Disrupting Our Own Shop—How VMware IT Creates Business Value

VMware IT Performance Annual Report 2018

vmware®

"The tech superpowers of cloud, mobile, AI, and IoT are critical to the development of today's business. While each is transformative in its own right, together they unlock new game-changing opportunities. As VMware continues to bridge across silos of innovation, the true challenge for the IT organization is to develop new capabilities and create new opportunities for diversity and inclusion, which in turn will impact quality of life for everyone on the planet."

PAT GELSINGER
CHIEF EXECUTIVE OFFICER
VMWARE

Table of Contents

Welcome from the CIO

Looking ahead to the coming year and all of the opportunities that lie ahead, I am even more passionate in my belief that there's no better time to be in IT at VMware. Last year, we set out not only to drive innovation in the Internet of Things (IoT), artificial intelligence (AI), and machine learning (ML), but also to sharpen our focus on our talent, ensuring that our people continue to learn and grow in an inclusive environment that promotes diversity of all kinds. To this end, I'm proud that Computerworld ranked VMware as the third-best place to work in IT.[1]

I'm proud of what the VMware IT organization accomplished this year. 2018 was an unprecedented year for IT Operations and for the quality and number of products and services that we showcased at VMworld® US and Europe. These innovations are not only accelerating our own digital transformation regarding people, processes, and technology, but they're also enabling our customers and partners to do the same. As I engage with customers around the world, what's becoming more clear is that IT transformation is not just a nice-to-have anymore; it's now an urgent business imperative, with business goals fully dependent on IT Operations. In fact, according to Gartner, two-thirds of all business leaders believe that their companies must pick up the pace of digitalization to remain competitive.[2]

Our dream—and one that I believe we can achieve—is to get to the No. 1 position. But how do we get there? It will take all of us, working together as an organization. It's about doing meaningful work, innovating, and feeling passionate about making a difference in the community. I feel honored to be working for a company whose value system supports inclusive communities, where people with diverse backgrounds and orientations feel included, welcomed, and want to come to work. My IT leadership team and I are committed to creating this kind of environment where people's voices are heard, and they can be authentic and inspired.

I like to say that we are disrupting our own shop at VMware. What does that mean, exactly? First, we're powering our products with AI and ML to bring more intelligence to everything we do. Second, combined with AI and ML, VMware edge and IoT solutions are emerging as critical components to make operations

[1] VMware. "Computerworld's 100 Best Places to work in IT 2018: VMware Ranks #3 Among Large Organizations." Leona Sullivan. June 18, 2018.

[2] Gartner, Inc. "Embrace the Urgency of Digital Transformation." Susan Moore. October 30, 2017.

more agile and capture next-gen opportunities. With greater frequency, organizations are requiring solutions for the edge that simplify IoT complexity, secure edge infrastructure at scale, and accelerate innovation with a ubiquitous, digital edge-to-cloud foundation.

In disrupting our own shop, we've become uniquely suited to helping IT organizations make the transition from service providers to true strategic business partners advancing the business. With this evolution, I am even more encouraged about the possibilities for CIOs to start running the business in CEO and leadership roles.

Albert Einstein said, "The true sign of intelligence is not knowledge, but imagination." As we continue to transform the workplace and reimagine how we live, work, and play, we can all learn from the collective experiences of our customers, partners, and communities disrupting their own shops and sharing in our successes. May the next year be one of growth, learning, and great momentum as we continue our transformation journey together.

Running a Tight Ship

At VMware IT, we understand that running a tight ship—paying close attention and continuing to improve the ways we work—empowers our people to think big. Our people will never stop asking the disruptive question, "Is there a better way?"

One of the most important jobs facing VMware IT is to help maximize the productivity of the company's software engineers. We are always seeking new and better tools to automate and streamline the process and accelerate development projects. Our engineering teams create and destroy 1,300,000 virtual machines (VMs) and 185,000 containers every week.

Keeping our complex infrastructure running at peak performance levels is a balancing act. IT managers want to minimize the time spent on routine tasks and devote more resources to innovation. At the same time, reliable, responsive service delivery is always the top priority. To meet this challenge, VMware IT deploys first-class tools, cultivates a DevOps culture, and invests in training our people to improve our operational efficiency.

2 out of 3
of all business leaders believe that their companies must pick up the pace of digitalization to remain competitive.[2]

Over 6%
Improvement in IT Portfolio Health in 2018.

We started an IT Portfolio Management function in 2017 to capture holistic IT spend within VMware and, due to these efforts, we've seen a year-over-year 6% reduction in our "Run" expense (with respective growth in higher value Grow and Transform investments).

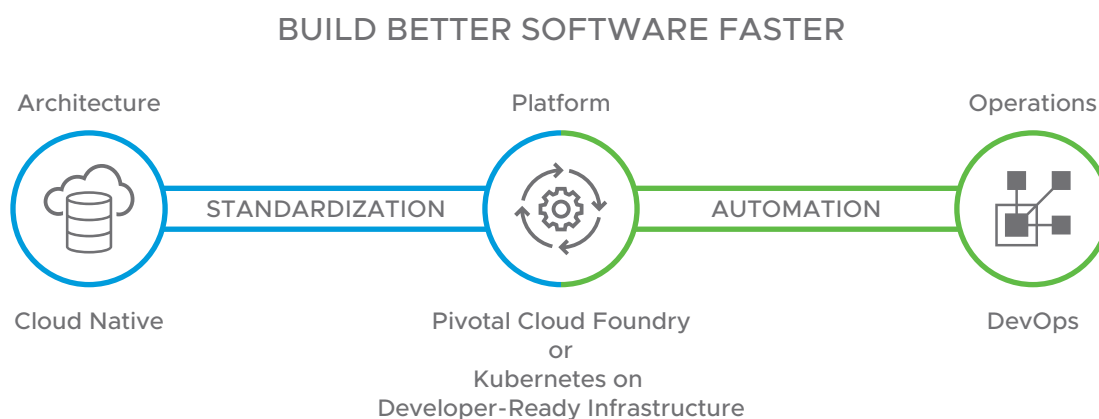"Before you can revolutionize IT, you need to make sure you keep the lights on."

BASK IYER
CHIEF INFORMATION OFFICER, VMWARE;
GENERAL MANAGER, EDGE/IOT, DELL TECHNOLOGIES

Boosting R&D Productivity and Disaster Recovery Readiness

First, a new service desk application enables engineers to track, manage, and resolve requests quickly and efficiently. A customizable workflow management system keeps teams organized and on schedule. A team collaboration tool integrates with the service desk application to enhance project transparency and automatically link issues to documentation. VMware's Application Lifecycle Management application offers an enterprise-level, industry-standard system for quality management. Working together, these tools empower engineers to finish their projects faster and increase the quality of released code.

The same empowerment philosophy applies to disaster recovery. We use VMware Cloud™ on AWS to maintain a replica of some of our critical application environments for seamless failover and failback to achieve our targets for recovery point objectives (RPOs) and recovery time objectives (RTOs). The service desk application helps avoid downtime if a developer's production site becomes unavailable: It initiates an immediate failover for the affected host site to the replica on VMware Cloud on AWS with minimal interruption of service.

