Technical Validation

Consistent Infrastructure and Operations with Dell Technologies Cloud Platform

Enterprise-class Hybrid Clouds for Traditional and Cloud-native Applications

By Jack Poller, Senior Analyst; and Vinny Choinski, Senior Validation Analyst

May 2020

This ESG Technical Validation was commissioned by Dell Technologies and is distributed under license from ESG.

Contents

ESG Technical Validations

The goal of ESG Technical Validations is to educate IT professionals about information technology solutions for companies of all types and sizes. ESG Technical Validations are not meant to replace the evaluation process that should be conducted before making purchasing decisions, but rather to provide insight into these emerging technologies. Our objectives are to explore some of the more valuable features and functions of IT solutions, show how they can be used to solve real customer problems, and identify any areas needing improvement. The ESG Validation Team's expert third-party perspective is based on our own hands-on testing as well as on interviews with customers who use these products in production environments.

Introduction

This ESG Technical Validation documents evaluation of Dell Technologies Cloud Platform. We evaluated how the platform enables organizations to extend their existing investments in infrastructure, people, and skills with a solution that provides day 0, day 1, and day 2 lifecycle management spanning public cloud, on-premises private cloud, and edge infrastructures. We also focused on how the solution integrates VxRail hyperconverged infrastructure, VMware Cloud Foundation, and VMware Tanzu Kubernetes Grid-Integrated (TKGI), unifying management, eliminating silos, and providing consistency across infrastructure, operations, and services.

Background

As organizations embrace digital transformation and the shift to modern cloud architectures, the infrastructure is both growing and becoming more complex. According to recent ESG research, nearly two-thirds (64%) of respondents said that their IT environment had become more complex in the last two years. However, IT budgets aren't keeping pace with this growth and complexity, and organizations continue to give their IT leadership the mandate to "do more with less." Thus, organizations seek increased employee productivity, improved business process, and reduced operating expenses from their IT investments (see Figure 1).[1]

Figure 1. Top Ten IT Investment Justifications

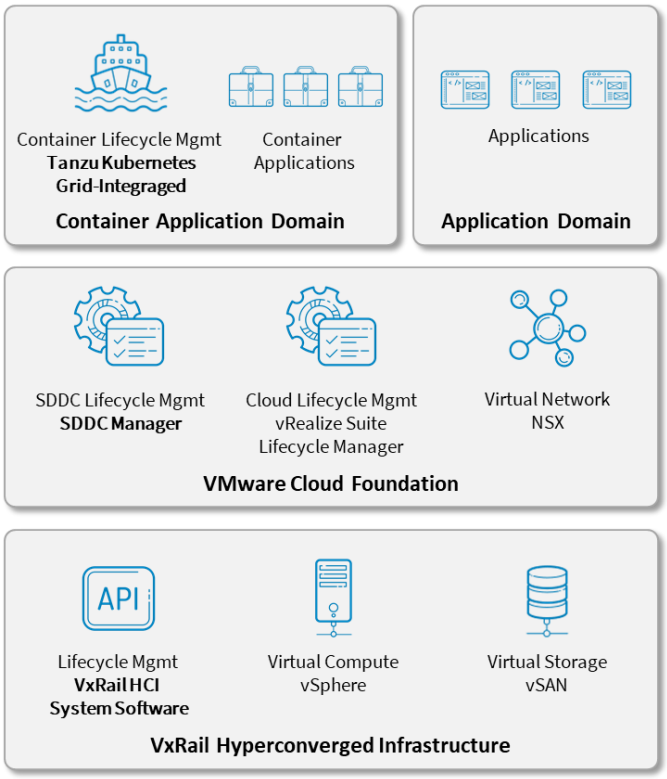
Source: Enterprise Strategy Group

Complexity is never a good thing when it comes to IT infrastructures—complexity means using a multitude of disparate management systems and APIs to deploy and maintain compute, storage, networking, virtualization, containerization, and the cloud. Much of today's modern environments are maintained by highly skilled IT staff using manual, repetitive processes. While IT teams have begun the shift toward automation, these steps are haphazard, uncoordinated, and limited to addressing immediate needs. Exacerbating the challenge, 34% of organizations report a problematic shortage of orchestration and automation skills.[2]

[1] Source: ESG Master Survey Results, *2020 Technology Spending Intentions Survey*, January 2020.
[2] ibid.

Dell Technologies Cloud Platform

Dell Technologies integrated a suite of infrastructure solutions from Dell Technologies and VMware with the goal of providing a single, unified, consistent model and operating structure for hybrid cloud infrastructures. Dell Technologies designed the solution based on three foundational architectural concepts: delivery of a turnkey solution, leveraging VxRail hyperconverged infrastructure (HCI); flexibility, with standardized designs incorporating VMware vSphere, vSAN, NSX, and Cloud Foundation; and full management, incorporating automation and orchestration for simplification and consistency across day 0 deployment, day 1 day-to-day operations, and day 2 maintenance, updates, and expansions.



Dell Technologies Cloud Platform provides a software-defined data center (SDDC) abstraction with a hybrid cloud environment and standardized infrastructure experience; a common set of data services for workloads; a common management model; and workloads abstracted and decoupled from the underlying hardware to enable workload mobility.

The Dell Technologies Cloud Platform SDDC abstraction is based on VMware Cloud Foundation (VCF). The VCF Standard architecture separates workloads into workload domains such as a management domain, used to host the Cloud Foundation management systems; a virtual infrastructure domain for typical and custom organization workloads; Horizon domains for Horizon virtual desktop workloads and management; and Tanzu Kubernetes Grid-Integrated (TKGI) domains for container workloads and management. As the solution uses VMware technologies including Cloud Foundation, organizations can move workload domains and workloads between their own private cloud and public clouds supporting Cloud Foundation, such as VMware Cloud on AWS or Azure VMware Solutions.

Dell Technologies and VMware co-engineered the solution, ensuring tight integration, orchestration, and automation of all components. Organizations deploying Dell Technologies Cloud Platform benefit from:

- **Consistency**—Utilizing VMware Cloud Foundation on VxRail ensures consistent deployment, management, operations, and scaling across infrastructure, compute, storage, networking, and workloads, and ensures workload mobility between public and private clouds.
- **Simplicity**—Co-engineering, tight integration, consistency, and the consolidation of compute, storage, and virtualization into a single solution help to eliminate silos and redundant tools, simplifying deployment, operations, and scaling.
- **Flexibility—**A wide range of node hardware configuration options, consumption models, service models, and deployment models provides flexibility, enabling organizations to right-size solutions to meet their performance, capacity, and budgetary requirements.
- **Scalability—**VxRail HCI is a clustered solution and can both scale up and scale out, enabling organizations to increase compute and storage capacity and performance by adding nodes. Tight integration in the infrastructure management stack automates and orchestrates expansions, simplifying infrastructure management. Nodes can be added to a

cluster in an automated, non-disruptive process. New nodes can be of different hardware configurations so new generations of hardware can be incorporated into existing clusters.

- Cloud mobility—VMware Cloud Foundation ensures organizations can migrate workloads between Dell Technologies Cloud Platform and public clouds including Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform, and more than 4,200 cloud partners.
- Agility—Using familiar VMware tools for provisioning, automation, orchestration, and governance accelerates deployment with a single operational hub for public, private, and edge clouds, and provides flexibility for workload placement.
- Modern architecture—Tanzu Kubernetes Grid-Integrated ensures highly available Kubernetes containerized infrastructure for running modern containerized applications in a flexible, multi-tenant environment. BOSH automates and orchestrates lifecycle management of the Kubernetes infrastructure, and tight integration with the VMware ecosystem simplifies and accelerates the administrative workload.
- Unified architecture—The SDDC separates workloads into workload domains and supports existing applications, modern container-based applications, and virtual desktop environments, eliminating the need for separate siloed environments for different workloads.
- Single vendor experience—Dell Technologies Cloud Platform architecture is based on standardized VMware Validated Designs, and Dell Technologies' support organization tests all configurations, updates, and patches to ensure effectiveness and compatibility. Customers can work directly with Dell Technologies for purchasing, deployment, services, financing, and full-stack solution support.

ESG Technical Validation

ESG's evaluation and testing of Dell Technologies Cloud Platform involved using an evaluation environment to simulate day 0 deployment, day 1 operations and management, and day 2 updates and expansion of the unified and integrated private cloud infrastructure. Our evaluation focused on the simplicity and consistency of management and operations of the infrastructure, and how Dell Technologies and VMware co-engineering the platform resulted in an integrated solution that provides users with a consistent HCI infrastructure operations experience for both vSphere clusters on VxRail and hybrid clouds using VCF on VxRail.

