the technology used to create, deploy and support infrastructure and applications in today’s enterprise and service-provider markets. This includes running the semi-annual Voice of the Enterprise: DevOps survey of both IT decision-makers and practitioners. Key areas of research also include cloud native, open source software and enterprise end users.

Prior to joining 451 Research, Jay worked as a journalist for various media firms and publications including CMP Media, LinuxInsider, NewsForge, Time Magazine and the Associated Press.

As a 451 Research analyst, Jay has been a speaker at numerous industry events, including IC3, DevOps Days, LinuxCon and OSCON, covering topics such as cloud computing, DevOps, open source software and enterprise case studies.
Executive Summary

Cloud-native technology and methodology – including containers, Kubernetes and serverless designs – is shaping modern software development and IT operations due to key advantages such as efficiency, security and developer speed. Cloud-native approaches are gaining traction across a range of verticals by supporting modern applications and services wherever they are deployed – whether on-premises or in private cloud, multiple public cloud or edge environments. Nevertheless, cloud native comes with cost and complexity challenges, and organizations must evaluate those when considering new cloud-native approaches.

To take full advantage of cloud native, today’s enterprise organizations must drive efficiency through unified, consistent operations, leverage cloud-native security advantages such as faster updates, and enable developers by abstracting and automating infrastructure management so the focus stays on new features, products and innovation. There is also the challenge of effectively leveraging open-source software, which is broadly supported by a rich community of developers and contributors, but can also be difficult in terms of support, security and meeting industry compliance and regulatory requirements.

Key Findings

- **Cloud-native architectures and operational capabilities such as microservices, autoscaling and API provisioning can help enterprises drive automation, optimization and efficiency.** Containers, microservices, Kubernetes, serverless and other cloud-native approaches are shaping the modern IT operational paradigm, which no longer centers on servers or virtual machines (VMs), but instead on hybrid and multicloud infrastructure strategies required in today’s market.

- **Cloud native is no longer limited to container applications, and enterprises should take advantage of consistently managing VM-based applications with cloud-native platforms and tooling.** A common pattern in the enterprise is to make on-premises and private cloud operations more like the public cloud services for consistency and manageability.

- **Broader cloud-native benefits beyond speed and efficiency – including better user experiences and business outcomes – are enabled by the automation and abstraction of cloud-native technology so teams can focus on new features, applications and innovation.** Technology that simplifies and automates provisioning, orchestration, interconnectivity and security can help deliver better developer experiences and outcomes.
The Value of Cloud Native

Cloud native refers to IT infrastructure and applications designed from the ground up to take advantage of cloud architectures and automated environments, as well as other operational functions such as API-driven provisioning, autoscaling and support for distributed applications. Though the term implies exclusivity to the cloud, enterprises are replicating that approach for on-premises, private cloud and VM-based applications. Thus, cloud native is not limited to the cloud but is instead a development and IT operations approach that spans modern hybrid and multicloud architectures.

The main drivers of cloud native include IT operations efficiency, security, and developer speed and productivity, according to our Voice of the Enterprise: DevOps, Workloads & Key Projects 2022 survey (see Figure 1). Fueled by these factors, as well as broader organizational and business benefits, cloud native is helping to define modern IT operations. This is also well-timed with enterprise cloud adoption and hybrid and multicloud infrastructure strategies, as a range of organizations across verticals are leveraging the cloud architecture and distributed application nature of cloud native.

Figure 1: Cloud-Native Advantages

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT operations efficiency</td>
<td>64%</td>
</tr>
<tr>
<td>Security</td>
<td>52%</td>
</tr>
<tr>
<td>Developer speed and productivity</td>
<td>41%</td>
</tr>
<tr>
<td>Application portability</td>
<td>39%</td>
</tr>
<tr>
<td>Cost</td>
<td>37%</td>
</tr>
<tr>
<td>Consistency/standardized process</td>
<td>34%</td>
</tr>
<tr>
<td>Executive mandate</td>
<td>27%</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

Q. What are the primary benefits of cloud-native technology, such as containers, Kubernetes and serverless, for your organization? Please select all that apply.
Base: All respondents (n=487)
Source: 451 Research’s Voice of the Enterprise: DevOps, Workloads & Key Projects 2022

