Automated Software Development Life Cycle (SDLC) Provisioning on the VMware Private Cloud

How VMware IT Uses the Software-Defined Data Center to Achieve IT as a Service

VMWARE IT SUCCESS STORY
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Executive Summary

The enterprise application group within VMware corporate IT oversees a portfolio of 215 business applications. The group’s application operations team (AppOps) provisions and manages development and test environments for 600 developers working on the VMware portfolio of enterprise applications. Facing pressure to increase business agility, AppOps sought to improve the slow, error-prone, manual process used to provision application environments at multiple points in the software development life cycle (SDLC).

Instead of working to fix the process-bound “human middleware” that used traditional virtual infrastructure, AppOps chose to replace and automate the provisioning process by leveraging the existing VMware on-premises private cloud based on a software-defined data center architecture. The team’s decision has resulted in the following significant benefits:

• Reduced application environment provisioning time from 4 weeks to 36 hours; on target to achieve goal of 24 hours.
• Increased productivity of 600 developers by as much as 20 percent.
• Improved capacity and service quality so that AppOps can now consistently respond “yes” to all project requests.
• Saved the business USD $6M per year in infrastructure and operating costs.

Key takeaway – VMware corporate IT decided to invest in improving business agility, and as a byproduct, increased service quality and dramatically lowered IT infrastructure and operating costs.
Business Needs Drive Corporate IT Changes

VMware corporate IT’s enterprise application group maintains a portfolio of 215 applications. One hundred are enterprise business applications—of which 50 are tier 1 applications receiving frequent development and upgrade attention. Roughly 600 developers share responsibility for upgrading all of the systems supporting a broad range of business-critical activities at VMware.

Within the enterprise application group, 27 engineers on the application operations team (AppOps) support 30-50 business-application upgrade projects each year, “standing up” working copies of production systems. Provisioning each instance is a complex effort that may include 10-50 or more application components. For example implementing Oracle ERP software with Web portals would require multiple application modules as well as various infrastructure, load balancer, storage and database technologies and multiple network, firewall and integration points. Moreover, provisioning environments that are nearly identical to production environments occurs up to five times during the complete software development life cycle (SDLC) process (see figure 1).

A typical business application development project takes 6-9 months. Because manually provisioning and quality controlling each instance was taking an additional 3-5 weeks, time waiting for provisioning multiple times during the SDLC process could extend a 7-month project by 2 months.

From a business and customer perspective, this slow, manual IT process created issues for developers. In a late 2012 meeting with dozens of business managers and application developers, AppOps heard a common set of complaints, “I can't develop.” “I can't test.” “I'm late with projects.” “I'm missing my goals.” “I'm waiting for the software that I need to run my business!”

Figure 1. SDLC Process With as Many as Four Development and Test Provisioning Gaps
The impact of manually deploying development environments was considerable, resulting in:

- **Lower productivity** – Every project experienced multiple delays, which prevented developers from actively working on related tasks. Due to provisioning gaps, developer wait time was as much as 20 percent of the overall project schedule. During one major project in 2012, there was no effective way to redirect or keep 250 developers productive during multiple SDLC instance provisioning gaps.

- **Project backlog** – At 100 percent capacity, AppOps could only manage 4-6 simultaneous manual provisioning projects, which was causing a development bottleneck. As a result, new requests from developers were sometimes rejected due to AppOps capacity constraints.

- **Increased project risk** – Because of the long lead times, previously provisioned SDLC instances were often shared between development project teams. A schedule slip from one project caused cascading delays that impacted multiple projects.

- **Inconsistent results** – Provisioning quality and lead times fluctuated widely due to process variations, schedule complexity and team member skill levels.

At the time, enterprise IT was supporting an internal, non-production environment that included nearly 8x the number of virtual machines as the production environment. Because multiple simultaneous development projects required several instances per project, 4,000 virtual machines were typically needed for non-production workloads compared to only 500 virtual machines for the production environment.