VMware Cloud Builder and VMware Cloud Foundation

ESG's evaluation of Dell Technologies Cloud Platform included deploying VCF on VxRail, SDDC lifecycle management, and TKGI lifecycle management.

The evaluation environment consisted of a fresh deployment of three VxRail clusters. The first cluster was used as the Cloud Foundation Management domain that must be fully deployed before installing Cloud Foundation management components. Using the native VxRail HCI System Software automation simplified and accelerated our buildout of a vSphere cluster and helped accelerate installing the Cloud Foundation management components. The second cluster was used for SDDC workloads and lifecycle management evaluation, and the third cluster was used for TKGI workloads and lifecycle management evaluation.

VMware Cloud Foundation

- ❑Deploy VMware Cloud Builder OVF
- ❑Deploy VCF on VxRail using VMware Cloud Builder

SDDC Lifecycle Management

- ❑Create a new VI Workload Domain using SDDC Manager
- ❑Create a new VxRail Cluster using VxRail Manager
- ❑Add the VxRail Cluster to the VI Workload Domain
- ❑Update the VI Workload Domain

Tanzu Kubernetes Grid-Integrated

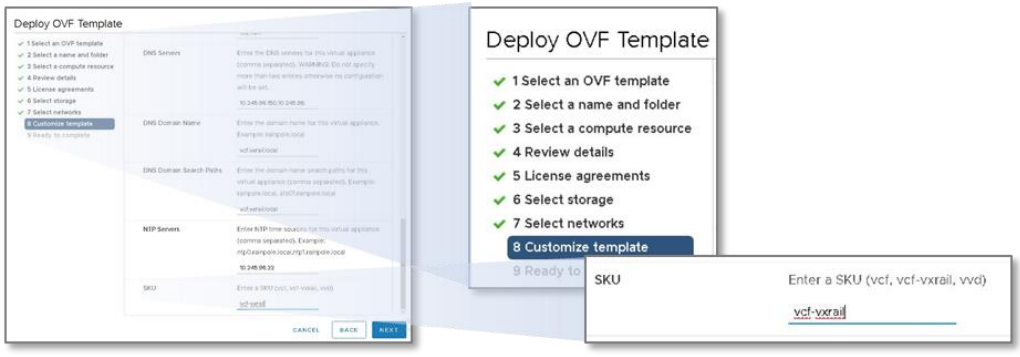
- ❑Create a Kubernetes cluster
- ❑Deploy a container app
- ❑Update the container app
- ❑Scale the Kubernetes cluster
- ❑Update TKGI
- ❑Update Kubernetes

ESG Testing

ESG started the evaluation by deploying VCF on VxRail. In this two-step process, we first deployed VMware Cloud Builder on top of a prebuilt VxRail four node cluster that was configured using the native automated VxRail Manager first run cluster build process, and then used Cloud Builder to deploy VCF on VxRail.

Dell Technologies and VMware jointly engineered VMware Cloud Builder with VxRail integration. Thus, during the vSphere OVF deployment process, when we specified *vcf-vxrail* for the deployment type SKU, the deployment wizard used built-in knowledge of VxRail Manager APIs and services running on the VxRail cluster to automate and orchestrate deployment of VCF onto the VxRail cluster, simplifying the installation and configuration process.

Figure 2. Using VMware Cloud Builder to Install VMware Cloud Foundation on VxRail



Source: Enterprise Strategy Group

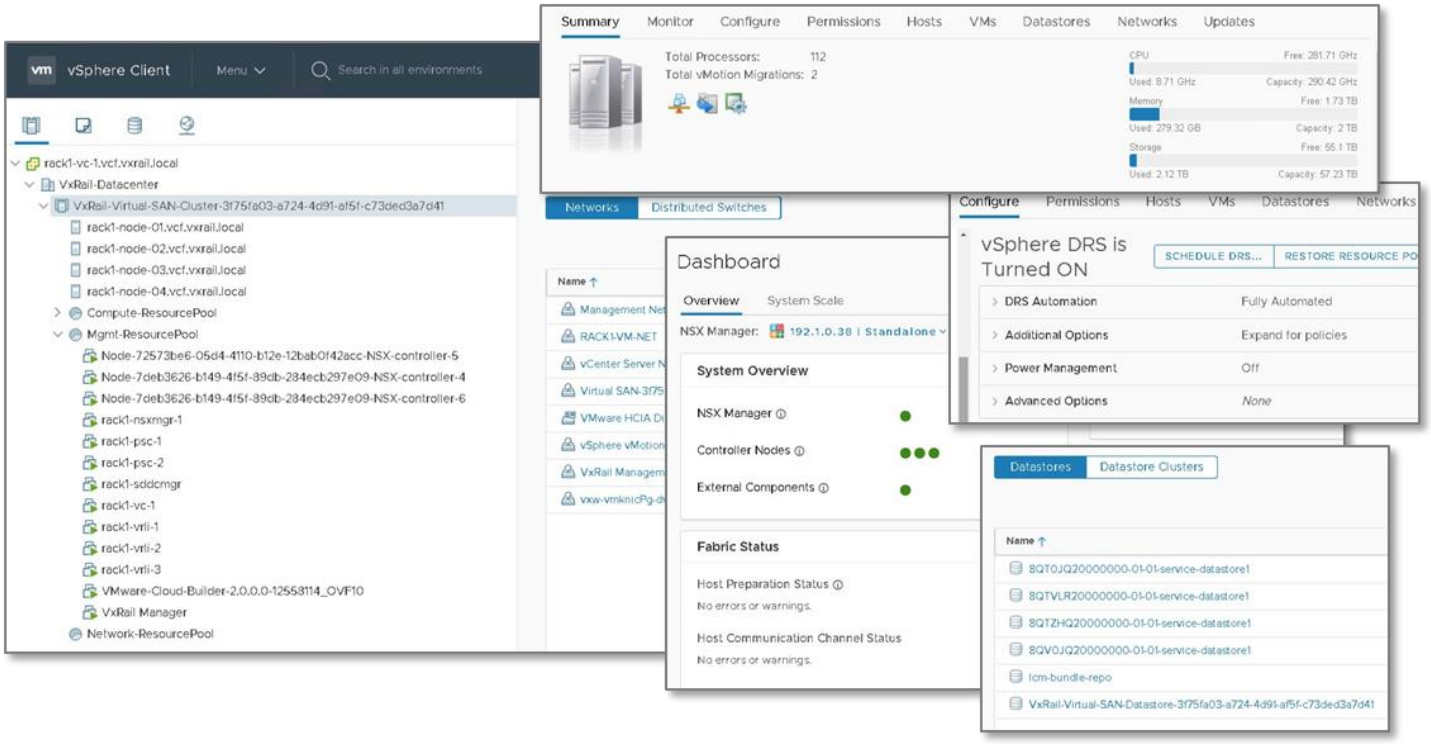
At the end of the deployment process, we started the VMware Cloud Builder VM, and logged in to the Cloud Builder web portal to deploy VMware Cloud Foundation and build the base SDDC infrastructure, including the SDDC management domain.

Dell Technologies and VMware provided a configuration worksheet that enabled us to pre-specify the configuration parameters. We filled out the worksheet and then uploaded it to the Cloud Builder. We clicked VALIDATE to verify our configuration, and then clicked BEGIN BRING-UP to start the process.

The unattended bring-up process completed after a few hours and automated numerous steps, including configuring ESXi, creating and configuring redundant platform services controllers (PSCs), and installing and configuring NSX and SDDC Manager, eliminating the time and effort of manually installing, configuring, and verifying each component.

As shown in Figure 3, Cloud Builder deployed three NSX-V Controller instances, one NSX-V Manager, two PSCs, one SDDC Manager, and three vRealize Log Insight instances. Using vCenter, we observed that vSphere distributed resource scheduler services (DRS) were enabled and configured for full automation. We also observed that the Cloud Builder installed and configured NSX-V, VXLANs, and default NSX-V firewall services, and that all services were operating normally, with no errors or alerts.