BUILD BETTER SOFTWARE FASTER

Architecture	Platform	Operations

STANDARDIZATION   AUTOMATION

Cloud Native	Pivotal Cloud Foundry or Kubernetes on Developer-Ready Infrastructure	DevOps

Improving SaaS Uptime

Our highest priority is transitioning from perpetual software to Software as a Service (SaaS). To help maintain the reliability of all our SaaS applications, VMware IT originally operated two Command Centers. One focused on internal IT services and a second focused on SaaS services. We have now consolidated support into a single Command Center that handles both IT and SaaS services. Highly trained site reliability engineers are on duty around the clock to solve problems quickly. Managing our SaaS deployment centrally reduces training costs, improves service reliability, and allows our SaaS applications to scale gracefully.

Shifting Our Data Center Footprint

As public cloud usage grows, private cloud usage grows as well. To support that growth, we expanded one of our largest data centers, which is also Leadership in Energy and Environmental Design (LEED) certified. Our internal data center service operates like an independent business with its own cost model, service-level agreements (SLAs), and chargeback mechanism.

As VMware grows, we also need to shift workloads to more modern data centers that feature lower Power Usage Effectiveness (PUE) and higher density. Moving workloads between data centers is time-consuming and can involve significant downtime. We recently moved all applications in an entire IT production data center to another data center using technologies such as VMware HCX, Disaster Recovery as a Service (DRaaS), and VMware vSphere® vMotion®. As a result, we limited downtime to just over four hours.

Advancing Security and Connectivity for Public Clouds

Deploying public and private clouds isn't enough: You need a way to operate them efficiently. VMware IT's Cloud-Connect-as-a-Service (CCaaS) solution functions as the glue that ties our clouds together, allowing IT to manage them as a single hybrid environment as well as connect and migrate workloads easily among the different clouds.

This innovative approach offers highly reliable and fast multi-cloud connectivity through dedicated connections from our two major on-premises data centers. As a result, we achieve advanced security, new levels of scalability, consistent network performance, enhanced IT visibility, and a single point of policy enforcement—all important components of our service delivery strategy.

Managing Configuration Information

To accelerate the evolution of a large infrastructure such as ours, IT staff needs information as quickly as possible. For example, to deploy a virtual machine, engineers require affinity information to make sure that redundant, load-balanced VMs are not deployed on the same hardware. In case of a hardware failure, technicians need to know which VMs, applications, and customers are impacted.

We addressed this challenge by implementing a home-grown configuration management database (CMDB) that centralizes all relevant information. Over the course of the year, our teams continued to discover additional use cases. For example, VMware IT recently started managing software licenses using the information in the CMDB. We are also mapping application costing with this system.

Ensuring High-Quality, Fast-Cadence Releases

We have taken steps to speed and simplify the complex, multi-step flow of code from the developer's desk, to the central repository, to merging with the existing stable codebase. Today, after years of refinement, we have fully streamlined this developer workflow. The end result is a stable codebase after every code commit and merge.

Components of this process include our Continuous Integration (CI) toolbox, which comprises Jenkins, open-source code review tools such as Review Board and Gerrit, and more. These components are offered through a managed SaaS solution that is operated and supported centrally 24x7. Teams can define their custom workflows for CI and enable the proper level of testing over another centrally managed system: Continuous Automated Testing (CAT). Nothing is left to chance.

Aligning IT Service Delivery with Operational Excellence Goals

VMware IT is undergoing a transformation to align with VMware's Operational Excellence goals. As a first step, our traditional approach to IT delivery is changing into a service-oriented delivery model. Like most technological transformations, our change management involves people, technology, and process elements. People and culture are at the core of this initiative.

On the technology side, we build reliability, resiliency, and robustness into our services to achieve high availability. We also track a core set of key performance indicators (KPIs) to meet SLAs and service-level objectives (SLOs). By diligently automating all components of the infrastructure, we gain the ability to perform deployment, rollback, and post-production operations.

On the process side, we monitor and assess applications and infrastructure through synthetic operations in both pre-production (staging) and production environments. As part of our Production Readiness Assessment (PRA), we continually review our business continuity, disaster recovery, security, and compliance plans to detect potential issues early, before the service goes into production.

In addition, VMware IT has embraced a DevOps culture across our engineering teams and adopted an aggressive cloud-native application development strategy based on containers, microservices, and dynamic orchestration. Key components of the VMware cloud-native environment include Kubernetes as a Service (K8aaS), the Pivotal Application Service (PAS), and Spring Boot—an open-source Java-based framework that is ideal for microservices development. VMware IT operates an internal K8aaS platform, Pivotal Container Service (PKS). Using K8aaS, VMware developers can deploy Kubernetes Pods and individual Docker-compatible containers on demand.

PaaS (Platform as a Service), an application runtime that supports continuous delivery and horizontal scalability, offers important capabilities such as containers, which are essential for creating stateful clusters, content management systems, and other applications. This feature-rich environment provides powerful tools for our software engineers, including Database as a Service, integrated monitoring, out-of-the-box abstraction and automation, quick provisioning, auto-scaling, and self-healing. An intuitive self-service portal functions as a one-stop shop, helping developers quickly access resources that help them streamline and accelerate cloud-native development. The business outcomes have been significant: Our VMware IT team can now onboard projects in less than a day, and we have seen a 95 percent decrease in support tickets for resource provisioning.

Operational Excellence begins with ownership and discipline. We implemented a build-and-operate model across all applications, enabling developers to retain end-to-end ownership of an application. Our Command Center is the common subsystem that monitors both infrastructure and applications. Command Center is integrated with third-party tools for notification, communication, and status updates.

VMware IT has embraced a DevOps culture across its engineering teams and adopted an aggressive cloud-native application development strategy.

Achieving Operational Excellence is a journey. VMware IT is confident that we are moving in the right direction by iteratively improving and automating every element of our operational machinery.

Driving SaaS Transformation

For an enterprise software company, moving to a SaaS model requires changes in every part of the organization, including IT. When the product release cycle moves from annual to weekly, dev/test and staging environments become as critical as the production environment. All environments require a similar degree of operational attention.

VMware back-office systems used to be critical at the end of each quarter to close the books. Now, our customers use SaaS services running on back-office systems continuously. This gives them the ability to see near-real-time figures without long running tasks.

Assessing Production Readiness

As VMware transitions from on-premises software to a SaaS model, our Cloud and Productivity Engineering team is working to enable a seamless transition. The focus of their work is the Production Readiness Program (PRP), which consists of the PRA and the Building and Operating SaaS (BOSS) program. This program applies both to SaaS services and to internal IT development.

As its name implies, a PRA helps IT answer the question, "Are we ready?" It functions as a one-stop shop for security, compliance, and operational best practices, and offers important technical guidance for determining service readiness. A key part of the assessment is to thoroughly analyze and understand the root causes of failures prior to launch, which reduces the incidence of post-deployment problems.

The BOSS program consists of the BOSS Guide and the BOSS Blueprint. Think of the BOSS Guide as a readiness catalog that provides curated information about key internal processes such as legal, business, engineering, and operations. The guide features a dynamic content layout together with searchable information and automatic updates to keep information fresh and relevant.

