MASTER OF YOUR VIRTUAL IT UNIVERSE:
Trust but Verify at Any Scale

*A Never-Ending IT Journey
around Optimizing, Automating,
and Reporting on Your
Virtual Data Center*

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INTRODUCTION

The journey of one begins with a single virtual machine (VM) on a host. Imagine a lone VM in space, cut off from physical systems, floating in the vastness of a data center. By itself, the VM is simply a one-to-one representation of its physical instantiation. But virtualized, it evolves into software defined and abstracted. It can draw upon a larger pool of resources should its host be added to a cluster. With that transformation, it becomes more available, more scalable, and more adaptable for the application that it is supporting.

Virtualization provides the ability to quickly scale across many axes without scaling their overall physical footprint. The skills required to do this efficiently and effectively are encompassed by optimization, automation, and report. The former two skills are complementary, and the last skill is key because IT professionals cannot save their virtual data center if no one listens or seeks to understand them. And, as always, actions speak louder than words.

In this eBook, I will cover practical examples of optimization, automation, and reporting in the virtual data center. In this case, order does matter. Automating without considering optimization leads to work being done without purpose. Optimization and automation without reporting leads to not getting credit for work being done correctly. Also, without reporting, you can't advise critical decision makers about how or when to take the proper course of action on a variety of issues.

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OPTIMIZATION:

The following is excerpted from **Skillz to Master Your Virtual Universe SOAR Framework**:

Optimization is a skill that requires having a clear end-goal in mind. Optimization focuses on understanding the interactions of the IT ecosystem, the behavior of the application stack, and the interdependencies of systems inside and outside their sphere of influence to deliver success in business objectives.

If one were to look at optimization from a theoretical perspective, each instantiation of optimization would be a mathematical equation with multiple variables. Think multivariate calculus as an IT pro tries to find the maxima while other variables change with respect to one another.

Optimization in the virtual data center focuses on virtual data center health across resource utilization and saturation, as well as resource capacity planning and resource elasticity. In the optimization chapter, we'll explore specific examples of optimizing for virtual data center availability and key performance indicators, and the context to leverage them for an optimal virtual data center.

AUTOMATION:

The following is excerpted from **Skillz to Master Your Virtual Universe SOAR Framework**:

Automation is a skill that requires detailed knowledge, including comprehensive experience around a specific task. This is because you need that task to be fully encapsulated in a workflow script, template, or blueprint. Automation, much like optimization, focuses on understanding the interactions of the IT ecosystem, the behavior of the application stack, and the interdependencies of systems to deliver the benefits of economies of scale and efficiency to the overall business objectives. And it embraces the do-more-with-less edict that IT professionals have to abide by.

Automation is the culmination of a series of brain dumps covering the steps that an IT professional takes to complete a single task. These are steps that the IT pro is expected to complete multiple times with regularity and consistency. The singularity of regularity is a common thread in deciding to automate an IT process. The chart below, called "Geeks and Repetitive Tasks," gives you a good perspective on an IT professional's decision to automate.

Automation in the virtual data center spans workflows. These workflows can encompass management actions such as provisioning or reclaiming virtual resources, setting up profiles and configurations in a one to many manner, and reflecting best practices in policies across the virtual data center in a consistent and scalable way.

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REPORTING:

The following is excerpted from **Skillz to Master Your Virtual Universe SOAR Framework**:

IT reporting at its best is pure art backed by pure science and logic. It is storytelling with charts, figures, and infographics. The intended audience should be able to grasp key information quickly. In other words, keep it stupid simple. Those of you following this series and my 2016 IT resolutions know that I've been beating the "keep it stupid simple" theme pretty hard. This is because endless decision-making across complex systems can lead to second-guessing, and we don't want that. Successful reporting takes the guesswork out of the equation by framing the problem and solution in a simple, easily consumable way.