**Options to Improve Agility**

To tackle agility and customer satisfaction concerns, AppOps needed to reduce provisioning time while increasing schedule predictability and service quality for all provisioned environments. The team began with a review of its existing provisioning process—a complex set of actions that included nearly 20 major steps with tasks to be completed by personnel in five different functional, globally distributed groups (see figure 2). AppOps quickly concluded it had a “human-middleware” problem—meaning the primary process constraint was not the tasks, but rather the scheduling and managing of people who were performing these largely repeatable tasks.

![Figure 2. Complex “Human-Middleware” Process Involved Multiple Functional Teams](image)

Specifically, lead times were impacted by the availability of individual resources, the timing of regional holidays, and the decision-making of people with differing priorities. Because tasks had to be completed in a specific order, scheduling conflicts created non-productive wait time at multiple points during the process. In addition, AppOps had to request infrastructure-related provisioning tasks through a ticketing system, further contributing to non-productive wait time.
AppOps considered two fundamentally different choices for optimizing the SDLC to increase agility and developer satisfaction:

**Fix the “human middleware.”** This approach would require applying lean methodologies to improve the process and automate specific tasks while keeping provisioned SDLC instances in a traditional virtualized data center environment.

or

**Replace and automate.** This approach would completely automate SDLC instance provisioning in a private-cloud environment using blueprints, policies, and automation and management capabilities in VMware vCloud® Suite.

“Our choice was to fix or replace and automate (the provisioning process). Since we had a private cloud based on the software-defined data center, the choice to replace and automate was obvious.”

— Paul Chapman, Vice President, Infrastructure and Operations, VMware

During the team’s deliberations, two critical factors contributed to choosing to replace and automate:

1. Re-engineering the existing provisioning process would not fully address the “human-middleware” problem. Even with task automation and flow optimization, the process would still rely on complex scheduling, including coordinating people with differing priorities operating in silos within globally disbursed functional groups. AppOps concluded that even if all tasks were automated, provisioning would remain process bound and not address customer needs or scale to meet VMware growth objectives.

2. VMware had already deployed a multitenant private cloud. The initiative was called “Project OneCloud,” and it delivered basic infrastructure-as-a-service (IaaS) capabilities for multiple internal groups of users. It was a lower cost and more agile infrastructure solution than traditional virtual server environments previously used by each tenant. With vCloud Suite cloud automation and management capabilities, the private cloud would eliminate the need to request resources through a ticketing system and streamline ongoing management and maintenance tasks. AppOps determined Project OneCloud would be a suitable environment to host all non-production workloads of the SDLC process.

### Project OneCloud – VMware On-Premises Private Cloud

- **Launched:** June 2012
- **Platform:** VMware vCloud Suite
- **Current Size:** 9 tenant groups and 38,000 virtual machines
- **Growth:** Planning for 12 tenants and 50,000 virtual machines by end of 2013

**Current example tenants:**

- Corporate IT AppOps team
- Hands-on-labs
- Global service and support (customer environment reproduction)
- TechOps (micro-research and development clouds)
- Sales engineering (product demonstration pods)
- VMworld and other events

The availability of this powerful resource has resulted in a “cloud-first” policy across enterprise IT. New workloads will be provisioned on Project OneCloud if possible, before other more expensive and less-flexible options are considered.
Three-Tier Operations Model

Project OneCloud delivers compute, storage and networking resources as a service. Based on a software-defined data center architecture, it enables unprecedented efficiency, agility and control by extending the concepts of virtualization and automation to all data center services. However, each tenant is responsible for operations related to the specific workloads that it is managing. Operations (Ops) responsibilities are divided among three tiers (see figure 3).

- **Application Ops** – Responsibility of the tenant. Individual tenants must still perform many required traditional operational tasks such as provisioning, configuration, monitoring, upgrades, maintenance and support.
- **Tenant/Service Ops** – Responsibility of the Project OneCloud team. As a service provider, the Tenant/Service Ops team oversees service definition, tenant onboarding and service-level agreement (SLA) management.
- **Infrastructure Ops** – Responsibility of the Project OneCloud team. Infrastructure Ops ensures the delivery of network, storage and compute resources to meet SLAs.