The BOSS Blueprint contains best practices for development areas such as security, compliance, performance, utilization, cost analysis, reliability, and business continuity. The BOSS Blueprint also shows IT teams interdependencies between services—for example, how one service's RTO, RPO, and SLO affect those parameters in other services.

The BOSS Blueprint contains best practices for development areas such as security, compliance, performance, utilization, cost analysis, reliability, and business continuity.

"Without VMware IT's feedback during the product development process, we could not deliver as good a product to our customers as we do."

RAGHU RAGHURAM
CHIEF OPERATING OFFICER
PRODUCTS AND CLOUD SERVICES
VMWARE

Drinking Our Own Champagne

Before being released to our worldwide customer base, VMware products are developed and tested in real-world environments—our own. The official name for this program is VMware on VMware (VoV), but we like to think of it as drinking our own champagne.

Through the VoV program, VMware IT partners closely with research and development (R&D) to identify bugs, request features, and validate that products are easily scalable—a vital must-have in the cloud era. As another aspect of VoV, VMware IT partners with our field organization to share product development journeys and thought-leadership topics with customers.

Experiencing New Levels of Excellence at VMworld 2018 US and Europe

VMworld events are a crucible where people and technology come together to push both to new levels of excellence. VMware IT draws heavily on our own best-of-breed products and services to provide the infrastructure that makes VMworld a must for our customers, partners, and vendors.

The VoV team was busy at VMworld 2018 US. Three thousand attendees heard VMware IT staff present topics based on their real-world deployment experiences with products ranging from VMware NSX®, VMware Horizon®, VMware vSphere, and Windows 10 to digital transformation, cloud-native development, and DevOps. One of our most popular sessions in the Leading Digital Transformation track was "A Fly on the Wall: VMware IT Staff Meeting."

These interactions serve a dual role: sharing our experiences using VMware products in our own environments, but also learning from our customers about their challenges and successes. The following sections describe the roles that key VMware products played in making VMworld 2018 a memorable experience for attendees and colleagues alike.

"VMware IT is a key element to enabling the two engines driving VMware: customers and innovation. Along every step of our customers' transformational journey into the cloud and the modern digital workspace, VMware IT serves as 'Customer Zero,' a proving ground where all of our products, solutions, and services are deployed internally and meet the highest standards. VMware IT enables flexibility, security, and choice so that customers can focus on business success."

SANJAY POONEN
CHIEF OPERATING OFFICER
VMWARE

VMworld 2018 US Usage Statistics – Total Delivered

11,875
LABS

121,922
VIRTUAL MACHINES

14,692
NSX NETWORKS

8,643,744
vSAN STORAGE (GB)

TOP 5 HANDS-ON LABS AT VMWORLD 2018

VMware NSX Data Center – Getting Started

What's New with VMware vSphere 6.7

VMware vSAN 6.7 – Getting Started

VMware Cloud on AWS – Getting Started

Virtualization 101

VMware Hands-on Labs: Test-Driving VMware Products

VMware Hands-on Labs provide customers with unique access to our latest full-product technologies before purchase—like test-driving a new car. Hands-on Labs are a perennial favorite at VMworld conferences everywhere in the world. This year's event in Las Vegas was no exception, delivering almost 12,000 labs in five days.

Delivering VMware Hands-on Labs presents unique challenges in terms of scalability, agility, and interoperability. To meet the need, VMware IT relies on our private cloud and two public clouds: VMware Cloud on AWS and IBM Cloud. Nearly half of the workload for VMware Hands-on Labs runs through the public clouds, clearly demonstrating the value of a hybrid cloud model to support large fluctuations in demand.

VMware Learning Platform: Training and More

VMware Learning Platform™ showed its mettle at VMworld 2018 US, supporting concurrent use by as many as 650 people at a time. Conference attendees obtained hands-on training for new and existing products, a methodology that we find to be far more effective than traditional video instruction. As a bonus, those potential users doubled as beta testers who put our newest offerings through their paces.

VMWORLD 2018 US HANDS-ON LAB

VMware Cloud on AWS: Powering the VMworld Portal

The VMworld Portal is an enterprise-grade application with a web interface and a database backend. While the VMworld Portal is accessible year-round, it naturally experiences a huge surge in demand during the conference itself.

Fortunately, VMware Cloud on AWS handles variable demands with ease. The VMware IT team could easily scale to support peak usage at VMworld 2018, adding needed resources within hours. When the doors closed behind the last of more than 20,000 attendees, the VMworld Portal had maintained an exceptional level of availability and responsiveness, even during the busiest events.

Architecting a Multi-Cloud Strategy for the Long Term

VMware Cloud on AWS serves as our hybrid cloud environment. Because our private cloud and hybrid cloud use the same software stack, it is easy to move workloads back and forth between the two clouds. One of the clouds acts as the disaster recovery application for the other cloud.

There were compelling reasons for VMware IT to incorporate a multi-cloud approach. While our private cloud offers tremendous control over operations, we did not want to build to peak capacity. By employing private, hybrid, and public clouds, our capacity is both unlimited and inexpensive. It is more cost-efficient to use hybrid and public clouds for bursting workloads.

Compliance is made easy as well. Corporate-wide compliance is still standardized on VMware's private cloud, incorporating physical data center presences (footprints) co-located with our various multi-cloud partners. These footprints include DNS, Active Directory, Layer 7 protection, deep pocket inspection, and all of the typical aspects found in an on-premises solution. In addition, consistent uptime is guaranteed if a single cloud goes down.

Our teams even eliminated one of the biggest potential drawbacks of a multi-cloud strategy—cost overruns—thanks to our acquisition of CloudHealth. Often, IT teams would utilize cloud services without knowing the ongoing costs, only to receive an often-unwelcome bill the next month. With CloudHealth, IT management knows the exact cloud costs at any given moment, and can respond appropriately to stay within budgets.

VMWARE MULTI-CLOUD DRIVERS

Cost and
Utilization
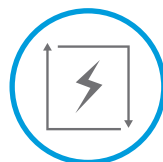
Resiliency and
Disaster Recovery

Mergers and
Acquisitions

More than 50%

reduction in VMware's public cloud expenses achieved through VMware IT's use of CloudHealth analytics.

Optimizing Cloud Spend with CloudHealth

In order to improve visibility and control costs for our public cloud spending, we researched several SaaS-based cloud management solutions and settled on the platform from CloudHealth, a leading cloud services company acquired by VMware in 2018. The CloudHealth platform makes important contributions by monitoring departmental cloud budgets and detecting wasteful spending. Managers receive automatic alerts when their group's cloud spend exceeds 80 percent of budget, giving them time for corrective action. Thanks to CloudHealth, VMware business units now have granular insight into the actual costs of using public cloud resources.

Reserved Instances (RIs), an AWS pricing model, allows users to reserve resources at a more advantageous price compared to on-demand pricing. VMware IT used the CloudHealth platform to analyze historical information and make more accurate forecasts of our needs. Armed with these predictions, we increased the RI portion of our AWS usage from about 20 percent to 65 percent, which cut VMware's public cloud expenses by more than 50 percent.