The most important aspect of reporting is knowing your target audience and creating the report just for them. Next, define the decision that needs to be made. Make the report pivot on that focal point, because a decision will be made based on your report. Finally, construct the reporting process in a way that will be consistent and repeatable.

Reporting in the virtual data center details the journey of the virtualization professional in the virtual data center. The story will start with details of virtual data center and key performance indicators. It will evolve into a journey of how to get what is needed to expand the delivery capabilities of the virtual data center. With agility, availability, and scalability at the heart of the virtual data center show, reporting is the justification for optimization and automation success.

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OPTIMIZATION

Optimization in the virtual data center spans virtual data center health across resource utilization and saturation while encompassing resource capacity planning and resource elasticity. Utilization, saturation, and errors play key roles in the optimization skill. The key question is: **what needs to be optimized in the virtual data center?**

RESOURCE SCALABILITY

Similar to other IT disciplines, optimization in the virtual environment boils down to optimizing resources, i.e. doing more with less. This often produces an over-commitment of resources and the eventual contention issues that follow the saturated state. If the contention persists over an extended period of time, or comes too fast and furious, errors usually crop up. And that's when the "no-fun" time begins.

Resource optimization starts with tuning compute (vCPUs), memory (vRAM), network, and storage. It extends to the application and its tunable properties through the hypervisor to the host and cluster.

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FOREST, TREES, AND LEAVES

The optimization exercise in a virtual data center ecosystem is symbolized by a forest, trees, and leaves concept. Optimization takes place across all those levels of granularity. For instance, the forests are your virtual data centers, the trees are your clustered resource pools or hosts, and your leaves are your virtual machines.

That's a lot of moving parts. How does a virtualization admin go about optimizing through the layers? Simple. Leverage process to impart rigor and discipline, technology in the form of a proper tool chain, and people for the requisite insights and ideation. Each environment is unique, and it takes experience and expertise to tailor the optimization scheme, especially the prioritization of applications and services.

More importantly, the optimization needs to take into account the totality of the environment, because it's all related.

LEAVES

VM optimization usually pertains to optimizing utilization metrics, such as CPU, memory, storage, and network with respect to the application workloads. Hypervisor features, like dynamic resource scheduling (DRS), vMotion® / live migration, and resource pools can distribute the shared resource capacity across VMs. One can even prioritize VMs as needed. However, all VMs on resource clusters are tied together, so when you optimize for one, you have to factor in less resources and priority scheduling for other VMs. This may be okay, but if all the VMs are mission critical or high priority, you will run into contention.

After utilization contention, there will come saturation as the VMs will have to wait in longer queue lines to fulfill tasks, or, in a worst case scenario, no longer be able to fulfill work requests. This will lead to error events as tasks failing to complete if the queues get overwhelmed. The converse is also true. Contention will also occur if idle or underutilized VMs hold resources that could be used by other VMs in the cluster or pool.

To optimize utilization to avoid saturation and errors, use the following protocol:

1. Understand the baseline performance of the application, the Quality-of-Service expectation, and the contention points. This requires being able to see into key performance indicators, and having this data trend over a long enough period of time.

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2. Establish thresholds to alert of potential suboptimal performance.

3. Integrate and recalculate the performance behavior data with the changes that take place in the data center environment. Repeat steps 1-3 over time.

TREES

Host optimization is maximizing utilization on a physical system without overwhelming it into a saturated scenario that might be fraught with errors. In a virtual data center, the host's resource will be abstracted and distributed across the VMs. The fine dance that occurs is balancing maximal host utilization without saturating the VMs and their application stack. The performance perspective is from the host point-of-view, meaning the performance counters here will be hypervisor-centric. Host optimization is encompassed by CPU scheduling, memory techniques, and architectural acceleration.

FOREST

The forest is the entire data center. All of the host systems combine to form clusters, and the clusters form the virtual data center. Optimization of the forest means having full insight into all the layers from VMs to hosts to clusters to data center. If architected correctly, any given contention at the VM level and host level should not affect the cluster. Similarly, any cluster contention should not affect the totality of the virtual data center.