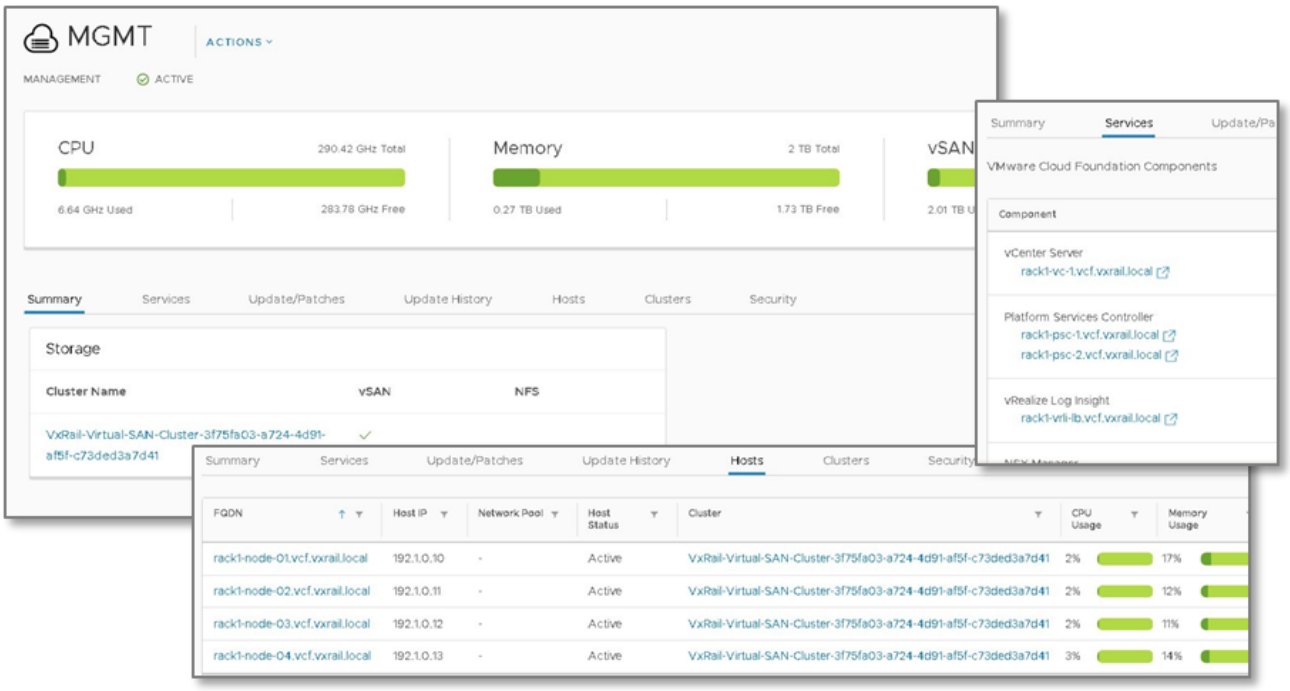
Figure 3. The vSphere View of the SDDC



Source: Enterprise Strategy Group

Cloud Builder created a VCF management domain that can be used by administrators to manage the entire cloud infrastructure. We logged in to VCF and reviewed the management domain. As shown in Figure 4, VCF displays the overall status and configuration of the domain, and provides tabs that enable administrators to review and modify domain configuration. We observed that VCF domains simplify the complex environment, and enable administrators to manage the infrastructure using a higher level of abstraction, simplifying administrator workloads.

Figure 4. The Preconfigured Virtual Infrastructure Management Domain



Source: Enterprise Strategy Group

Why This Matters

IT organizations quickly discover that delivering the simplicity, speed, accessibility, scalability, flexibility, self-service, and other benefits of private clouds can be a complex and painful exercise, requiring the coordination and integration of many components.

ESG validated that Dell Technologies Cloud Platform automated and orchestrated the buildout of a private cloud infrastructure. We pre-specified the desired configuration, and, leveraging built-in integration with VxRail, the vCenter OVF deployment wizard installed and configured the Cloud Builder virtual appliance. Then, using Cloud Builder, we automatically built our private cloud infrastructure, installing and configuring Cloud Foundation, NSX-V, PSCs, and vRealize Log Insight in a high-availability cluster configuration.

Cloud Builder reduces the burden on system architects by deploying a standardized, pretested cloud environment architected using Dell Technologies and VMware best practices that are designed to obtain the best performance and security. The deployment process leverages Dell Technologies and VMware co-engineering that incorporates knowledge of VxRail into vSphere and Cloud Builder. This tight integration used VxRail APIs, automation, and orchestration tools to enable an unattended buildout of a hybrid cloud infrastructure running on VxRail HCI, reducing cloud architect and system administrator workloads by automating the complex and time-consuming effort of manually designing, installing, and configuring a complex cloud infrastructure with multiple disparate components.

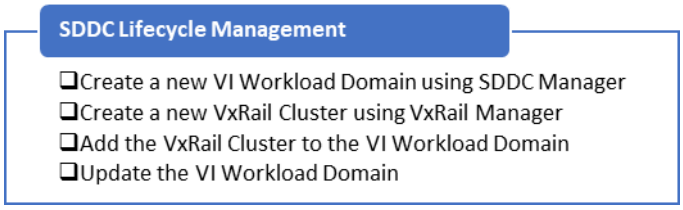
SDDC Lifecycle Management

The full-stack integration of VMware Cloud Foundation (VCF) and VxRail Manager simplifies and automates lifecycle management for day 0 deployment, day 1 operations, and day 2 maintenance, updates, and expansions.

VCF helps administrators manage the software-defined data center, pooling and organizing resources into workload domains (policy-based resource containers with specific availability and performance attributes that combine vSphere, vSAN storage, and NSX networking into unified consumable entities). During the day 0 installation process, Cloud Builder creates a management domain for managing the SDDC running on the VxRail cluster. Administrators can use VCF to automate creation and deployment of domains for Horizon virtual desktop infrastructure (VDI), TKGI container workloads, and other virtual infrastructure workloads. These workload domains aggregate resources from one or more VxRail clusters that have been added to those domains.

Dell Technologies and VMware co-engineering results in full-stack integration, automation, and orchestration of the administrative workload. Administrators can use VCF to manage VxRail-based hybrid cloud infrastructures including day 2 VxRail hardware and the VMware software patch and update operations.

ESG Testing

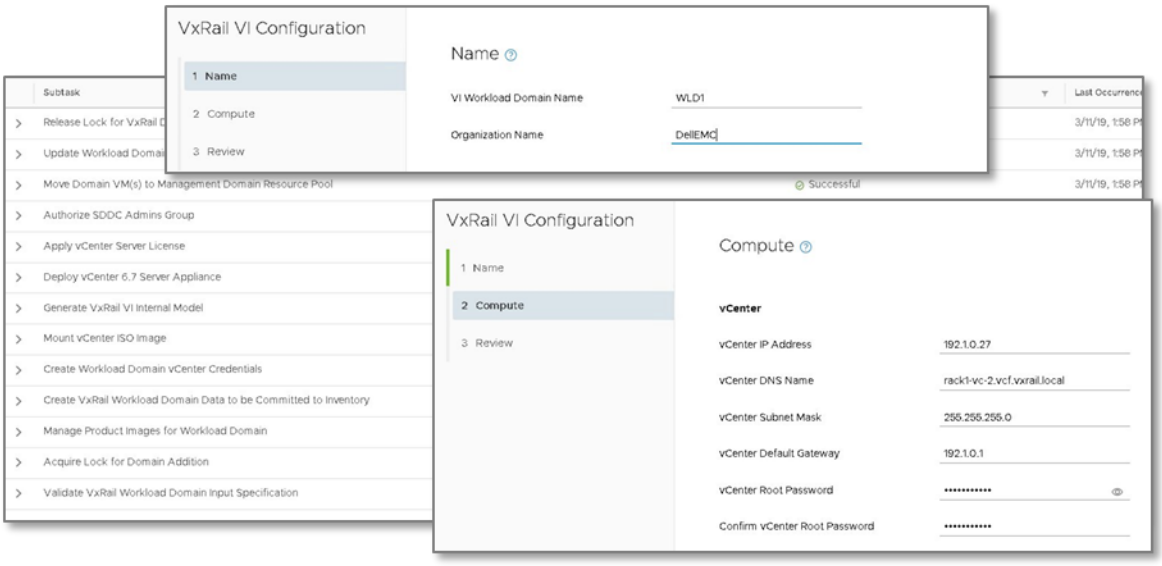


ESG's evaluation of Dell Technologies Cloud Platform SDDC lifecycle management included four steps. We created a new virtual infrastructure (VI) workload domain to host enterprise workloads. To provide compute and storage resources for the workload domain, we created a new VxRail cluster and added the cluster to the VI workload domain. As the last step, we evaluated day 2 lifecycle management by updating the VI workload domain.

First, ESG created a virtual infrastructure workload domain to run application workloads. The steps involved in this process have been designed to seamlessly integrate with the same native VxRail cluster management operational experience that has been jointly engineered by Dell Technologies and VMware for all VxRail cluster management. This delivers a consistent HCI operations experience for administrators using VxRail for standard vSphere cluster deployments and for VCF hybrid cloud deployments.