Achieving Application-Level Disaster Recovery with VMware Cloud on AWS

The traditional IT approach to disaster recovery is implemented in active/passive mode, with equal capacity in the primary and disaster recovery sites. That means the capacity in disaster recovery sites is idle and unused. In addition, most of the replication is infrastructure-based, which makes it difficult to do any granular failover. This leads to a lack of disaster recovery testing and, consequently, a low confidence level in disaster recovery. As a result, disaster recovery is rarely used and not functional when it is used because of the lack of testing. In short, we are wasting half our capacity.

VMware Cloud on AWS comes with DRaaS, which enables granular failover at the application level. This approach is much more functional and has more use cases. Also, if VMware Cloud on AWS is used for disaster recovery, in most cases, you will not need all the compute capacity all the time. You can ramp up the compute capacity during a disaster.

Running a First-Class Private Cloud

VMware operates one of the largest private clouds in the world—something in which we take great pride. However, we can never rest on our laurels—there's always room for improvement. In 2018, VMware IT was tasked with finding better ways to manage our growing population of private clouds throughout the VMware infrastructure. The goals were to improve agility and scalability.

It was a challenging initiative. VMware IT supports technical marketing, global support services, R&D, and other tenants with a range of services including Infrastructure as a Service (IaaS) and Desktop as a Service (DaaS). In addition, our private clouds used a range of software products including VMware vRealize® and VMware vCloud Director®.

Changing the Mindset

The team began by looking beyond technology issues to understand the organization's working culture. Structurally, VMware IT had a mindset that emphasized operations over site reliability tasks such as automation and self-healing work. The plan was to turn that around and put the focus on automation and self-healing work—prioritizing Dev in the DevOps model.

Also, a siloed workload system was getting in the way of problem resolution. In addition to handling daily operations, junior site reliability engineers were responsible for troubleshooting. In contrast, their senior counterparts were busy building new services focusing on architecture and site reliability tasks.

Learning Collaboratively

One of the guiding principles of DevOps is collaborative learning—and we decided to bring that culture into VMware IT. Now, senior and junior staffers share responsibility for incident management. To facilitate initial troubleshooting, all site reliability engineers are trained in the basic tenets of private cloud management. Following another DevOps principle, VMware IT now puts a strong emphasis on incorporating automation at every step—even one-off projects—which creates efficiencies throughout the entire IT ecosystem.

DevOps Benefits

1,200
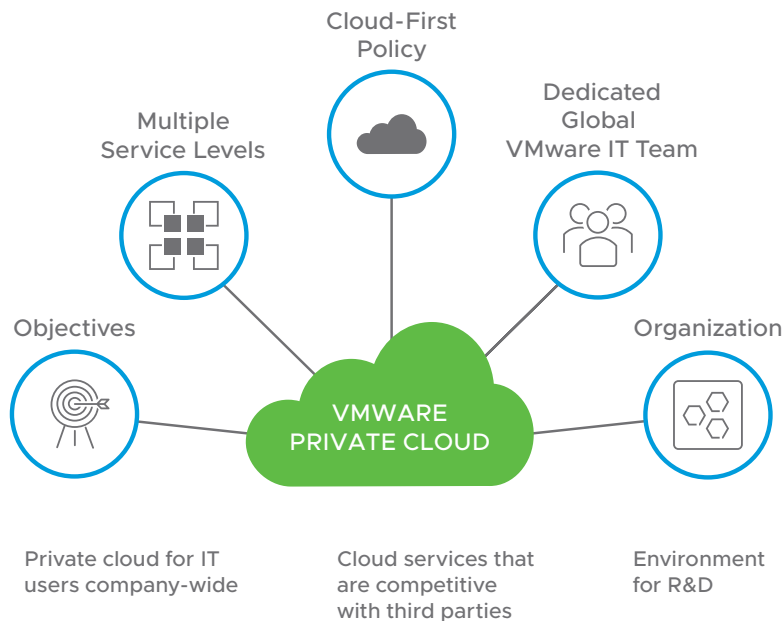incidents automatically resolved by VMware IT in one month, without human intervention

300%
increase in code check-ins reported by VMware IT

Learn more about our IT best practices in this short animated video.

These changes have paid dividends. The VMware private cloud is cost-competitive with leading cloud providers. Our consolidated private cloud now features high availability and fast resource provisioning. Automation is driving efficiencies in every aspect of our operations: In a recent month, VMware IT automatically resolved 1,200 incidents.[3] Tenant productivity is higher, and our VMware IT team reports that code check-ins have increased by 300 percent.[4] In short, we are setting a new standard for private clouds—a result that is strongly aligned with VMware IT's cloud strategy.

VMWARE PRIVATE CLOUD STRATEGY

Cloud-First
Policy

Multiple
Service Levels

Dedicated
Global
VMware IT Team

Objectives

Organization

VMWARE
PRIVATE CLOUD

Private cloud for IT
users company-wide

Cloud services that
are competitive
with third parties

Environment
for R&D

Securing Applications with VMware NSX

VMware IT used micro-segmentation to improve security for our SAP enterprise application suite. We employed VMware NSX to segment individual workloads within SAP modules. That approach—one of the more challenging micro-segmentation projects in our experience—allowed us to implement a zero-trust architecture that blocks all data flows between servers except those allowed by security policies.

After extensive testing, our team concluded that the new approach significantly improved security for our SAP implementation. As a result, we have retrofitted other applications, including Informatica and Oracle. All new VMware IT projects now require micro-segmentation. Our experience conclusively shows that NSX micro-segmentation is a deterrent to cloud-centered attacks.

[3, 4] VMware IT.

VMWARE NSX MICRO-SEGMENTATION BOLSTERS
SECURITY BY ENABLING A ZERO-TRUST ARCHITECTURE

Micro-segmentation prevents threats from spreading to other applications.
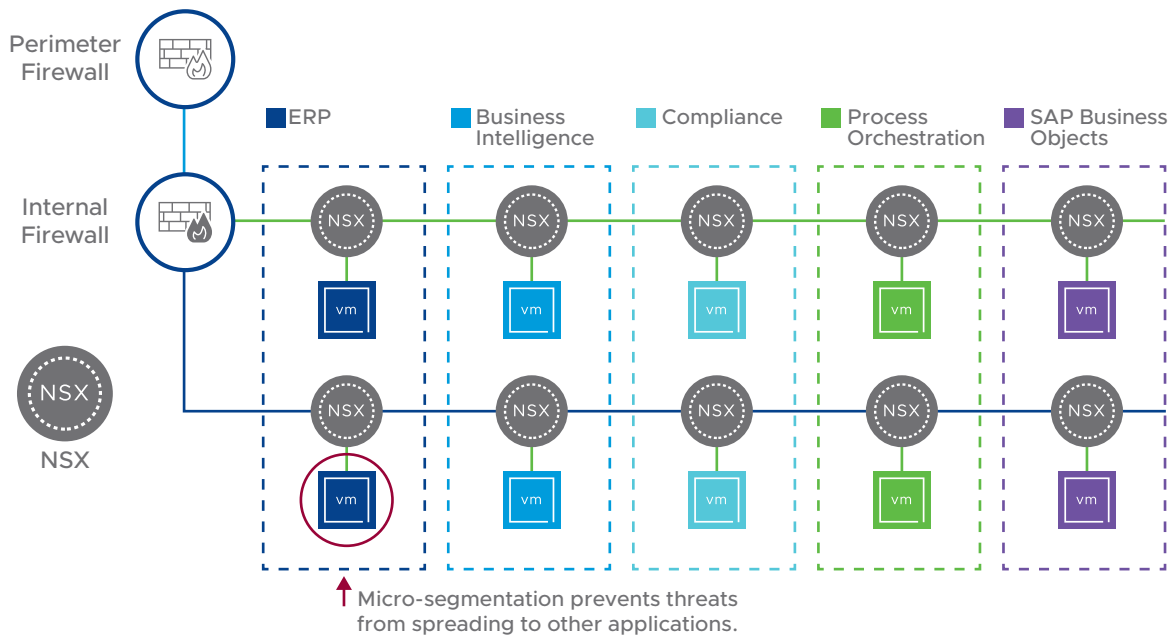
Migrating SAP HANA to VMware vSAN

VMware IT started using VMware vSAN™, VMware's hyperconverged infrastructure platform, before the product was publicly available. The first application we migrated to vSAN was our virtual desktop infrastructure (VDI). That trial was successful, so we expanded our vSAN deployment to include other business-critical applications in the past few years.