SUBOPTIMAL EXAMPLE AT THE FOREST, TREES, AND LEAVES LEVEL

vCPU and vRAM penalties manifest in saturation and errors, which leads to slow application performance and tickets being opened. There are definite costs to oversizing and undersizing virtual machines (VMs). Optimization seeks to find the fine line with respect to the entire virtual data center environment.

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To optimize compute cycles, look for vCPU utilization and their counters, as well processor queue length. For instance, in VMware®, the CPU counters to examine are: %USED, %RDY and %CSTP. %USED shows how much time the VM spent executing CPU cycles on the physical CPU. %RDY defines the percentage of time a VM wanted to execute but had to wait to be scheduled by the VMkernel. %CSTP is the percentage of time that a SMP VM was ready to run, but incurred delay because of co-vCPU scheduling contention. The performance counters in Microsoft® are System\Processor Queue Length, Process\% Processor Time, Processor\%Processor Time and Thread\% Processor Time.

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Of course, a virtualization maestro needs to factor in hypervisor kernel optimization/reclamation techniques as well as the application stack and the layout of their virtual data center infrastructure into their optimization process.

In the next chapter, we'll explore automation concepts.

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AUTOMATION

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EMBODIMENT OF AUTOMATION

Scripts, templates, and blueprints embody IT automation. They are created from an IT professional's best practice methodology - tried and true IT methods and processes. Unfortunately, automation itself cannot differentiate between good and bad. Therefore, automating bad IT practice will lead to unbelievable pain at scale across your virtual data centers.

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> "Start with an end goal in mind. What problems are you solving for with your automation work? If you can't answer this question, then you're not ready to automate any solution."

To combat that from happening, keep automation stupid simple. First, automate at a controlled scale following the mantra, "Do no harm to your production data center environment." Next, monitor the automation process from start to finish in order to ensure that every step executes as expected. Finally, analyze the results and use your findings to make necessary adjustments to optimize the automation process.

AUTOMATE WITH PURPOSE

Start with an end goal in mind. **What problems are you solving for with your automation work?** If you can't answer this question, then you're not ready to automate any solution.

After establishing a reliable baseline for your environment, you should then look to automation to relieve yourself of much of the required manual tasks. Truly optimizing a virtualized environment starts with instrumenting the environment with an automated management technology that gathers data, analyzes performance and provides automatic alerts to form the basis for more advanced automation and orchestration.

Of course, as the data center continues to consolidate and roles become much less siloed, many IT professionals may become "accidental" virtualization administrators who may lack the fundamental expertise of trained specialists. You may fall into this camp. This challenging situation is on top of an already difficult one when it comes to remediating virtual environment performance issues. In fact, according to the 2016 State of Data Center Architecture and Monitoring report by ActualTech Media, on average, IT administrators report needing anywhere from an hour to a full day to accurately identify the root cause of a virtualization performance problem, and even longer to remediate.

But the challenge is not insurmountable. The learning curve can be drastically reduced with virtualization management that provides the ability to cut through the noise to quickly surface the root cause of a performance problem and enable near immediate remediation through recommended and even automated actions that are formed from the analysis of data that is unique to your virtual data center.

This will also offer you relief from manual troubleshooting exercises across key constructs like compute, memory, storage and the network by automatically analyzing an environment's historical data to report on how it has grown or been utilized over time and then predict how it will look in the future based on algorithms that factor in today's utilization pattern, historical growth spurts, etc. Instead, you can dedicate more time to investigating relevant, adjacent technologies and honing your modern data center skillsets.

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Overall, organizations that successfully transition to greater automation within their virtual environments will create a more resilient and responsive virtualized infrastructure that truly unleashes the benefits of virtualization, including enhanced speed, greater cost savings and simplified end-user servicing.