As shown in Figure 5, the VCF workload domain creation process launched the VxRail VI configuration wizard. We entered configuration information including network addresses and passwords and the name of the new workload domain, *WLD1*. The automated process completed in about ten minutes. VCF completed all tasks, including validating the configuration, managing product images, creating the domain configuration and credentials, deploying a vCenter Server appliance, authorizing an SDDC admins group, moving domain VMs to the management resource pool, and updating the inventory.

Figure 5. Using VCF to Create the VxRail-based VI Workload Domain



Source: Enterprise Strategy Group

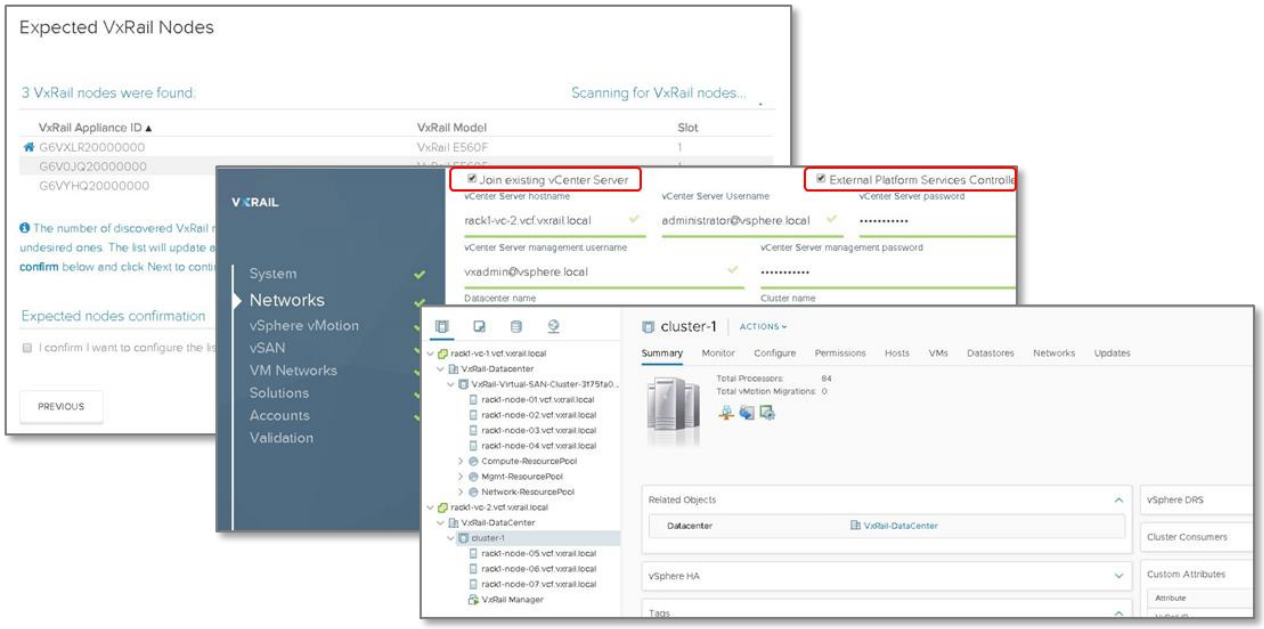
The next step in deploying the VI workload domain was to configure a VxRail cluster to provide the compute, storage, and memory resources for the domain. We used a new three-node VxRail cluster that had just been powered on. Because VxRail comes pre-installed with all necessary software, we were able to bypass the manual process of installing and configuring vSphere and vSAN. Instead, we used the native VxRail Manager deployment wizard process to automate the installation and configuration process of creating a vSphere cluster.

As shown in Figure 6, using a web browser, we confirmed that the deployment wizard had correctly detected and identified the three nodes in the cluster, and then provided configuration information by uploading a JSON-formatted configuration file that we had previously created in conjunction with Dell Technologies. The deployment wizard validated the configuration, populated all fields, and enabled us to review and confirm the configuration.

The Dell Technologies and VMware co-engineered automation enabled us to automatically join the VxRail cluster to the vCenter Server and Platform Services Controller we had just created for workload domain *WLD1*. This is an example of how the end-to-end workflow process in SDDC Manager was engineered to leverage native VxRail deployment operations capabilities. The unattended deployment processed a workflow of more than 75 individual steps, which saved time and effort, and helped to reduce the opportunity for human errors.

We observed that the process joined a second vCenter Server (that was deployed by SDDC Manager during the workload domain creation step) that was now controlling a VxRail data center containing one cluster. The cluster contained a VxRail Manager VM and three VxRail hosts for compute services. The cluster was also configured with vSAN providing storage services.

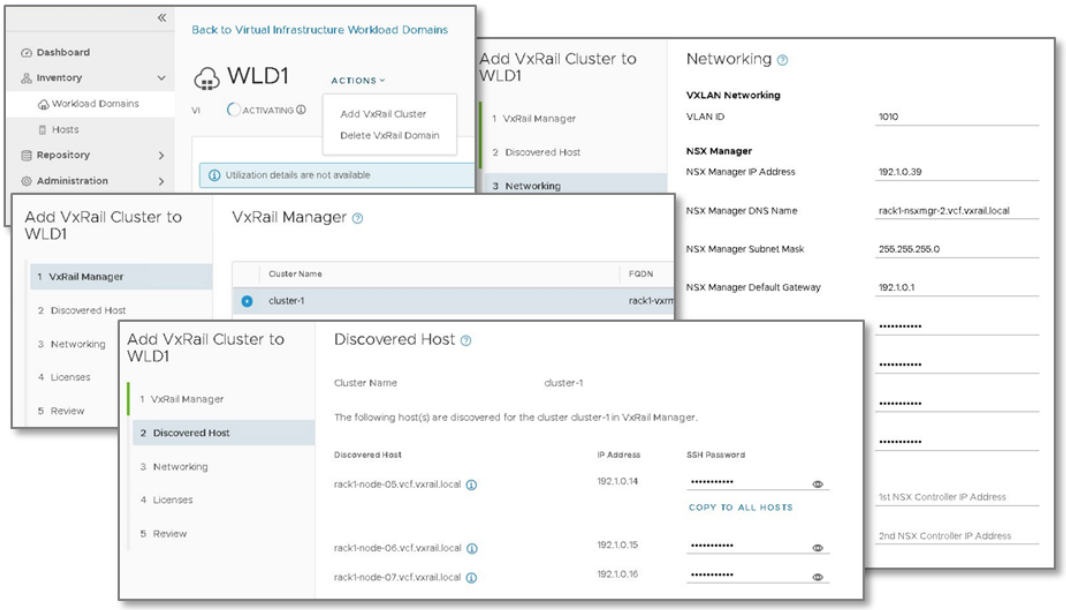
Figure 6. Configuring the VxRail Cluster



Source: Enterprise Strategy Group

Next, we added the VxRail cluster to the VI workload domain. As shown in Figure 7, we specified the VxRail Manager for the new cluster, which enabled VCF to communicate with VxRail Manager to discover cluster configuration information and perform the necessary cluster operations. Using the wizard, we provided SSH passwords and network configuration for the discovered hosts, and the wizard prepopulated license keys using our original Cloud Builder configuration files, so we did not have to re-enter data.

Figure 7. Adding the VxRail Cluster to the VI Workload Domain



Source: Enterprise Strategy Group

The wizard validated the configuration; updated the inventory; populated the cluster-managed object IDs, SSH keys, licenses, and credentials; and installed and configured NSX, including completing the NSX host prep for all nodes in the

