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SPOTLIGHT

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Digital-first organizations are looking to provide cloud operations and DevOps teams with the latest automation tools and capabilities. Infrastructure as code is an important capability to help manage the increasing complexity of multiple clouds and cloud-native architectures. The benefit of treating infrastructure as application code is that it can act as a key differentiator for creating business value.

The Evolving Landscape of Infrastructure as Code

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Introduction

Infrastructure as code (IaC) is the next evolution of provisioning and managing cloud resources. Enterprises are increasingly using a kitchen-sink approach to the cloud. Multiple clouds are becoming popular as enterprises continue to grow investments in public cloud providers, private internal clouds, and hybrid approaches. The ability to define infrastructure in human- and machine-readable software code for various clouds has steadily gained adoption in recent years. This code can then be version controlled, reused, and stored in a central repository such as Git. As companies increasingly utilize more and more clouds in their software architecture, the demand for IaC has grown.

Line-of-business owners and CIOs are driving IT to take advantage of the benefits of newer cloud-native applications. To meet these requirements, cloud operations groups need the ability to write once and deploy infrastructure anywhere. As a result, operations teams are adopting software-defined IaC to meet this challenge.

AT A GLANCE

KEY TAKEAWAYS

Infrastructure as code (IaC) is the next evolution of provisioning and managing cloud resources.

Key benefits of IaC include:

- Scalability and reliability
- Standardization
- Reduced cost
- Proven ROI
- Speed to market
- Improved security
- DevOps optimization

Digital transformation projects have caused environments to grow in size and scope. This growth has led to an increase in requirements for consistent management and interoperability to reduce complexity. Standardization and the ability to use agile development techniques and DevOps in the infrastructure arena are crucial to delivering resources for these projects with speed and quality. As enterprises face a growing skills gap, the ability to support these projects is in jeopardy. The training to support the collection of clouds used by many enterprises is taxing to operations teams. By focusing the training on learning one language of IaC, teams can continue to do more with less.

Definition of IaC

IaC is the process of provisioning IT resources through definition files defined in software code only. Customers use IaC for on-premises resources or resources held in a public cloud provider's datacenter. It replaces the physical hardware and manual installation process of new servers or other IT resources. IaC further extracts beyond simple virtualization — eliminating the need for operations to use virtual consoles. These consoles require operations teams to manually navigate drop-down menus and menu screens to configure virtual services each time.

IaC allows IT staff to write code to define the needed resource. This code contains all the configuration elements and parameters to create the desired server or other infrastructure objects. IT uses IaC development with the same processes as any new application development. A central repository, such as Git, is often used with IaC. Best practices for software to improve quality, such as peer reviews and unit testing, are standard with IaC. Furthermore, IaC can be easily copied or reused in the future to save additional time and enhance the standardization of cloud resources.

Further, as container utilization has skyrocketed with new cloud-native application development, IDC has seen rapid growth in the need to manage hundreds of parameters associated with container-based environments. IaC vendors quickly added this capability to help companies manage their cloud-native container applications. Many IaC tools allow for automation and support for container-as-a-service offerings from leading hyperscalers and for open source Kubernetes running on an organization's virtual servers.

Benefits

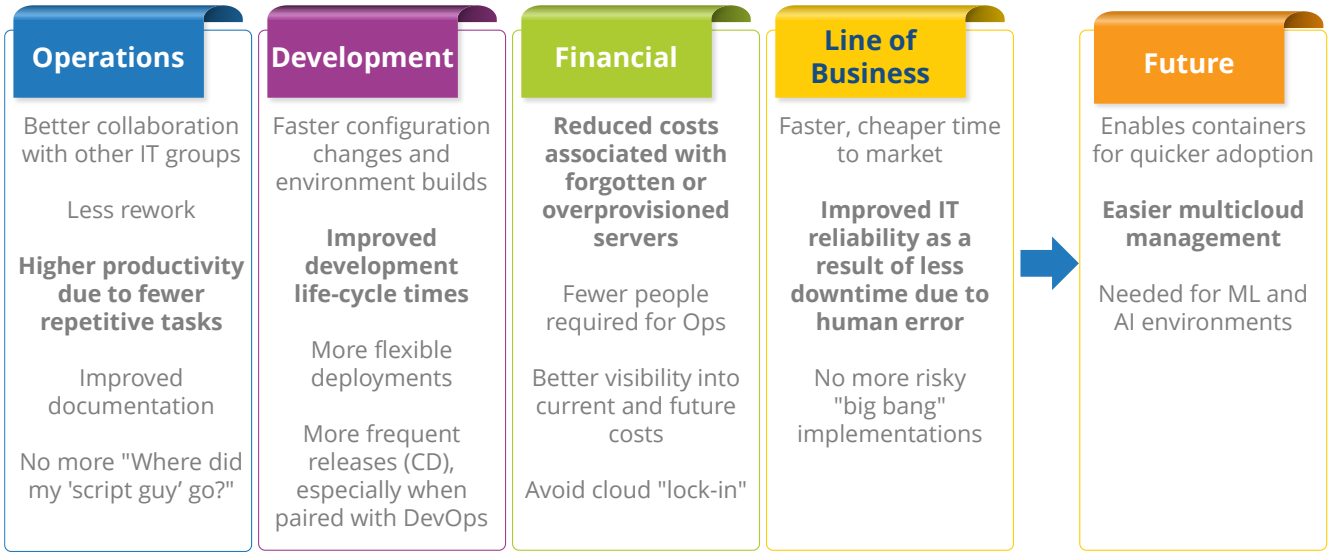
Organizations utilizing IaC can realize multiple benefits, including the following:

- **Speed to market.** The ability to create new infrastructure resources in seconds based on reusable code is a tremendous advantage of IaC. Developers can pull existing code for Git-style repositories and provision needed elements to support new, cloud-native applications faster than ever. As a result, developers can focus on building better applications instead of being blocked and waiting for infrastructure provisioning.
- **Standardization.** IaC improves standardization and reduces configuration drift in two ways. Code reuse and consistent testing mean new infrastructure is provisioned consistently. Second, because provisioning and deprovisioning can occur quickly, some companies choose to re-implement entire environments every month, ensuring no configuration drift and continually improving performance through "fresh" server instances.
- **Scalability and reliability.** Once IaC is defined, code reuse enables organizations to stand up environments quickly, reducing errors, cost, and time.
- **Cybersecurity.** IDC research shows IT automation improves compliance and adherence to best practice security standards. An emerging trend is the concept of IaC security that can uncover infrastructure weaknesses or misconfigurations that could lead to a security breach. When IaC security vulnerabilities are found, updating the central repository with the latest fixes speeds up remediation times.
- **Reduced costs.** Enterprises can lower training costs by adopting a single tool for IaC. Because all leading IaC solutions support multiple clouds, training on each hyperscaler cloud's unique tools is no longer necessary. Developers as well as site reliability engineering (SRE), and operations teams can participate in IaC creation and testing. Also, "shifting left" the provisioning of infrastructure resources reduces the workload on operations and improves efficiencies. In a tight labor market, the ability to find and retain skilled employees is essential. Training several teams on IaC solutions helps ensure IT can deliver business value promptly.

- **DevOps optimization.** Treating IaC as just any other application code means enterprises benefit from version control to reduce human errors in using the wrong template or image. By participating in the application life cycle, IaC benefits from unit testing and other quality assurance processes used by mission-critical applications. Using a CI/CD pipeline and workflow approvals reduces human error while controlling costs and reducing delivery times.

Figure 1 highlights some overall IaC benefits broken out by different roles.

FIGURE 1: ***Infrastructure as Code Overview***



Source: IDC, 2022

Trends

Trends to watch for around IaC include the following:

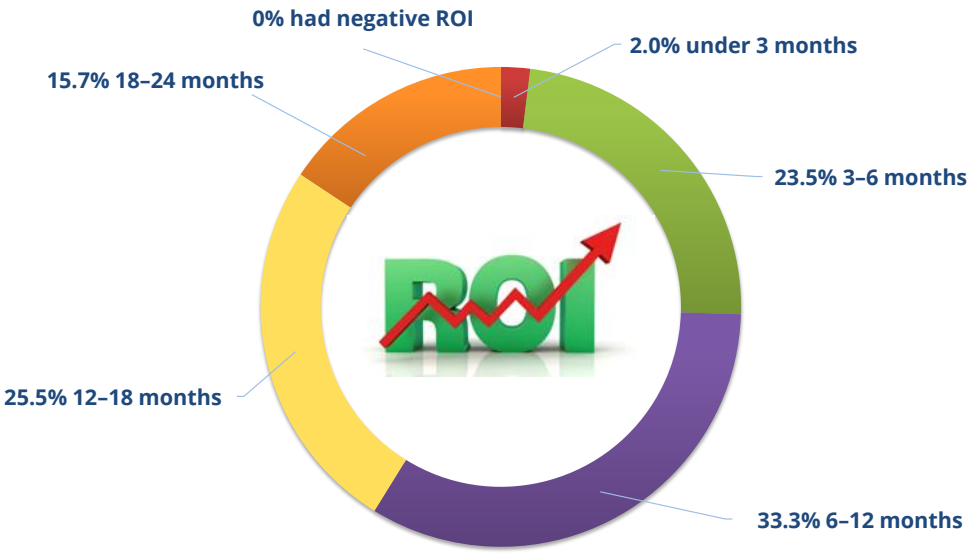
- **Open source and industry standards continue to drive innovation.** Some IaC vendors use an open core model where they offer a base version of the software as free open source code but charge a fee for the enhanced commercial offering to access the enterprise features.
- **Infrastructure metadata is on the rise.** As server provisioning moves increasingly to IaC, the next logical step is to enable automation platforms to access this code or "data" from a central Git repository. Next-generation automation solutions could then compare this gold standard in near real time to all the virtual servers and containers in the environment. In addition, this capability will allow proactive, automated remediation of configuration drift and vulnerabilities from a central console.
- **Governance is a growing priority in cloud management for many organizations.** Policy as code is a future direction that allows the speed and agility of the cloud but with guardrails that enterprises are missing today. Further, IaC provides auditability and attestation of complex infrastructure configurations.
- **Using a single tool to provision all clouds is becoming a requirement.** IaC suppliers should continue improving the ease of use of their tools' command-line (CL) and web interfaces.

- **IaC deployment favors software as a service (SaaS).** Many IaC products started as standalone, on-premises products. However, SaaS is rapidly becoming the preferred deployment model.
- **Integration with CI/CD pipelines is another way IaC can participate in the DevOps arena.** IaC solutions integrated with CI/CD automation tools provide a natural fit. This capability will increase collaboration between operations and developers, driving organizations toward GitOps adoption. GitOps uses Git as the sole source of truth for both the software and configuration artifacts.
- **IaC vendors are adding new infrastructure elements with increasing frequency.** Storage, compute, and networking were the primary infrastructure items used in IaC in the past. Today, IaC tools support firewalls, IP address management (IPAM), load balancers, and other infrastructure components.

Figure 2 shows how the economics of adopting IaC to manage and provision infrastructure can help organizations realize accelerated ROI paybacks on their investment.

FIGURE 2: ***Automation of IT Operations Has a Swift Payback Period***

Q ***What ROI payback period do you believe is associated with your IT operations automation investment?***



n = 100 companies with greater than US$1 billion in revenue

Source: IDC, 2022

Considering VMware

VMware, founded in 1998, is best known for its flagship hypervisor solutions and has a history of providing automation solutions to optimize IT provisioning and operations. Fortified by in-house development and the strategic acquisitions of Pivotal in 2019 and SaltStack in 2020, the company expanded its automation focus from on-premises virtual machines (VMs) to streamline cloud adoption. In addition, Broadcom recently announced its intention to acquire all of VMware and rebrand the Broadcom software division under the VMware group.

VMware's Aria Automation (formerly VMware vRealize Automation and vRealize Automation Cloud) is designed to provide IaC across multiple cloud technologies. Applying capabilities such as Aria Automation's declarative templates and Aria Automation Config (formerly SaltStack Config) allows an organization to hide differences and complexities across clouds and accelerate cloud transformation. So, developers and IT operations teams are insulated from individual cloud idiosyncrasies and share a common IaC automation experience. This consistency provides a unified view across clouds while enabling self-service IaC and scalability.

Aria Automation is made up of seven primary components:

IDC reports that 70.8% of enterprises regard managing IT delivery costs as a high or top priority for 2022.

- **Aria Automation Assembler** (formerly Cloud Assembly) orchestrates and expedites self-service infrastructure consumption and delivery.
- **Aria Automation Templates** (formerly Cloud Templates) uses an IaC framework for infrastructure provisioning and workflow.
- **Aria Automation Consumption** (formerly Service Broker) aggregates native content from multiple clouds and platforms into a unified self-service catalog with centralized policies.
- **Aria Automation Pipelines** (formerly Code Stream) speeds software delivery and streamlines troubleshooting with release pipelines and analytics.
- **Aria Automation Orchestrator** (formerly Orchestrator) utilizes a drag-and-drop custom workflow orchestration engine that simplifies the automation of complex IT tasks.
- **Aria Automation Config (formerly SaltStack Config)** is an event-driven software configuration management capability for virtualized, hybrid, or public cloud enriched by the Salt Project open source community.
- **Aria Guardrails** enforces cost optimization, security availability, and speed of delivery continuously through a common policy engine across public clouds.