Key among cloud-native advantages is efficiency. Capabilities such as automated provisioning, configuration and scaling can help drive efficiency by enabling smaller IT teams to manage large-scale and even massive-scale infrastructure. Cloud native also enables rightsizing whereby the platform automates management and orchestration according to the needs of the applications running on it. Cloud-native automation capabilities can also optimize lifecycle management, scaling and recovery for distributed applications running across hybrid and multicloud infrastructure. By providing a consistent runtime experience across these environments, cloud native can help simplify and streamline IT operations, including cluster lifecycle management and orchestration. Organizations must also leverage observability that encompasses a unified view into infrastructure and applications to identify bottlenecks, speed root-cause analysis and deliver insights for optimal and efficient deployment.
Security is another big advantage and driver of cloud-native approaches. Containers are lightweight and thus provide a smaller attack surface. In addition, cloud-native constructs enable organizations to rapidly update and repair distributed applications. Cloud-native approaches also offer flexibility, allowing organizations to quickly build up or tear down and redeploy infrastructure and applications in a known, good state. In addition, cloud native can support the ability to more frequently rotate user credentials to further reduce risk. It is important, however, for organizations to reassess their security integration and posture with cloud-native deployments, rather than continue with existing or VM-based security measures. Containers and cloud native are different, so there are different considerations and priorities that must get a fresh review in order to secure software releases and IT operations. Although our research has found that a growing number of organizations are including security elements in their workflows, it also highlights organizational challenges of DevSecOps, particularly persisting silos of developer and security teams. Thus, it is important that platforms and tools offer features, capabilities and data for both disciplines to encourage collaboration and align objectives the same way developers and IT operators have worked together to break down silos.

Another cloud-native benefit – developer speed and productivity – is among the primary drivers of adoption. Enterprises rightfully want to give their developers a good experience and enable them with the faster onboarding and fuller productivity of cloud-native technology and methodology. Cloud native can also keep software developers focused on software development, rather than on configuration and other manual tasks, by abstracting underlying infrastructure and application dependencies. Beyond the technical advantages, cloud native enables developers to design resilient applications and services that can stay online amid disruption. Cloud native has also emerged as the latest tooling for DevOps – collaboration between software developers and IT operations teams for faster releases, more efficient IT management and overall organizational agility – which can be enabled by containers, Kubernetes and other cloud-native technology.

Enterprises do not have to shift all of their applications to cloud native at once. They should focus on the right types of applications that fit this newer technology and methodology – typically newer applications. However, many organizations are also containerizing more data-rich and stateful applications, including mission-critical ones. As cloud-native advantages are delivered and proven inside the organization, the approach is typically broadened to include more applications, much like how DevOps spreads in enterprise organizations.

**Made for a Hybrid/Multicloud World**

Cloud-native technology fits the current enterprise mandate to develop, deploy and manage applications across hybrid and multicloud infrastructure, which includes on-premises, private cloud, multiple public cloud and edge environments, given application portability is another primary advantage. Because containers package applications and their dependencies, they can be deployed consistently across these different environments with portability of not only the applications, but the services and data that go with them.

In addition to being a container orchestration framework, Kubernetes is also a distributed application platform that can help organizations effectively manage software across hybrid and multicloud infrastructure. Containers were well timed with enterprise adoption of cloud computing, and now Kubernetes is well timed with the need for a single control plane. Historically, we have seen Kubernetes deployed in public and private clouds, as well as on-premises, and our latest research indicates that trend continues (see Figure 2). SaaS and IaaS are highlighted as leading venues, followed by modern and legacy on-premises environments. Deployment of Kubernetes for edge environments is lower (31%) but likely to grow as cloud-native use cases spread across more industries.
Figure 2: Kubernetes Deployment Venues and Deployment Models

<table>
<thead>
<tr>
<th>Venue Description</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software as a service (SaaS)</td>
<td>54%</td>
</tr>
<tr>
<td>Public cloud infrastructure (IaaS)</td>
<td>53%</td>
</tr>
<tr>
<td>Modern on-premises environment</td>
<td>45%</td>
</tr>
<tr>
<td>Legacy on-premises environment</td>
<td>36%</td>
</tr>
<tr>
<td>At an edge environment</td>
<td>31%</td>
</tr>
<tr>
<td>Other off-premises environment</td>
<td>5%</td>
</tr>
</tbody>
</table>

Q. Where does your organization run Kubernetes? Please select all that apply.
Base: Organizations where Kubernetes is in use or POC (abbreviated fielding) (n=270)