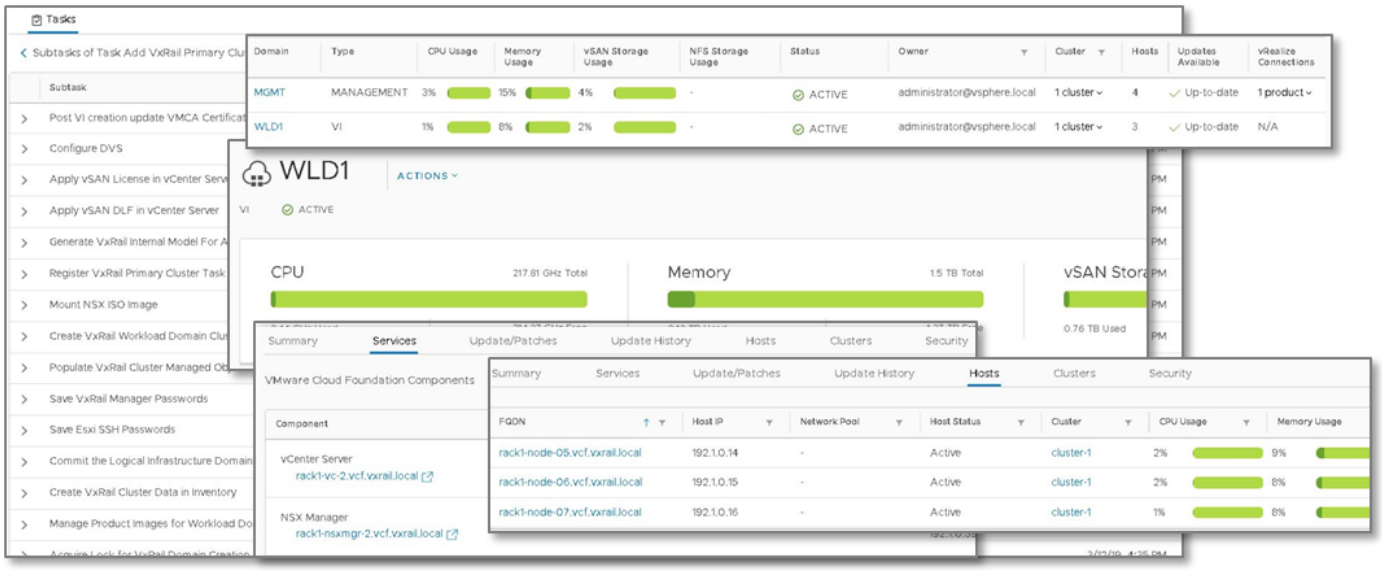
cluster. This automation was the result of the joint development effort between Dell Technologies and VMware. Starting from the point at which the native VxRail Manager automated cluster operations completed, the process automated all steps to make the VxRail cluster ready for VCF use.

As shown in Figure 8, the VCF workload domain dashboard provided status and resource information for both the VCF management domain (MGMT) and the VI workload domain (WLD1). Drilling down for more information on the WLD1 domain, we observed the real-time compute, memory, and storage resource utilization. We clicked on the Services tab and observed that the domain included one instance of vCenter Server and one instance of NSX Manager. The hosts domain displayed the host configuration and real-time resource utilization of the three hosts in the domain.

ESG observed that VCF abstracted many of the complexities of the infrastructure, enabling us to manage logical groupings of resources. Details of resources were available with a mouse click when we needed to explore further. We also observed that the WLD1 vCenter had been linked to the management domain vCenter, enabling us to see all vCenters and their respective clusters in one vCenter view.

Each vCenter was deployed in Enhanced Linked mode, granting a VCF administrator global visibility into all workload domain infrastructure. With each workload domain managed by its own vCenter and NSX Manager, administrators have the flexibility to establish different domain security and configuration policies based on business or workload needs.

Figure 8. Exploring the VI Workload Domain



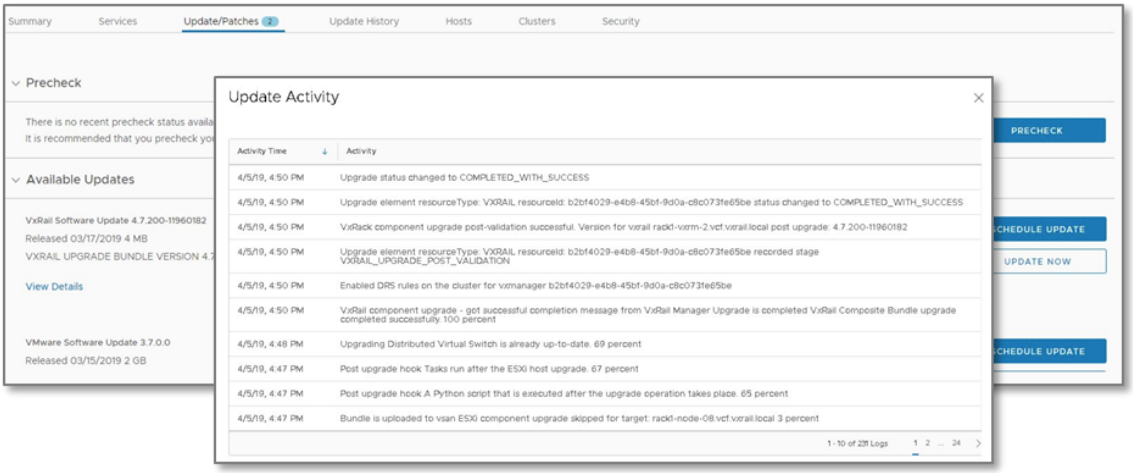
Source: Enterprise Strategy Group

Simulating day 2 operations, we updated the WLD1 workload domain. As the first step, we configured SDDC Manager with credentials for the VMware and Dell Technologies support repositories. SDDC Manager monitors these repositories and notifies the administrator when updates are available for either VCF or VxRail.

As the result of the co-engineering between Dell Technologies and VMware, all VMware Cloud Foundation and VxRail support bundles are pre-validated, enabling administrators to perform full-stack lifecycle management, including firmware, using SDDC Manager. The fully integrated and seamless workflow uses native VxRail Manager API calls to execute VxRail cluster hardware and software updates. This eliminates the requirement to manage firmware independently from VCF software and saves time and effort as administrators do not need to research, validate, and determine which updates are compatible with the different workload domain clusters in their environment.

The Update/Patches tab of VCF's workload domain dashboard displayed two available update bundles, one for VxRail software, and one for VMware software, as shown in Figure 9. We used the automated precheck feature that ensures that the environment is in a healthy state and there are no issues that would cause the update to fail. If there were errors, VCF would display any outstanding issues along with guidance on how to remediate the problems.

Figure 9. Updating the VI Workload Domain and the VxRail Cluster



Source: Enterprise Strategy Group

Why This Matters

According to ESG research, organizations are suffering from a problematic shortage of IT skills: 34% of organizations lack IT orchestration and automation skills, 33% suffer from a lack of cloud architecture/planning skills, and 32% have a deficiency of IT architecture/planning skills.[3]

ESG validated that the full-stack integration of Cloud Builder, VMware Cloud Foundation, and VxRail Manager simplifies and automates the building and day-to-day operations of private clouds. We used VCF to perform unattended creation and configuration of a new VI workload domain and unattended creation and configuration of a new VxRail cluster. We then added the VxRail cluster to the VI workload domain using VCF.

The process leveraged the joint engineering and integration between Dell Technologies and VMware, enabling us to launch an unattended and automated installation and configuration of a complex cloud infrastructure using VxRail HCI System Software and VMware software. The automation and orchestration alleviated error-prone and time-consuming manual efforts.

VCF leverages VxRail update bundles, pre-validated by Dell Technologies and VMware to ensure firmware, software, and running version compatibility, enabling full-stack lifecycle management via a seamless SDDC Manager workflow utilizing native VxRail Manager API calls, simplifying the upgrade process. We used VCF's built-in precheck to ensure that the environment was in a healthy state and there were no issues that would cause the update to fail, and then we performed an automated unattended update of all relevant VxRail and VMware components in the environment.

Dell Technologies and VMware co-engineering automated, simplified, and accelerated the entire process of building a cloud infrastructure, ensuring we could go from VxRail power-on to a private cloud infrastructure ready for application workloads without having to be cloud, virtualization, storage, or networking experts, and without having to manually install, configure, and orchestrate multiple complex components.

[3] Source: ESG Master Survey Results, *2020 Technology Spending Intentions Survey*, January 2020.

VMware Tanzu Kubernetes Grid-Integrated

Tanzu Kubernetes Grid-Integrated (TKGI)[4] is a suite of tools designed to automate, orchestrate, and simplify Kubernetes lifecycle management. TKGI incorporates BOSH (an open source tool for infrastructure release engineering, deployment, and lifecycle management), TKGI (API and GUI to configure and deploy platform components), and Harbor (an open source container registry). VMware has integrated TKGI into the VMware SDDC ecosystem, providing administrators with consistent and unified infrastructure lifecycle management.

The evaluation environment consisted of a fresh deployment of a TKGI instance. This included a TKGI API server, an Ops Manager instance, and a Harbor container registry instance running in a freshly created TKGI workload domain in the VCF on VxRail cloud infrastructure.