In 2018, VMware IT undertook to migrating SAP HANA to vSAN while avoiding user downtime during the process. We started with one of our scale-up SAP HANA instances. Thanks to meticulous preparation and execution, the migration was straightforward and users were not even aware of the switch.

Overall, VMware vSAN is delivering tangible benefits to VMware IT. Provisioning is faster because the vSAN data store is part of the vSphere cluster instantiation. vSAN helps VMware IT reduce our capital expenditures and lower our total cost of ownership.

With the recent migration of SAP HANA to vSAN, our IT product environment now supports all major databases on vSAN. As vSAN evolves, we will continue to run early versions in our production environment. As a result, our customers can be confident about running vSAN in large-scale deployments of enterprise resource planning (ERP) applications that include SAP HANA.

Safeguarding Our Vital Assets

As VMware drives innovation by disrupting the status quo, we must guard against a very different kind of disruption: cyberattacks. The security risk for global businesses is changing dramatically as it becomes increasingly difficult to manage security at scale. A skyrocketing number of devices, a vast array of security options, and the growing sophistication of threats are altering the technology landscape.

During the last year, IT Security focused on two areas to mitigate the risks posed by a rapidly changing landscape. First, we honed the effectiveness of our cyber-hygiene program by emphasizing five fundamental areas: least privilege, patching, multifactor authentication, encryption, and micro-segmentation. Systems that are verifiably well maintained are less likely to be vulnerable to cybersecurity risks. Second, IT took steps to improve our resiliency, that is, our ability to prepare for and respond to emergency events.

Improving Enterprise Resiliency

Traditional IT has focused on disaster recovery. However, VMware IT has led with enterprise resiliency. One of our key responsibilities is protecting VMware's people and assets through a formal global enterprise resiliency program. Business continuity, disaster recovery, crisis management, and emergency response are the foundations of this program.

To achieve our vision of incorporating resiliency into VMware's DNA, the resiliency team partners with global support functions such as Communications, Real Estate and Workplace, and Human Resources. These partnerships have resulted in the integration of resiliency information into the company's new-hire orientation and people manager programs.

In addition, resiliency is a key part of the corporate workforce planning program, which provides for the safety, security, and resiliency of VMware sites across the globe. The program develops customized site plans based on factors such as the number of people, the nature of their work, and potential risks at a site.

This integrated enterprise resiliency approach enables VMware to act more quickly and effectively while building the resiliency of our company and our people.

> Resiliency is a key part of the corporate workforce planning program, which provides for the safety, security, and resiliency of VMware sites across the globe.

Centralized Management

Access rights follow colleagues as they change jobs or locations.

Built-in Controls

In 2018, we upgraded our compliance strategy to build controls into our IT infrastructure, whether on premises or in the cloud.

Centralizing Identity and Access Management

As VMware expands its operations, IT is confronted with integrating and securing high-risk applications as well as devices. AccessNow is an identity governance and administration (IGA) system that centrally and automatically applies the principle of least privilege, or minimum necessary access, across the enterprise to help VMware comply with current regulations. The system uses a combination of technology and automated process flows to cross-reference identities and access.

Centralized controls enable access rights to be automatically provisioned as employees change their job status. The system also streamlines manual tasks and makes provisioning significantly faster. In addition, IT complies with regulatory requirements to minimize its exposure.

Rebooting Our Compliance Approach

A core VMware IT belief is that security must be intrinsic to our culture for VMware to manage its cyber risks effectively. In 2018, we undertook a reboot of our compliance activities to validate that security and the right controls are built into our IT infrastructure—whether on premises or in the cloud. This reboot is critical as VMware's infrastructure evolves into a modern hybrid cloud solution where traditional approaches to compliance simply do not scale.

To document VMware's compliance with regulations covering privacy, government, healthcare, financial services, and other areas, IT developed a Common Controls Platform to centrally store company compliance information and generate customer reporting. As a result, we can map new compliance requirements to existing controls to optimize our compliance operations.

The platform is also a central clearinghouse for system-generated compliance artifacts and traditional audit attestations. IT greatly streamlines VMware's ability to respond to external queries as well as assure our company's customers and partners of the integrity of the supply chain.

Trimming Our Security Portfolio

Like most large enterprises, VMware had experienced a steady growth in the number and variety of products used in our security infrastructure. To improve VMware's agility and security, in 2018 VMware IT pared down the number of approved components dramatically, focusing on critical capabilities that enable security, resiliency, and compliance from the inside out. Streamlining our security portfolio not only decreases our risk exposure but also improves our agility in fighting threats.

Not surprisingly, two of our own products figure prominently on the consolidated list: VMware NSX for micro-segmentation and VMware AppDefense™ for protecting applications in virtualized environments.

Speaking Up for Security Standards

VMware is faced with managing security on a worldwide scale, a charter that involves working with many current and evolving security standards. VMware joined the industry conversation through participation in initiatives by the Fast IDentity Online (FIDO) Alliance, an industry consortium dedicated to promoting interoperability among authentication devices. In particular, we play an active role in discussions concerning the FIDO Universal Second Factor (U2F), an open standard that strengthens and simplifies two-factor authentication. By adding our voice, we hope to drive industry change.

Joining Operations

To protect our people, data, and physical assets, VMware IT required a closer alignment between physical and information security, which share a common mission. By sharing data to identify and respond to threats, our teams can collaboratively address occurrences such as unauthorized login attempts, stolen laptop response, employee travel advisories, and secured onsite events.

Long term, the groups will merge into a joint, physically co-located operation and intelligence function. This consolidation is part of IT's preparation for IoT, which will add thousands of computing nodes to the network and increase VMware's risk exposure.

Pervasive Concerns
Security concerns cross geographical and organizational boundaries.

"VMware is committed to disrupting not just VMware, but the entire industry."

BETSY SUTTER
SVP AND CHIEF PEOPLE OFFICER
VMWARE

Optimizing the Colleague Experience

IT is an enabler of people, not technology. While automation, AI, and bots can help us perform our jobs better and faster, VMware's ultimate success lies with its people. People bring forth ideas, find opportunities, and solve problems. VMware IT enables our employees—whom we refer to as "colleagues" to denote our shared interest in doing our best work—through a proactive mindset and technology. The results of this approach are significant: improved productivity, greater satisfaction, and lower costs. A delightful colleague experience sparks innovation by helping attract and retain the best talent in a competitive market.