<table>
<thead>
<tr>
<th>Deployment Model</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public cloud service</td>
<td>72%</td>
</tr>
<tr>
<td>Commercial version/distro</td>
<td>52%</td>
</tr>
<tr>
<td>Free, open source community version/distro</td>
<td>31%</td>
</tr>
</tbody>
</table>

Q. What best describes your company's deployment model for Kubernetes? Please select all that apply.
Base: Organizations where Kubernetes is in use or POC (n=297)

Today’s enterprise organizations are using a mix of public cloud services, Kubernetes distributions and open-source software, all of which must be supported comprehensively and consistently for maximum value (see Figure 2). These different cloud-native options are typically deployed alongside one another across enterprise application portfolios. This includes public cloud services from the hyperscalers, but few companies are “all in” on any one of them. Instead, they must support private, hybrid and multicloud deployments that include Kubernetes distributions. Some organizations use purely open-source Kubernetes that can be deployed initially to prove effectiveness and benefits, but only the most advanced organizations are really capable of implementing pure open-source Kubernetes, particularly in production and at scale or in line with internal and external security and compliance requirements. Supported Kubernetes will likely make sense for most organizations that lack sufficient skills and staff and are focused on reducing their risk.
Addressing Cloud-Native Challenges

Security

While security can be an advantage and driver of cloud native, it is also consistently ranked as a top cloud-native challenge, according to our research (see Figure 3). Cloud native may provide a smaller attack surface and simpler updates, but it also represents a new approach that requires updated thinking on security. Cloud native also has a high bar to meet in terms of security considering the solid security management and reputation of VMs, particularly when containers are compared to VMs on multi-tenant security.

Solutions:

To truly take advantage of cloud native and drive security advantages while addressing security challenges, organizations can leverage automation to drive consistency while still promoting rapid updates. Other measures, such as more immediate and automated software patches, can also enable a more strategic security approach, as opposed to a tactical, triage situation. Enterprise organizations must shift away from a “break the build” approach that represents a stop sign for software development when security issues arise. Instead, they should put “guardrails” in place, including identity access and role-based access control, to reduce risk without slowing developers and DevOps teams. This can also help address another cloud-native challenge that tends to accompany security: compliance.

Figure 3: Cloud-Native Challenges

Q. What are the primary challenges of using cloud-native technology such as containers, Kubernetes or serverless in your organization? Please select all that apply.

Base: All respondents (n=487)
Source: 451 Research’s Voice of the Enterprise: DevOps, Workloads & Key Projects 2022

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security</td>
<td>47%</td>
</tr>
<tr>
<td>Cost</td>
<td>37%</td>
</tr>
<tr>
<td>Complexity</td>
<td>35%</td>
</tr>
<tr>
<td>Lack of skills/personnel</td>
<td>34%</td>
</tr>
<tr>
<td>Compliance concerns</td>
<td>34%</td>
</tr>
<tr>
<td>Resistance to change</td>
<td>27%</td>
</tr>
<tr>
<td>Existing processes are sufficient</td>
<td>25%</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>
Cost
Cost is ranked as a big cloud-native challenge, highlighting both technical issues, such as the need for automation to offset the operational expense of operating a vast number of ephemeral applications and services, and organizational issues, such as budget allocation.

Solutions:
Today’s enterprises must take advantage of cost-tracking and analysis tools to leverage cloud-native approaches most effectively and efficiently. Cost is also a factor in hybrid and multicloud strategies since certain infrastructures, including on-premises and cloud, may be more economical for certain applications.

Complexity
Cloud native is well known for its complexity, in large part because it entails the management of dozens or more container clusters, each with as many as hundreds of nodes and applications.

Solutions:
The API-based provisioning and collaboration of cloud native can actually enable simpler integration among software and IT operations components. Cloud-native complexity can also be reduced by providing a consistent runtime and experience across hybrid and multicloud infrastructure.

Lack of skills and personnel
Lack of skills and personnel has consistently been a challenge with cloud-native approaches, similar to what we saw with DevOps when that trend began more than a decade ago. Talent is in high demand and comes at a premium, and turnover and poaching are real concerns.

Solutions:
To attract and retain good technology talent, organizations must provide their technical teams with opportunities to learn, advance and expand their expertise, as well as provide challenging yet rewarding work that is centered on software and IT operations innovation, rather than manual tasks and red tape.

Open-source software
Open-source software and a broader community of developers, contributors and end users is a powerful component of cloud native but can be difficult to navigate in terms of support, integration, certification and vendor backing. Today’s enterprises typically expect the cloud-native software they’re using to be open source to benefit from the broader community, flexibility with other software components, and developer speed and productivity. At the same time, most organizations require paid support to ensure they meet support, security and compliance needs.