ESG Testing

Tanzu Kubernetes Grid-Integrated

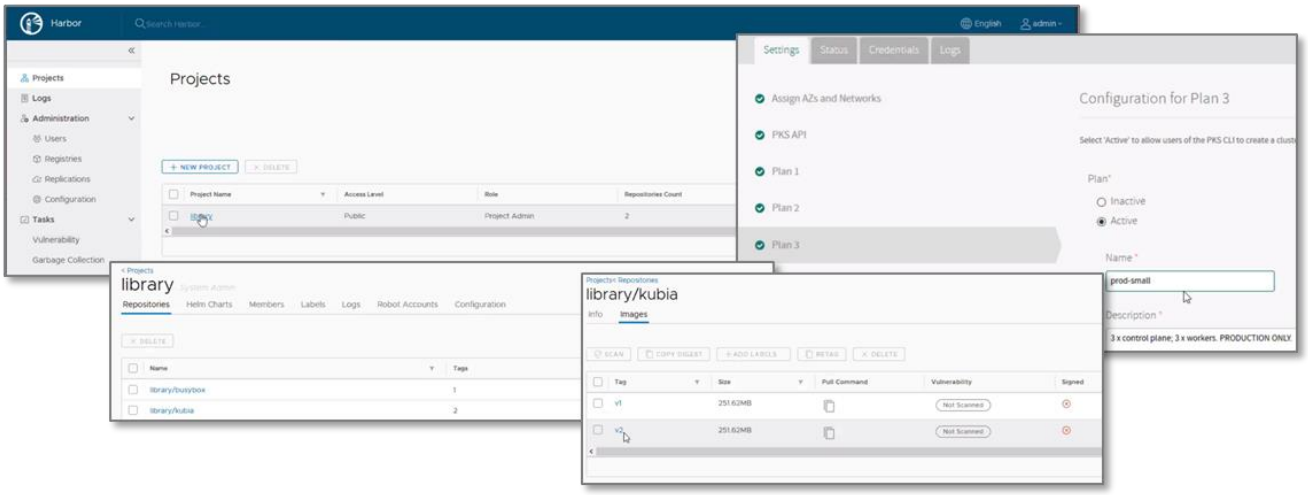
- ❑Create a Kubernetes cluster
- ❑Deploy a container app
- ❑Update the container app
- ❑Scale the Kubernetes cluster
- ❑Update TKGI
- ❑Update Kubernetes

ESG's evaluation of TKGI lifecycle management included creating a Kubernetes cluster and deploying a demo container application. We updated the application and then scaled the cluster. Finally, we updated the TKGI instance version and the Kubernetes cluster version.

ESG started by reviewing the TKGI environment. We logged in to TKGI Ops Manager and displayed the available plans, as shown in Figure 10. TKGI plans are configurations for Kubernetes clusters, enabling administrators to specify Kubernetes cluster parameters including the number and configuration of master and worker nodes, availability zones, and master and worker persistent storage. We reviewed Plan 3, which was named *prod-small* and was configured for three master nodes, a maximum of ten worker nodes, and an initial start of three worker nodes, providing room for scaling.

Next, we logged in to Harbor Registry and explored the project library. The evaluation environment included two versions of kubia, a demo container application.

Figure 10. The TKGI Dashboard and Harbor Image Registry



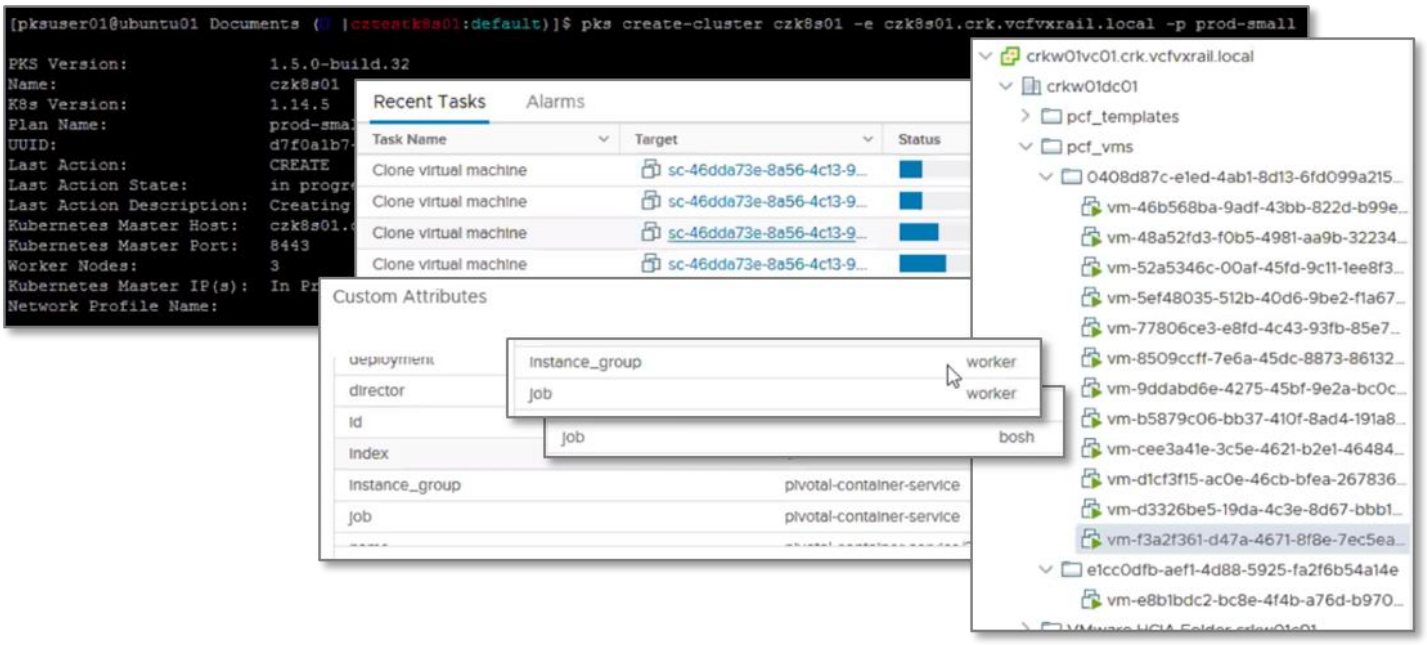
Source: Enterprise Strategy Group

[4] VMware recently rebranded the offering that was once known as VMware Enterprise PKS to VMware Tanzu Kubernetes Grid-Integrated. Some screen graphics and descriptions in this evaluation reflect the retired PKS branding. However, Dell Technologies and VMware have requested we use Tanzu Kubernetes Grid-Integrated in this validation.

Next, we created a Kubernetes cluster. As shown in Figure 11, we used the TKGI command line interface and executed the command `pks create-cluster`, specifying the name of the cluster, the name of the server hosting the Kubernetes API, and the preconfigured plan *prod-small*. TKGI leveraged the automation and orchestration included in BOSH to create a Kubernetes cluster made up of virtual machines. BOSH cloned and configured VMs for the Kubernetes master and worker nodes specified by the plan *prod-small*.

We used vCenter to review the automation tasks and to explore the resulting VM inventory. Each VM in inventory included custom attributes, including job and instance group. Some of the VMs represented core components such as BOSH or TKGI, and some represented the Kubernetes cluster and were tagged as worker or master, enabling us to identify the role for each automatically created VM.

Figure 11. Creating a Kubernetes Cluster



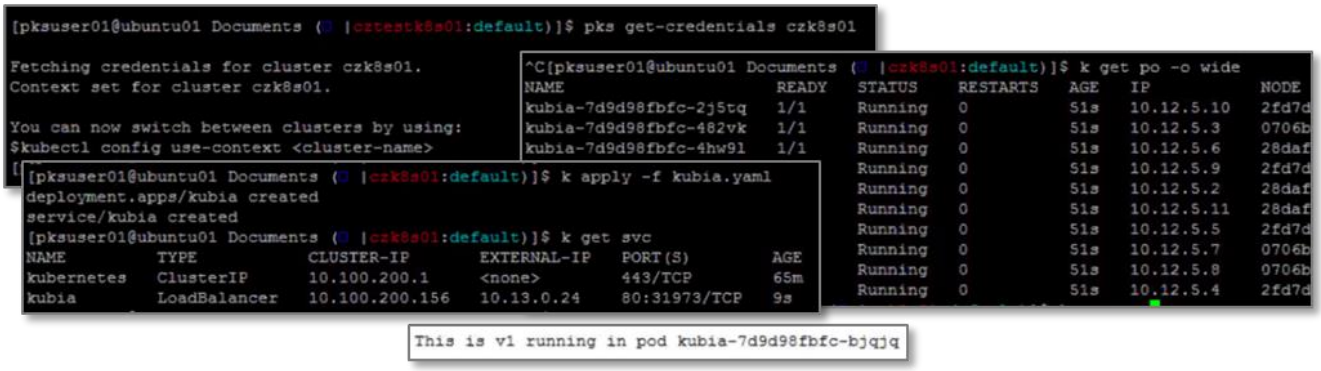
Source: Enterprise Strategy Group

To validate the cluster, ESG deployed kubia, a demo container application. The first step was to configure our user credentials to enable access to the Kubernetes cluster that was just deployed. TGKI automates the complex effort of manually obtaining certificates. Instead of using native kubectl CLI procedures and building a kubeconfig file, we entered the command `pks get-credentials`, specifying the cluster, and TKGI automatically built the kubeconfig file for us, as shown in Figure 12.