This separation of duties results in each tenant selecting and installing the cloud automation and management capabilities it requires to deploy and manage its workloads. AppOps had the most sophisticated cloud management and automation requirements of any tenant using the private cloud. It needed to provision complex SDLC instances at different stages of the SDLC process—a degree of cloud automation and management capabilities other tenants did not require.
Project Goals

The process of automating provisioning and management of SDLC instances had a key dependency. The AppOps team needed advanced levels of automation and control only available in a private cloud based on a software-defined data center architecture.

With this dependency in mind, the team established two related goals:

**Goal 1 – Replace and Automate the Process**

AppOps set out to deploy all SDLC instances within 24-hours of a request—a process that would include 16 hours of provisioning and environment testing plus 8 hours of functional testing. Achieving this 24-hour goal would improve developer productivity, reduce schedule risk and project backlog, and improve service quality. In contrast to the former complex manual process, a small team of engineers would manage blueprints needed for 16 different SDLC instances and oversee the automated process.

A 24-hour goal would alleviate customer concerns about developer productivity, schedule risk, project backlog and service quality.

**Goal 2 – Transition Workloads to the Private Cloud**

Because AppsOps realized achieving its one-day deployment goal was not feasible in a traditional data center environment, the team planned to transition 4,000 non-production workloads to the private cloud. With automated deployment capabilities in place, all new SDLC instances could be provisioned in the VMware private cloud. Manually provisioned instances in the traditional environment would be “turned off” after their final use. Going forward, the enterprise application group would no longer need to maintain the infrastructure to support 4,000 non-production virtual machines.

Corporate IT launched a project in 2012 to meet these goals. Achieving them required transformation in three key areas (see figure 4).

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**Figure 4. Achieving Project Goals Required Transformation in Three Areas**

Corporate IT’s goals included more than incremental change. IT needed executive-level support and investment to drive transformation in three areas:

- **Architecture transformation** – IT planned to shift from the traditional data center environment to the private cloud, and deploy cloud management and automation capabilities to provision complex stacks and multistep workflows.

- **Operations transformation** – IT prepared to convert the manual “human-middleware” process to an end-to-end, automated process with blueprint-based provisioning. Key tasks would include training personnel, modifying job descriptions, and transitioning resources to more value-added roles.
Financial transformation – IT expected to transition from a project-infrastructure funding model to a service-consumption and chargeback model. This would mean that instead of incurring costs for building and maintaining infrastructure to support 4,000 virtual machines, IT could pass the cost of workloads on the private cloud to the individual projects requesting SDLC instances.

Architecture Transformation

The decision to replace and automate the process-bound “human middleware” required transformation of the architecture from traditional virtual infrastructure to the private cloud based on a software-defined data center. Previously, the enterprise application team included a group of system administrators who were responsible for maintaining the infrastructure needed to support 4,000 virtual machines related to non-production SDLC instances. Today, some of that team is responsible for developing cloud automation and management capabilities on the private cloud. They use the advanced management and automation capabilities of vCloud Suite to manage and control the virtual compute, network and storage resources in the underlying software-defined data center architecture.

The extensibility of vCloud Suite supports advanced AppOps requirements to automate and verify integration of multiple working applications in a typical SLDC instance and manage integration with third-party components (see figure 5).

The following cloud automation and management capabilities are deployed to manage SDLC instances:

- **Service portal** – An AppOps engineer uses this capability to log in and select one of 16 instances to provision. The engineer also chooses the service profile, SDLC phase, and resource size and duration. This component is based on VMware vCloud Automation Center™.

- **Blueprint management** – This capability enables the AppOps blueprint manager to aggregate application and middleware components, provisioning workflows and deployment plans into blueprints used to deliver, scale and upgrade each SDLC instance. This component is based on application services within vCloud Automation Center.