Solutions:
Enterprises need help tapping open-source software expertise, meeting licensing and other requirements of open source and ensuring security and compliance of infrastructure and applications built on open source. Thus, we typically see a mix of free, community open source and paid support within organizations. Despite this reliance on vendor support, we do see end users and customers playing an increasingly prominent role in open-source software projects and communities, such as Kubernetes special interest groups, where they influence things such as feature priorities and roadmaps.
Pathfinder | Driving Value From Cloud Native Anywhere

An expanding scope of applications

Cloud native is no longer limited to the cloud, as enterprises are replicating it for management of on-premises environments and VM-based applications (see Figure 4). We also see cloud native expanding beyond web and stateless applications to include stateful apps, such as databases and data analytics workloads. This is fueled on the demand side by organizations’ desire to cast a wider net across their application portfolios with cloud native, and on the supply side by advances in cloud-native technology, such as support for persistent data volumes and stateful applications in Kubernetes. As cloud native matures, it is also being used to deploy and manage more production, mission-critical and traditional applications.

Figure 4: A Variety of Container Venues

Q. Where do containers run in your organization? Please select all that apply.
Base: Organizations where containers are in use or POC (n=337)
Source: 451 Research’s Voice of the Enterprise: DevOps, Workloads & Key Projects 2022

Enterprises are also increasingly seeking cloud-native benefits beyond speed and efficiency, particularly business outcomes such as user experience and customer satisfaction. This again ties to enabling developers and IT operators to focus on new features and solid experiences as opposed to configuration and provisioning issues that have been automated and abstracted using cloud native.

Solutions:

To get the most out of cloud native, today’s enterprises must lean on vendor offerings and managed services so that instead of concerning themselves with provisioning and configuring and evolving cloud-native deployment, teams can focus on creating better software, services and experiences for their customers. This includes support on best execution venue for applications across hybrid and multicloud infrastructure, utilization and cost optimization, and Day 2 operations support that includes monitoring and troubleshooting.
Conclusions

Adoption of cloud-native technology is poised to continue growing as it is applied to a wider swath of enterprise application portfolios. Organizations should take advantage of cloud-native capabilities, starting with new applications and initiatives where there is less friction. Not all applications can get the cloud-native treatment, but with a growing set of capabilities and support, many of them can, including data-rich and mission-critical ones. While enterprises are at different stages of their digital transformation journeys, they can begin adopting cloud native to start and scale up as they become more advanced. Enterprises should seek out approaches and offerings that match their particular infrastructures, needs and roadmaps.

Another key consideration as enterprises wade deeper into cloud-native adoption is that the various technologies and approaches – containers, microservices, Kubernetes, serverless, service mesh, etc. – are not mutually exclusive and are typically deployed concurrently by organizations. In addition, these cloud-native components are closely related. For example, Kubernetes adoption often portends deployment of serverless and service mesh. Organizations should be cognizant of the desire by developers, IT operators and combined DevOps teams to take advantage of all of these cloud-native technologies and leverage their experience for expanded deployments.

To get the most out of cloud-native technology and methodology, organizations will also need integration, automation and abstraction to have a single control plane whereby they can manage their applications – whether on containers or VMs, modernized or non-modernized, on-premises or in the cloud – consistently and thus more effectively. Cloud native holds the promise of simply and rapidly scaling applications, and the same is true for its benefits that can be demonstrated to make the case for broader adoption.

As a primary contributor to the Cloud Native Computing Foundation, VMware is the most trusted vendor for enterprise workloads running across clouds, according to Management Insights. As such, VMware provides modern technology solutions to address the challenges of cloud native.

VMware Tanzu for Kubernetes Operations provides enterprises with the foundation for building, operating and managing a modern, Kubernetes-based container infrastructure across multi-cloud. It simplifies provisioning and management of Kubernetes with tools, automation and data-driven insights to boost developer productivity, secure applications and data, and optimize infrastructure performance across your entire multi-cloud IT estate.

VMware Aria Cost powered by CloudHealth (formerly CloudHealth) and VMware Aria Operations for Secure Clouds (formerly CloudHealth Secure State) enable enterprises to simplify cloud financial management, streamline cloud operations, and strengthen cloud security and compliance across public cloud and multi-cloud environments.

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