Next, we reviewed the config file for the kubia application and noted that the yaml file specified ten instances of app version v1 exposed via a load balancer running on port 80. The kubia demo application leveraged an NSX load balancer that was included in the environment through the full-stack integration of VMware and Kubernetes provided by TKGI.

We deployed the app using the native Kubernetes CLI command kubectl. (Note all kubectl commands were executed using an alias "k" instead of "kubectl" for brevity.) We initiated the deployment using the command `k apply -f kubia.yaml`, and then used the command `k get pods` to verify that there were ten pod instances running. We used the command `k get svc` to find the IP address of the load balancer, and then directed our web browser to the load balancer IP address. The webpage displayed the output of the kubia app: the version and the pod name. Refreshing the page multiple times showed different pod names, confirming that the app was running on multiple pods and the load balancer was performing round robin load distribution.

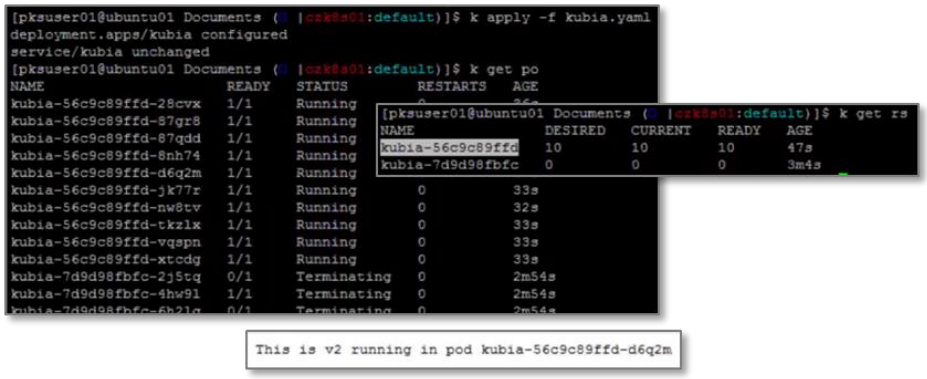
Figure 12. Deploying and Testing a Container App



Source: Enterprise Strategy Group

Next, we updated the demo app. ESG edited the *kubia.yaml* file and changed the application version from v1 to v2. We updated the running configuration to update the app by applying the new config file using the command `k apply -f kubia.yaml`. We used the command `k get pod` to review the status of the cluster and noted that some pods were terminating, and others had just been started. As with the original version of the kubia app, we reloaded the web browser and observed both v1 and v2 were running until all v1 pods terminated. At that point, reloading the web browser showed only v2 running on all pods.

Figure 13. Updating a Container App

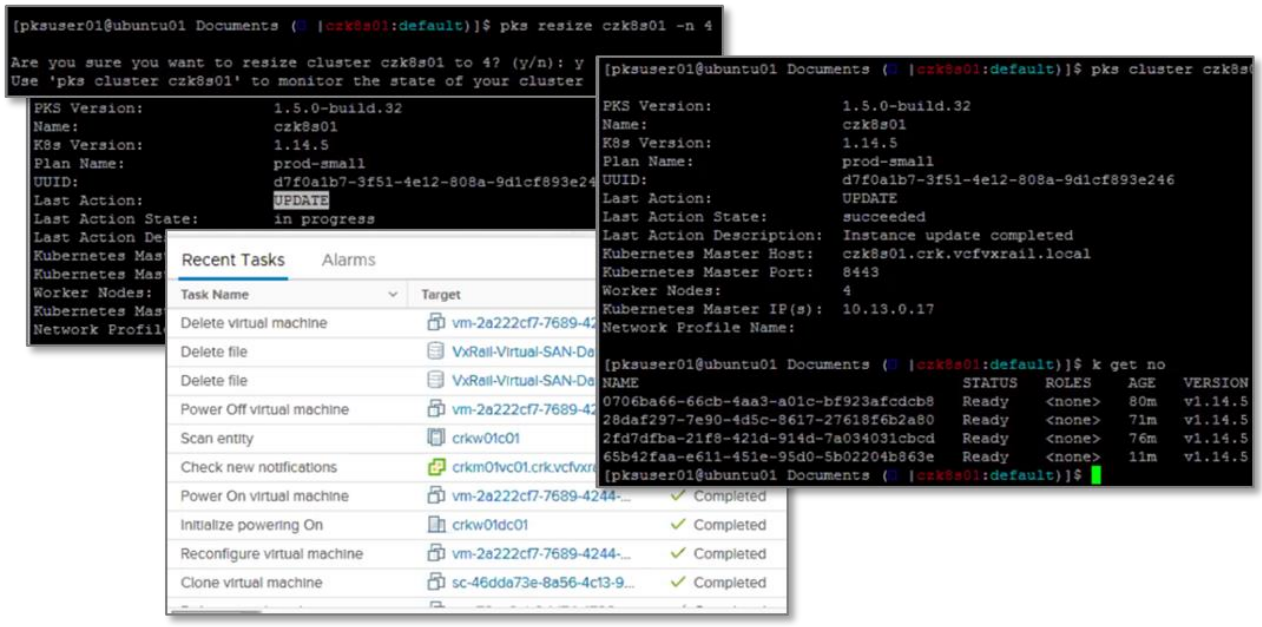


Source: Enterprise Strategy Group

Next, we scaled the cluster, adding a compute node. As shown in Figure 14, ESG used the command `pks resize -n 4` to scale the cluster from three to four nodes. We observed that the update was in progress with the command `pks cluster`. TKGI invoked BOSH to clone a new VM for the new node in the cluster, and we observed the tasks in the vCenter Recent Tasks pane.

We reran the command `pks cluster` and observed that the update was successful. We displayed the node status with the command `pks get nodes` and observed that three nodes were between 71 and 80 minutes old, and one node was 11 minutes old.

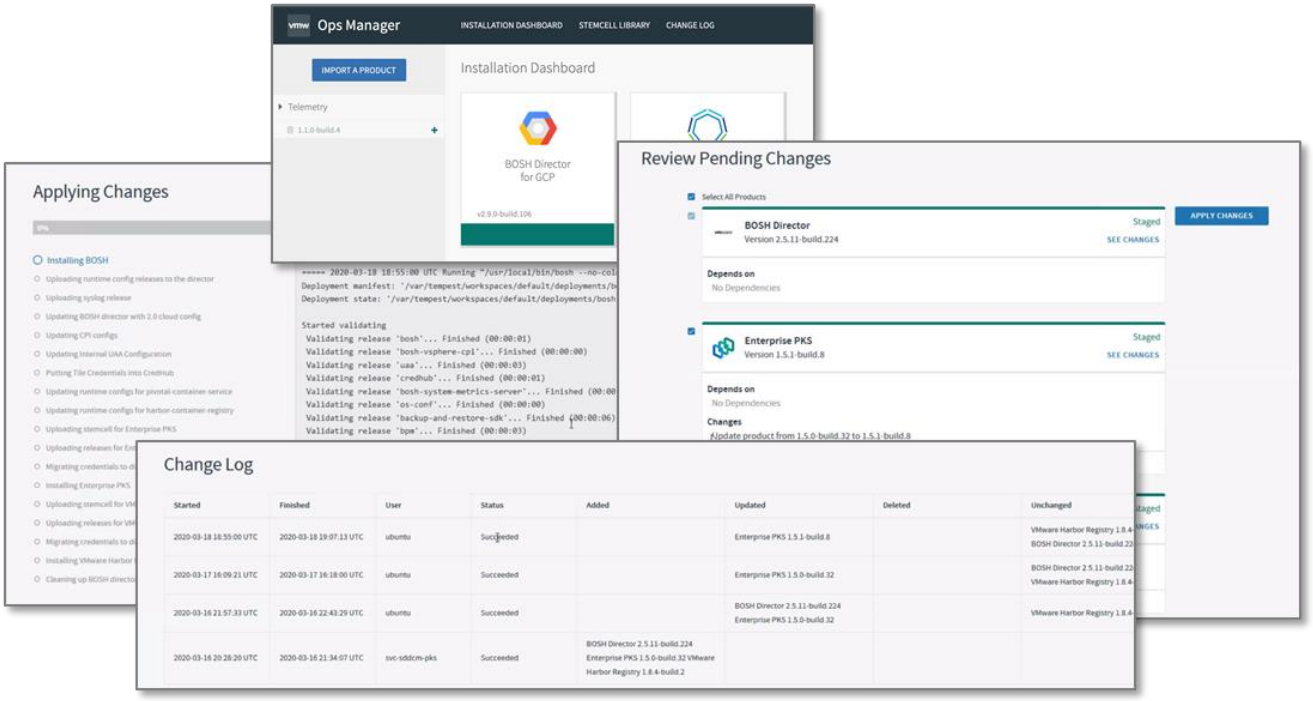
Figure 14. Scaling the Kubernetes Cluster



Source: Enterprise Strategy Group

Simulating day 2 update and maintenance tasks, ESG updated TKGI. Using TKGI Ops Manager, we observed that TKGI 1.5.0 was installed as shown in Figure 15. We clicked on IMPORT A PRODUCT and selected the TKGI upgrade file we had previously downloaded. Ops Manager updated the inventory and displayed TKGI 1.5.1 as an option, which we selected. Ops Manager displayed a pop-up enabling us to review the pending changes, and we clicked APPLY CHANGES. We observed the activities in the Ops Manager update window and, when the update was complete, we reviewed the Ops Manager change log.