- **Resource management** – With this capability, the tenant cloud administrator can manage virtual data center partitions for development, testing, user acceptance testing (UAT), staging and load testing, as well as automation and management tools. This component is based on VMware vCloud Director®.

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![Figure 5. Cloud Automation and Management Extensibility](image-url)
Automated SDLC Provisioning on the VMware Private Cloud

• **Orchestration** – AppOps uses this capability to help automate tasks related to preprovision setup, configuration, provision-time auditing and management, post-provisioning workload inventory and monitoring. Its plug-in architecture supports the integration and management of third-party components. This component is based on VMware vCenter™ Orchestrator™.

• **Extensions** – These building blocks provide the additional automation and audit capabilities needed to verify integration and cross-system service functionality of complex application stacks. These components are based on the vCloud Director Software Development Kit (SDK) and application programming interfaces (APIs).

• **Third-party components** – These modules enable AppOps to integrate other technologies such as load balancers and network and security monitoring agents, as well as code repositories, IP address management, LDAP and other tools.

A team of five automation engineers was deployed to set up virtual data center environments then implement and refine the cloud automation and management capabilities. That team has been serving as administrators in support of phases 1 and 2 as automation and management capabilities evolve. Once the project is completed, two administrators will continue to manage tenant resource environments, as well as maintain automation and management capabilities.

**Operations Transformation**

The choice to replace and automate the process-bound “human middleware” also required transformation of operations.

Previously, a team of 27 AppOps engineers was responsible for manually provisioning SDLC instances. The team spent a significant amount of time project-managing and coordinating complex workflows that involved multiple tasks completed in a specific order across global teams. AppOps maintained runbooks that documented the steps required to provision and test more than 20 instances. And engineers managed requests using ticketing systems that various functional groups used to prioritize infrastructure-related requests.

Today, a team of five AppOps engineers takes development team requests and uses a service catalog to select and provision required SDLC instances. In the service catalog, an AppOps engineer selects from 16 standardized instances, chooses a target environment (dev, test, UAT), service profile, resources size and duration, and then initiates and monitors the automation. During the workflow, the AppOps engineer can stop or reprovision specific applications if there are issues. Once the process is completed, the AppOps engineer delivers the tested environment with a custom dashboard that developers can use to monitor the health of their systems. An AppOps engineer delivers a tested environment to developers with a custom dashboard that they can use to monitor the health of their systems.

The transformation to fully automated provisioning required multiple operational changes, including the following:

• **Role (modified)** – The AppOps engineer primary role has shifted from manually provisioning, configuring and testing pieces of a whole to using a service catalog to initiate an automated workflow with a view of the complete SDLC instance being provisioned.

• **Skills** – As the primary subject-matter expert, the AppOps engineer now requires automation and systems engineering experience to initiate and monitor the automated workflow. This skill-set enhancement requires training and ongoing education.

• **Role (new)** – A blueprint manager is now responsible for working with developers to maintain a portfolio of SDLC instances. This new role is also responsible for managing more than 80 application blueprints, and the workflow logic required to combine and provision each instance.

• **Role (eliminated)** – A project manager is no longer needed to prioritize SDLC requests, coordinate forward project schedules, or manage task requests among global resources.

• **Process** – AppsOps is transitioning the focus of its work effort from “after the service request” to “before the service request” to ensure service catalog items can be provisioned on demand.
• **Governance** – The focus of SDLC provisioning governance is now on the service catalog and underlying blueprints, policies and workflows. Continuous process improvement efforts involve updating blueprints to make provisioning more repeatable.

• **Organization** – AppOps now works closely with the team responsible for implementing cloud automation and management capabilities. These automation engineers, previously responsible for the administration of infrastructure in the traditional data center environment, have gained greater responsibility and are now focused on higher value tasks.

Overall, the new capabilities required significant operational changes—all of which support the broader IT strategy to deliver IT as a service. Lessons learned from these operations changes will be propagated to other parts of the IT organization.