M&A Made Easy

Mergers and acquisitions (M&As) have become a key growth driver for today's enterprises, and VMware is no different. To date, we've successfully integrated more than 40 companies. When integrating a new acquisition, our IT team considers acquired-employee productivity, business continuity, and customer experience.

VMware IT has developed a program to make Day One a great start for members of our acquired workforce. We assist in new colleague orientations, making everyone aware of how IT fits into VMware's culture and processes. In these person-to-person encounters, our staff strives to create a sense of inclusion and belonging.

To provide Day One access to email, collaboration tools, and other critical business applications, VMware IT developed a set of tools and processes to seamlessly provision and onboard large numbers of people. New colleagues can securely access company networks and systems as soon as they complete onboarding, which maintains business continuity throughout the transition period.

Over 65%

of IT colleagues have earned VMware technical certifications. On average, IT employees had 28 hours of training during the year.

Reimagining Help

Like many dynamic companies, VMware initially relied on a SaaS solution for our help desk operations. As the company's workforce grew to tens of thousands of colleagues, this SaaS system simply could not scale to accommodate our needs. VMware IT decided to develop a system tailored to our unique requirements. HelpNow+ was the result.

HelpNow+ makes use of the best cloud technology available—our own. The HelpNow+ system can proactively alert colleagues before they are even aware something is wrong. HelpNow+ handles many routine user requests automatically, freeing up the IT staff to tackle more complex issues.

According to a recent internal survey by VMware IT, HelpNow+ is off to a good start: Ninety-five percent of colleagues report a positive experience, much better than our previous third-party system. VMware IT also immediately addresses negative survey feedback, allowing us to resolve issues quickly and reassure colleagues that IT is listening. External customers have expressed interest in the system based on the demos that we have shown.

Workplace of the Future

VMware IT recognizes that our colleagues' needs and expectations of technology continue to evolve. Through our Workplace X initiative, we are researching ways to revolutionize the colleague workspace experience using personalization, intelligent automation, and emerging technology.

We imagine workspaces of the future that will give colleagues automatic access to a personalized set of tools and services, no matter where they are physically located. The result will be highly personalized experiences that use intelligence to pull together people, files, content, and meeting rooms and collaboration platforms (when needed). Authentication—via voice, fingerprint, facial recognition, or near-field communication (NFC)—will provide simple but secure access to these context-aware spaces.

VMware IT is also experimenting with ways to produce hassle-free audio-visual and video meeting experiences. One-touch video and audio conferencing and wireless presentations are being replaced by emerging technologies such as location beacons and IoT devices to personalize the meeting experience. We envision a work environment where a colleague can enter a meeting room and be automatically connected to other participants and the relevant content. Meeting productivity improves as colleagues no longer sacrifice precious minutes setting up the meeting.

Central to realizing this vision is an extended reality (XR) experience, which brings together virtual reality (VR), augmented reality (AR), and mixed realities to deliver an immersive workplace experience that incorporates all five senses, including smell. The entire physical workplace experience could change as desks, computers, and monitors evolve to virtual workspaces with built-in collaborative and VR/AR technologies. By recognizing that these changes are coming, VMware IT can make better decisions about what investments are required to support future technologies and skills.

A key benefit of these completely new experiences is a new level of colleague engagement. One example is the VMware global campus: Colleagues can now experience campus tours through XR, bringing each campus to every colleague across the world.

We are continually experimenting with new processes and technologies to provide a delightful experience for our colleagues, partners, and customers.
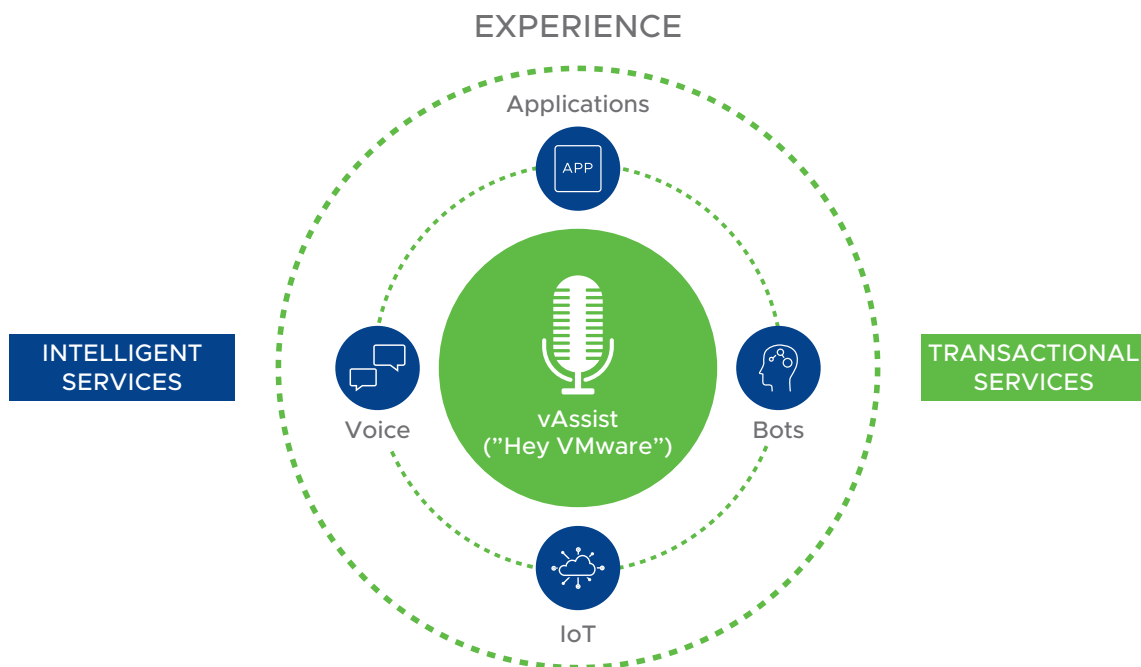
Mobile Apps Take Center Stage

Mobile apps empower colleagues, customers, and partners to access and act on information on the go. IT relies on VMware Workspace ONE® to help its developers deliver a consumer-grade experience without sacrificing enterprise security. Since its adoption, our mobility transformation initiative has accelerated, and our VMware IT team has seen a 30 percent increase[5] in developer productivity.

Workspace ONE is also the core of VMware's vAssist, a voice-enabled adviser and virtual assistant. vAssist leverages AI, ML, IoT, natural language patterns, and bots to deliver a complete digital experience through our mobile apps. These emerging technologies play a critical role in helping our colleagues to do their best work.

THE vASSIST VIRTUAL ASSISTANT

EXPERIENCE

Applications

APP

INTELLIGENT SERVICES

Voice

vAssist ("Hey VMware")

Bots

TRANSACTIONAL SERVICES

IoT

For example, IoT, Bluetooth beacons, and radio-frequency identification (RFID) sensors are enabling a rich digital experience at the VMware Discovery™ Center, our new customer briefing site in Palo Alto, California. The center features multiple touch-enabled video walls and VR demos. A companion mobile app gives visitors access to briefing agendas, presenter details, the briefing team, and directions. Once there, visitors can use the app to download content via NFC and leave feedback.