Figure 15. Updating VMware TKGI

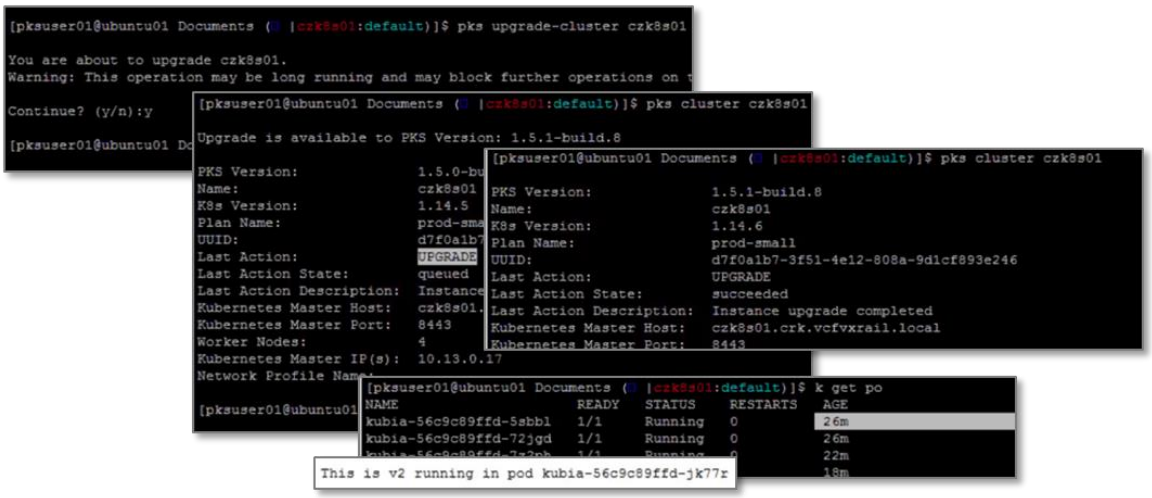


Source: Enterprise Strategy Group

The TKGI update included a Kubernetes update. ESG updated Kubernetes with the command `pks upgrade cluster`. TKGI invoked BOSH, which performed a rolling update, creating new pods running the new version of Kubernetes and terminating old pods. The command `pks cluster` enabled us to observe the update status. When the update was complete, we verified the running Kubernetes version using the command `pks cluster` and verified the age of the pods using the kubectl command `k get pods`.

Throughout the upgrade process, we refreshed the kubia webpage and observed no interruption in application availability.

Figure 16. Updating Kubernetes



Source: Enterprise Strategy Group

Why This Matters

Container adoption is maturing. According to ESG research, 61% of organizations are using containers for production applications, and 79% of those organizations have had production applications on container technology for more than a year. However, implementing a container infrastructure comes with challenges: organizations lack container expertise and struggle with finding the appropriate underlying infrastructure to support containers.[5]

ESG validated that TKGI simplified and automated container infrastructure deployment, day 2 operations, and lifecycle management. Using a TKGI workload domain running on VxRail, we created a cluster, obtained our credentials, deployed an application, upgraded the application, scaled the cluster, and upgraded Kubernetes. Each operation required a single command, and the built-in automation performed all steps, simplifying and reducing administrator workload. We upgraded TKGI and Kubernetes using TKGI Ops Manager, which executed prechecks to ensure an error-free unattended upgrade. TKGI's built-in automation and orchestration simplified and accelerated administrative workload and provided consistency across deployment, operations, and updates.

We found that the Dell Technologies Cloud Platform enabled us to run container workloads on the same infrastructure we used for traditional virtualized infrastructure workloads. The automation, orchestration, and integration of TKGI and VCF on VxRail provided a unified environment for all workloads, simplified and accelerated lifecycle management, and provided consistency of operations.

[5] Source: ESG Master Survey Results, *Trends in Modern Application Environments*, December 2019.

The Bigger Truth

As organizations turn to hybrid cloud infrastructures to meet the needs of the business, architecting, deploying, and configuring the necessary resources continues to present challenges. IT consumes valuable time cobbling together DIY cloud environments, relying on manual processes and the specialized knowledge of highly skilled staff. A critical lack of IT skills impacts the capabilities of internally developed solutions, which are often suboptimal and may struggle to support virtual and containerized workloads.

IT's efforts to automate some of the many manual lifecycle management processes are often limited and cannot support the complex automation and orchestration of the many intertwined components in large-scale hybrid cloud infrastructures. To eliminate this wasted time and labor, organizations need a solution that automates and orchestrates the entirety of hybrid cloud infrastructure lifecycle management.

ESG validated that Dell Technologies Cloud Platform automates, simplifies, and accelerates day 0, day 1, and day 2 lifecycle management, reducing IT architect and administrator workloads. ESG's evaluation revealed:

- Dell Technologies Cloud Platform automated and orchestrated the buildout of private cloud infrastructures, deploying a standardized validated design leveraging Dell Technologies and VMware best practices that are designed to obtain the best performance and security.
- The automated, orchestrated, and unattended deployment capabilities of the platform reduced dependencies on virtualization, storage, and networking expertise, and eliminated manual installation and configuration of multiple disparate components, enabling us to build and maintain complex hybrid cloud infrastructures quickly and easily.
- The platform leverages Dell Technologies and VMware co-engineering that incorporates knowledge of VxRail into vSphere, Cloud Builder, and VMware Cloud Foundation, enabling an unattended buildout and lifecycle management of a hybrid cloud infrastructure running on VxRail HCI.
- Full-stack integration of Cloud Builder, VMware Cloud Foundation, and VxRail Manager simplified and automated day 0, day 1, and day 2 private cloud full-stack lifecycle management and enabled us to build a private cloud infrastructure ready for application workloads without having to be cloud, virtualization, storage, or networking experts.
- Pre-validation of all VMware Cloud Foundation and VxRail support bundles by Dell Technologies ensures compatibility with one another and with the running version of VCF on VxRail. The platform's built-in precheck validates that the environment is in a healthy state and there are no issues that may cause an update to fail.
- TKGI simplified and automated container infrastructure deployment and operation. Many common complex tasks could be executed with a single command leveraging the built-in automation, reducing administrator workload.
- The Dell Technologies Cloud Platform can be used to simultaneously support multiple disparate workloads, including traditional virtualized workloads and modern containerized workloads. The integration, automation, and orchestration of Dell Technologies VxRail, VMware VCF, and TKGI provided consistency across deployment, operations, and upgrades.

ESG evaluated Dell Technologies Cloud Platform in a controlled environment, and due to the many variables in each production data center, it is important to perform planning and testing in your own environment to validate the viability, efficiency, and efficacy of any solution.

Dell Technologies Cloud Platform is an integrated suite of hybrid cloud infrastructure solutions designed to help organizations build and operate cloud infrastructures using standardized designs for HCI, cloud, and container infrastructures. Dell and VMware co-engineered the solution, working to integrate VxRail HCI, VMware Cloud Foundation, and VMware Tanzu Kubernetes Grid-Integrated. If your organization is looking to increase business agility and operational efficiency by streamlining IT infrastructure and optimizing lifecycle management, then ESG believes that you should consider the consistency, simplification, and acceleration of building and operating your hybrid cloud architecture with Dell Technologies Cloud Platform.

Enterprise Strategy Group is an IT analyst, research, validation, and strategy firm that provides market intelligence and actionable insight to the global IT community.

 www.esg-global.com

 contact@esg-global.com

 508.482.0188