**Financial Transformation**

Finally, the option to automate and replace the process-bound “human middleware” requires transformation of IT financial management from overall IT allocation to a service-delivery orientation. As the final point of project transformation, the evolution of IT financial management for this project is ongoing.

Previously, infrastructure required to support individual project requirements was allocated separately from other enterprise IT resources. Costs were allocated to assets and projects. The real cost per SDLC instance per virtual machine was difficult to determine.

With automated SDLC provisioning in a private cloud environment, cost per virtual machine is explicit. Costs are fully revealed and IT is now well positioned to transition from a project-infrastructure funding model to a service-consumption and charge-back model.

Rather than incurring building and infrastructure maintenance costs—and supporting infrastructure needed for thousands of SDLC virtual machines—the enterprise application group can focus on provisioning and managing SDLC instances for developers. The team plans to show and then charge back the cost of SDLC instances based on how long they are used by development teams.

Along with enabling greater financial visibility, the team expects to have to institute an approval process to ensure SDLC instance requests are funded before they are provisioned. IT anticipates financial transformation will help manage demand as business stakeholders better understand their per SDLC instance fees.

The team plans to show and then charge back the cost of SDLC instances based on how long they are used by development teams.

**Project Status and Next Steps**

The project to deploy cloud automation and management capabilities in the private cloud and transition SDLC instances to the new environment occurred in two phases:

**Phase 1 (completed)** – Efforts during phase 1 focused on deploying basic automated provisioning and management capabilities and transitioning 2,800 dev, test and UAT workloads to the private cloud.

The following key capabilities were implemented in phase 1:

• vCloud Suite was deployed in a private-cloud tenant environment.
• Virtual data centers were set up for each dev, test, UAT instance, along with automation and management tools.
• A service catalog was implemented with provisioning policies and workflows. It initially included more than 50 application blueprints with deployment plans and service profiles for different virtual data centers.
• Extensions were added to provide advanced automation capabilities and integration with third-party applications.
• Monitoring, analytics and performance management were linked to scaling.
The first SDLC instance provisioned via end-to-end automation in the private cloud environment occurred after four months of work.

The team charted progress against the project goals (see figure 6). As the environment stabilized, the group increased the number of blueprints and improved automation:

• New blueprints were added to the service catalog, bringing the total to more than 80.
• Network and security virtualization were added to the private cloud. As a result, additional capabilities and extensions were added to enhance automated management and deprovisioning.
• Automated functional and environmental testing was added.

**Figure 6. Summary of Key Metrics and Progress Toward Goals**

The first automated provisioning of an SDLC instance occurred after four months of work. The first instance provisioned using the new automation capabilities took 172 hours. Additional improvements were then made, which have reduced provisioning time to 36 hours.

The virtual machines that had previously been manually provisioned in a traditional data center environment have been “turned off” and 2,800 virtual machines are now transitioned to the private cloud.

**Phase 2 (planned):** Efforts in phase 2 are focused on further enhancing automation and management capabilities and transitioning 1,200 load-test and stage virtual machines to the private cloud environment (for a total of 4,000 virtual machines*).

The following key capabilities will be implemented in phase 2:

• Virtual data centers will be set up for load-test and staging instances.
• Full software-defined data center capabilities of the private cloud will be leveraged to enable variable-cost service profiles and further lower the cost of storage resources.
• More application blueprints will be added.
• More functional and environment test capabilities will be implemented to reduce total deployment time to 16-hours provisioning and 8-hours testing.
• Financial management will transform with usage-based chargeback.
• Analytics will be added to enable scaling based on workload performance.

*The team expects to complete the move of stage and load-test virtual machines to the private cloud in the first half of 2014.
Benefits Summary

By investing in and achieving goals related to improving agility for its customers (application developers), corporate IT achieved higher service quality and significantly lower costs.

Automated Provisioning – Improved Developer Productivity and Reduced Operating Costs

- **Developer productivity increased 20 percent or more.** By eliminating the 3-5 week provisioning wait time that occurred multiple times during the SDLC process, VMware optimized the productivity of 600 developers. As the company grows and the number of enterprise business application development projects increases, this benefit will improve project throughput and reduce the need to hire more developers.