IoT and bots also lie at the heart of Smart Workplace, a mobile app now in use at three VMware offices. Colleagues can use the app to view the real-time availability of co-workers and schedule workstations and meeting rooms.

[5] VMware IT.

Modern Management

More than 90 percent of the devices that VMware IT supports for our colleagues run on Windows, macOS, Chrome, iOS, or Android.[6] In 2018, IT fundamentally transformed the way these devices are managed by adopting central provisioning through the cloud using VMware Workspace ONE UEM (unified endpoint management). As a result, devices are freed from attachment to a particular domain. IT staff can now centrally maintain security and perform reporting across all the operating systems.

To further improve efficiency, we streamlined laptop delivery in 2018. VMware IT put a process in place to fully provision Windows laptops at the factory and ship them directly to colleagues, who often report they are up and running within 15 minutes of delivery. Authentication takes place via VMware Identity Manager™ and Workspace ONE.

Anywhere, Anytime, Anyplace

Adoption of a private cloud within VMware has given IT the ability to better leverage technology that improves the colleague experience. For example, we are able to provide a single sign-on so colleagues can securely access work resources anywhere, anytime, and anyplace.

We've also streamlined the password reset process and expanded authentication options. The entire process now takes just minutes. As a result, service desk calls have dropped by 40 percent. Expanded authentication options include facial recognition, fingerprint scanning, and PIN codes.

30%

increase in developer productivity since the adoption of Workspace ONE, according to VMware IT findings.[5]

75%

reduction in delivery time for fully provisioned Windows laptops in 2018, from 30 days to 7 days. Our goal is to get a new Windows laptop to colleagues in less than 1 day.

DESKTOP OS DISTRIBUTION
- Windows: 57%
- Mac: 41%
- Linux: 2%
- Horizon (concurrent): 20%

MOBILE OS DISTRIBUTION
- iOS: 77%
- Android: 23%

[6] VMware IT.

Bringing the IT Service Desk to Our Colleagues

Oasis, VMware IT's service desk, strives to meet our colleagues where they are. That's why we offer multiple channels, including live chat, email, video, social, telephone, and face-to-face meetings. This commitment plays out in several ways:
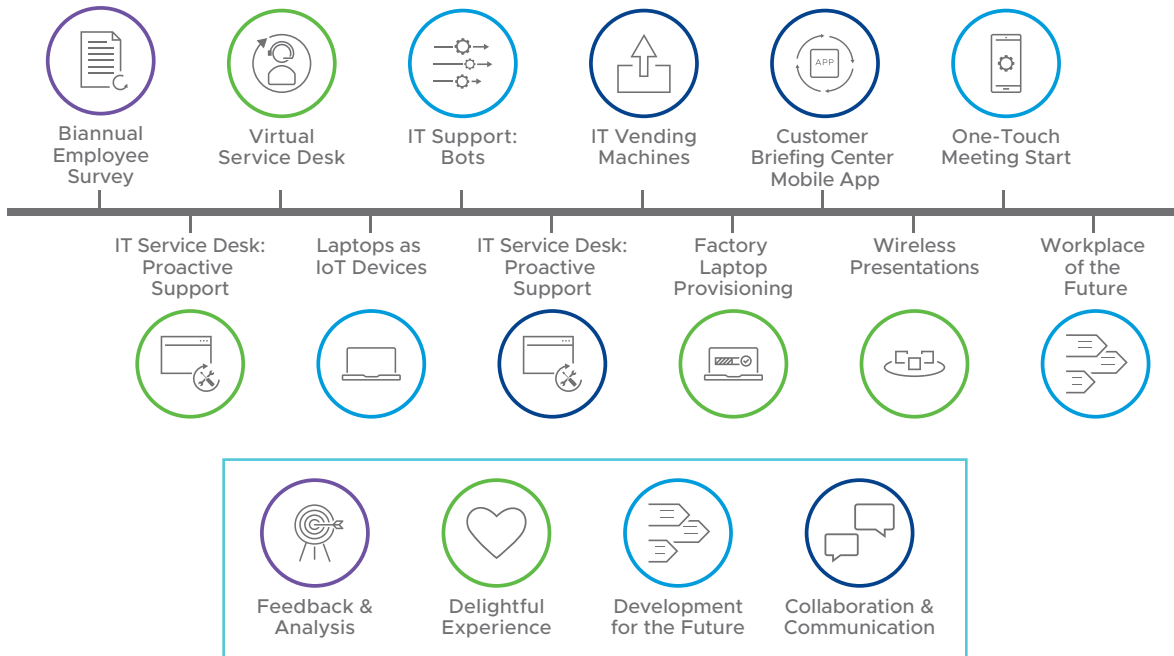
- The "doctor is in" tech bars continue to grow in popularity.
- With a swipe of their badge at our vending machines, colleagues can easily acquire peripherals. Coming soon: laptops.
- Virtual Oasis, an instant video chat system with a remote service desk technician, is being piloted in locations that lack a resident IT professional.
- Bots, driven by AI and automation, are answering common questions asked in chat. If the issue isn't resolved, a live agent joins the conversation.
- A new HelpNOW+ desktop and mobile app enables colleagues to place requests with internal departments and access a knowledge base for quick answers with just a couple of clicks.

Guiding the Oasis journey is an emphasis on being proactive. Oasis is a place to learn, engage, and get great support. Service desk representatives are empowered to proactively suggest tips, resources, and technology during their interactions. Colleagues are encouraged to learn about new technologies and new ways to use existing technologies.

Mapping the Colleague Experience

Providing a delightful colleague experience involves many moving parts. A roadmap helps integrate these parts into a holistic colleague experience by translating them into actionable tasks. By creating a timeline, goals, and metrics, we initiate a dialogue both within IT and with the business using a shared vocabulary. In that way, we can factor the impact on productivity, efficiency, retention, and risk into our investment decisions.

COLLEAGUE EXPERIENCE ROADMAP

Biannual Employee Survey · **Virtual Service Desk** · **IT Support: Bots** · **IT Vending Machines** · **Customer Briefing Center Mobile App** · **One-Touch Meeting Start**

IT Service Desk: Proactive Support · **Laptops as IoT Devices** · **IT Service Desk: Proactive Support** · **Factory Laptop Provisioning** · **Wireless Presentations** · **Workplace of the Future**

Feedback & Analysis · **Delightful Experience** · **Development for the Future** · **Collaboration & Communication**

Fostering Collaboration and Colleague Satisfaction

To reflect its role as the enabler of delightful experiences, our End User Services group changed its name to Colleague Experience and Technology in 2018. Investments in the colleague experience deliver many unanticipated productivity and efficiency benefits over time. By minimizing the friction points between people, devices, and locations and working toward the workspace of the future, VMware IT fosters greater collaboration and colleague satisfaction.

Enabling our colleagues to do their best work is the foundation of the Colleague Experience and Technology group. Innovation lies at the heart of this experience, where we constantly experiment with new processes and technologies to provide a rewarding experience for our colleagues, partners, and customers. To continue to innovate successfully, we will continue to push the boundaries of change and invest in the opportunities that provide the most value and impact.