Aria Automation also provides cloud governance for appropriate checks and balances across the enterprise. Features include approvals, action permissions, resource quotas, and role-based access control (RBAC). Organizations can configure governance by designing cloud tenancy and policies to ensure governance across clouds with customizable RBAC. Further, organizations can establish unified control across clouds and workload types (i.e., VMs or Kubernetes based).

For DevOps teams, Aria Automation can help empower the "Ops" in DevOps by facilitating cloud access for developers, enabling the alignment of infrastructure and application operations. It does this in the following ways:

- The multicloud IaC features infrastructure pipelines and bidirectional Git integrations to enable GitOps adoption. Cloud services can be exposed using preconfigured access and compliance policies to accelerate internal service delivery security.
- Declarative templates hide the complexities of various back-end infrastructure-as-a-service (IaaS) components. Templates enable consistent governance, configuration, and compliance across different consumption models. IaaS cloud services can be accessed via native APIs, GUIs, and code using different automation frameworks, including Aria Automation Config, Aria Automation Orchestrator, Aria Automation Action-Based Extensibility (ABX), or broker services from other third-party tools.

- Integrated programmable IaC at the object or operating system level features a low-code approach. This flexibility enables DevOps teams to ramp up quickly and leverage application development best practices in infrastructure operations. Further, teams can program, test, and reuse infrastructure configurations. Teams new to automation may find that VMware's use of YAML as the core language of the VMware IaC makes adoption easier. Many developers and operations teams are already familiar with this language.

Cloud operations teams can leverage Aria Automation day 2 automation and event-driven management of multicloud infrastructure for auto-drift remediation and remote execution. These capabilities can help support limited IT staff, streamline the response to critical issues, and improve the mean time to recover (MTTR) from production outages. Additional benefits for IT operations teams include the following:

- Teams have the ability to build tractable environments, import common vulnerabilities and exposures (CVE) data from third-party security tools, and automate vulnerability remediation, compliance, and security enforcement. As a result of these capabilities, security efficiencies and posture are improved, thereby reducing operational risk.
- Aria Cloud Templates use tags to describe intent and define how and where a service should be delivered. Leveraging the Aria Automation cloud organization framework, administrators can define cloud zones (resource zones), projects (user groups), and cross-cloud resource mappings. Based on inputs and properties, a smart placement engine will define the optimal provisioning target and generate a provisioning diagram for transparency.
- Cost optimization and insights via the vRealize integrations with CloudHealth help improve performance and track and optimize cloud costs.

Challenges

VMware has made significant investments in its IaC, but it faces the following challenges:

- **Established competitors.** IaC for infrastructure provisioning is a crowded space with established players and new smaller competitors entering the market (*IDC Market Glance: DevOps, 3Q21,* August 2021, #US48129721). VMware should adhere to its strategy of insulating DevOps and IT operations teams from the complexities of multicloud provisioning.
- **Coopetition.** Locking customers into proprietary solutions is a failing approach in the modern multicloud and open source world. Collaboration between competitors to achieve mutually beneficial results must remain relevant. While the VMware approach to IaC can assist customers using competitive cloud solutions, it also provides an opportunity to approach prospective customers as a true partner rather than a vendor. Further, established partnerships with Amazon AWS and Microsoft that leverage VMware cross-cloud services only strengthen the company's competitive position.
- **Acquisition by Broadcom.** Recently, VMware confirmed its planned acquisition by Broadcom in a deal valued at $61 billion, and the combined company will have a software business that will exceed $20 billion. In the short term, competitors will try to use the acquisition as an opportunity to promote uncertainty and doubt in the minds of VMware customers. As this deal will take time to close, during this period, VMware should continue to aggressively support and enhance its IaC solution to remain competitive and reduce ambiguity about its future approach toward innovation.

Conclusion

Infrastructure as code is an essential evolution for operations teams. It is a tool that provides agility, better compliance, and improved cost control. According to IDC's *Future Enterprise Resiliency and Spending Survey, Wave* 3 (April 2022, n = 828), 70.8% of enterprises regard managing IT delivery costs as a high or top priority for 2022. IaC and automation offer strong returns on investment, allowing employees to focus on delivering business value and controlling costs. IaC also reduces training needs through a single domain-specific language to provision new resources. The benefits of operations fully participating in DevOps processes and tools can be extensive, including faster delivery, fewer errors, and less configuration drift.

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