- **Development project schedule risk reduced.** Project-schedule dependencies on SDLC instance availability have been removed. No longer process bound, AppOps can provision what developers need, when they need it. Developers do not have to wait for other development projects to finish so an instance can be reused.

- **Quality of SDLC instances improved.** Blueprint-based provisioning ensures that every time a deterministic provisioning and test process is run, the output is identical. Human error is eliminated. AppOps no longer needs to tweak instances after deployment. The team simply modifies blueprints and provisions again.

- **Annual IT operating costs reduced by USD $1.5M.** Automation reduced the number of people responsible for manually provisioning and quality controlling SDLC instances. VMware corporate IT was able to refocus these staff efforts on higher-value work.

Transition Workloads to Private Cloud – Enable Automation and Reduce Annual Infrastructure Costs

- **Cost per virtual machine reduced 80 percent.** The basic service cost per general-purpose virtual machine has been reduced from an estimated $113 to $20 per virtual machine per month (including the equivalent VMware license cost). A single cloud administration team now supports the infrastructure needs of 10 or more tenants.

- **Resources are now managed via API.** The traditional ticket-based system required manual effort from multiple teams to set up and configure infrastructure and applications. Now fully automated, the provisioning process requires no task prioritization—and no wait time.

- **Resources “turned off” when finished.** To avoid a long lead-time for a new SDLC instance, developers previously kept old instances running for future needs. With on-demand provisioning, resources can be returned to the resource pool, in essence creating a disposable infrastructure model.

- **Annual infrastructure costs reduced by USD $4.5M.** By transitioning 4,000 virtual machines to the private cloud, the AppOps team will dramatically lower the cost of infrastructure needed to support non-production SDLC instances.

“With this capability, we moved our delivery model into true agile mode.”

— Job Simon, Vice President, IT Strategy and Architecture, VMware
Lessons Learned

Throughout the project, VMware corporate IT used VMware technologies and gained experiences that led to the following observations:

**Agility investments are self-sustaining.** Corporate IT’s decision to invest in increased agility to meet customer needs yielded significant additional benefits. Enhanced automation and standardization improved the quality of development environments, increased project schedule predictability, and significantly reduced operating and infrastructure costs. The choice to replace and automate rather than to fix the process-bound “human-middleware” task workflow was an effective way to simultaneously meet customer needs and reduce IT costs without hindering innovation as many cost-reduction focused projects do.

**vCloud Suite is a full solution.** The Project OneCloud team deployed vCloud Suite to build and manage a private cloud based on a software-defined data center architecture. The AppOps team also implemented vCloud Suite to automate provisioning and management of SDLC instances. Out-of-the-box functionality gave both teams the ability to automate and manage a wide range of core tasks. But the extensibility of the solution—accessed through the SDK and APIs—enabled AppOps to deliver additional required automation and management functionality, as well as integrate and control multiple third-party solutions.

**On-demand capabilities change IT service consumption.** SDLC instances are no longer viewed as scare resources. Previously, developers felt the need to keep an instance operational for multiple projects. Now when development finishes with an instance, AppOps releases those resources back into the provisioning pool. Corporate IT is working to measure the resource-utilization impact of this significant behavioral shift. It is still unclear if automated provisioning will reduce the overall number of non-production virtual machines as faster, better capabilities are expected to lower barriers and increase demand for development work.

**APIs replace ticketing and late-night meetings.** Using a service catalog and API calls in place of ticketing systems, phone calls and runbooks, helps IT clarify and simplify communication about the services it delivers and what to expect in return. Now there is efficiency where before operations had the time-consuming, difficult and highly variable task of scheduling and coordinating work between multiple globally distributed teams.

Additional Resources


Discover how VMware professional services can help your cloud strategy and roadmap at [http://www.vmware.com/services/accelerate/](http://www.vmware.com/services/accelerate/).