Doing the Right Thing

The VMware Foundation Service Learning program encourages colleagues to donate time and talent to nonprofit organizations.[7] In 2018, VMware IT established the IT for Good Giving Network, which takes this commitment one step further by encouraging colleagues to apply their professional expertise to nonprofit, IT-related challenges.

Through customer interactions, volunteers can observe firsthand the obstacles that nonprofits and underserved communities face when trying to conduct business. This experience often results in the creation and implementation of new, out-of-the-box solutions.

For example, our volunteers in Palo Alto, California, are developing IT for Good to digitally transform nonprofit business operations. This initiative can help eliminate manual intervention and process redundancies to enable capacity building at low to no cost.

In Bangalore, India, volunteers developed and delivered a 10-week digital marketing course to the speech- and hearing-impaired community. Through coaching and interview preparation, volunteers provided a previously underserved segment of the community with access to gainful employment as digital marketers.
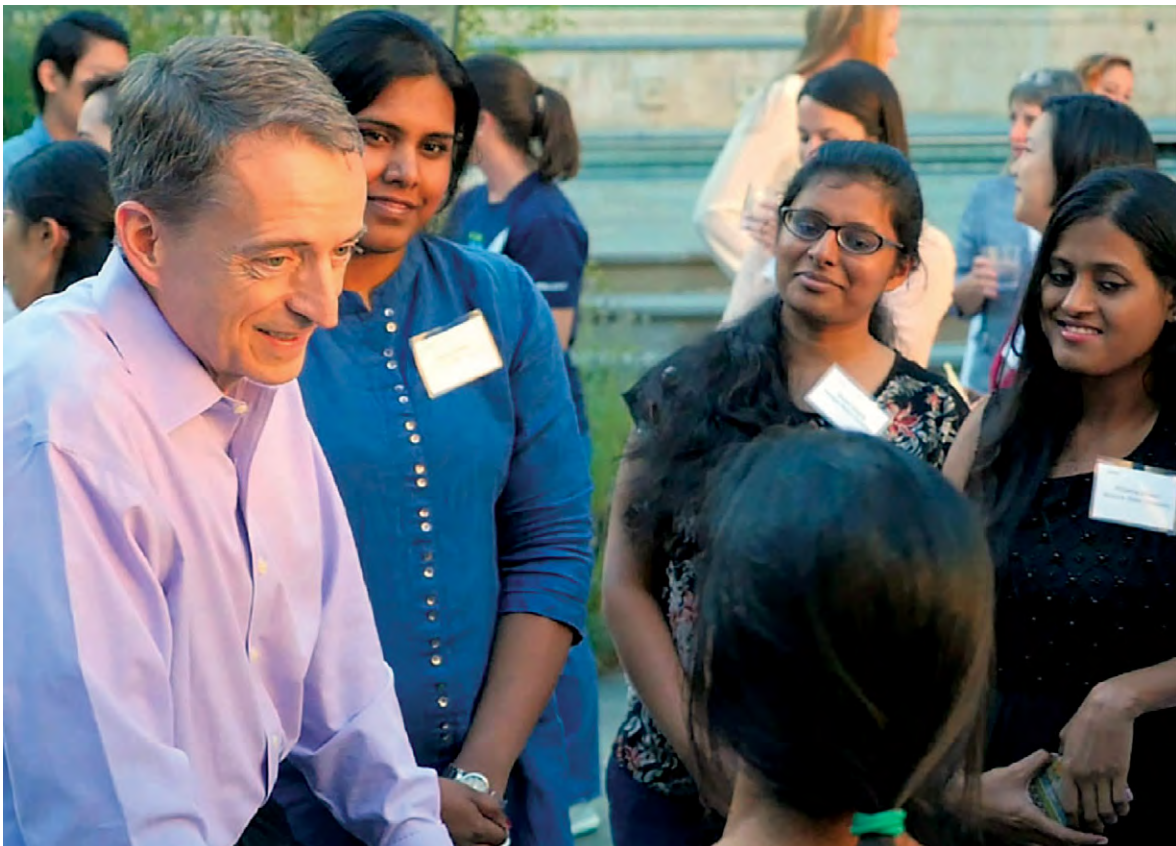
[7] VMware Foundation and Taproot Foundation. "Transforming Technology Pro Bono: A Practical Approach to Engaging Technology Talent for Nonprofit Capacity Building." May 2017.

Fostering Inclusion and Diversity

Fundamental to VMware's culture are our shared EPIC2 values—they're what make us who we are. These values include execution, passion, integrity, customers, and community. "Our EPIC2 values inform what we do, how we work, and how we interact with our colleagues, customers, and community," says VMware SVP and Chief People Officer Betsy Sutter.

These values play out in VMinclusion, a business-led strategic initiative to attract and engage the multinational, multicultural talent critical to our global business. We place high importance on a culture of integrity and values that differentiates us from our competitors. We celebrate the wide variety of dynamic backgrounds, experiences, and perspectives of our people.

Through VMinclusion, we aim to harness the power of human difference and build a community that includes all forms of diversity.

Investing in Sustainability

VMware has set ambitious environmental goals for 2020: carbon neutrality and 100 percent renewable energy for our global operations.[8] We continue to realize tangible results toward that end—for example, consistently exceeding our annual target of reducing carbon emissions intensity by 10 percent.

VMware is proving that business fundamentals and environmental responsibility can go hand in hand by reducing our absolute Scope 2 (purchased electricity) emissions by 4 percent even as the company experiences 8 percent financial growth. Whether by upgrading to LED lights or vetting planned travel for Scope 3 (business air travel) emissions, VMware is solidly committed to a green future.

EPIC2 VALUES

Our business-led VMinclusion initiative helps create a colorful and diverse workplace where everyone can do their best work.

540 MILLION

MT CO_2e avoided through virtualization over the last 15 years.[8]

VMware IT

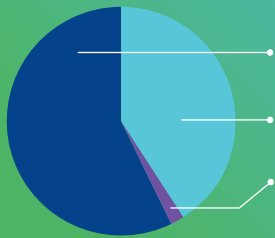## Creating Business Value Through Innovation and Disruption

Colleague Experience & Technology

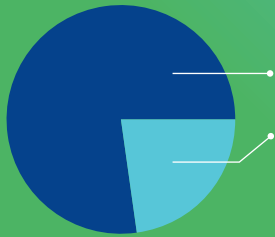**Colleague Satisfaction Rate**

94.4%

First Contact Resolution Rate

85%

Primary Desktop OS Distribution

- 57% Windows
- 41% Mac
- 2% Linux

Mobile OS Distribution

- 77% iOS
- 23% Android

IT-Managed Environment

1.3M Average number of VMs created and destroyed each week

185K Average number of containers created and destroyed weekly

117 Offices

210 On-premises applications

9 Data centers

97 SaaS applications

12MW Power capacity for data centers

55 Apps micro-segmented using NSX

33K Total number of servers

5K Software features developed and delivered by IT

8K Total number of IT-managed servers

8.3K Number of unique colleagues using Horizon based on a 30-day average

12PB vSAN raw storage

>20 Number of customer-facing VMware SaaS services supported by IT

If you would like to hear more about the work we are doing in VMware IT, feel free to reach out to us directly at vmwonvmw@vmware.com or via the below social media channels:

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