AUTOMATION – MORE THAN LOGGED EVENTS

Automation using logs to provide auto-remediation is a use case that IT organizations are trying to leverage and put into their practice. There are two situations that arise in this particular case. First, the remediation is quite simple and deterministic such that automation is trivial. The other automation scenario is more complex is falls into the realm of machine learning as decisions and pivots need to be made with not only historical baselines but with data from what's happen in the near past and in the present.

Unfortunately, machine learning algorithms aren't readily available for consumption in most IT organizations. And even if they were, their automatic actions still require oversight. Again, trust but verify needs to be held true. There is a happy median, one that a virtualization admin can take advantage of their experience and expertise while relying on a tool, which incorporates known truths like knowledge base articles and best practice from hypervisor vendors and an aggregation of customers.

EXPERIENCE AND EXPERTISE REQUIRED

Any automation worth its weight in gold needs the experience and expertise of an IT professional. There's no avoiding the guidance that is required to deliver in one's unique data center environment. Overcoming incidents and contention in a virtual data center mean something and has value for any organization. The key for the IT professional is to translate value from said experience and expertise into the automation workflow.

WATCHER OF THE AUTOMATED WORKFLOW

Who watches the automation? A proper tool needs to be used ensure that the automation process runs efficiently and effectively. It's not enough to merely complete nor to work as designed. What if the design is faulty or bad? Then, the faulty and bad design will propagate through the entire workflow leading to automation badness in the form of contention, saturation, and errors. With a proper monitoring tool, the risk of bad automation can be mitigated before it follows the workflow at scale.

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> "Right sizing VMs is one example of taking recommendations to properly size virtual compute and memory."

AUTOMATION VIA RECOMMENDATIONS

Recommendations that are based on knowledge base or best practice policies can form the foundation for automation of remediation workflows. Taking into account optimization baselines, trends and analysis, recommendations can be strategically implemented to offload the burden of managing every change and their associated impact on the performance and health of the virtual data center.

Right sizing VMs is one example of taking recommendations to properly size virtual compute and memory. Below is a figure that shows how recommendations based on best practices can be used to take remediation actions. Over time, recommendations can be customized to any given virtual environment since each is unique in their own way. This is where the value of a skilled virtualization master comes to bear. These optimization policies need to be refined and customized before being consumed in automation scripts and workflows.
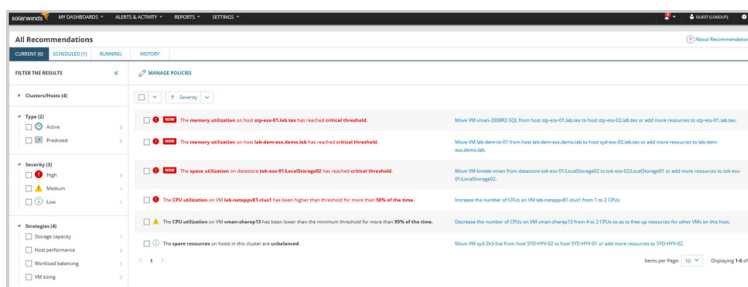
In the next chapter, I'll cover reporting, which makes sure that end-goals of optimization and automation lead to positive outcomes in decision making.

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REPORTING

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The most important aspect of reporting is knowing your target audience and creating the report just for them. Next, define the decision that needs to be made. Make the report pivot on that focal point, because a decision will be made based on your report. Finally, construct the reporting process in a way that will be consistent and repeatable.

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REPORTING

The last critical component of any IT strategy is reporting. If for no other reason, reporting is the best way for you to translate data into dollars, bridging the gap between the IT department and business management.

You should look to establish a process, where reports on consumption of resources—and possibly even projected costs—can be shared with business decision-makers and end-users. Such reporting helps surface the "good" stemming from an efficiently managed virtual environment, such as reclaiming 25 percent of virtual resources through optimization processes. Space reclamation of that size could mean an organization no longer needs to invest significant capital in new servers. Instead, new VMs can be provisioned within the existing virtual environment.

In addition, and in consideration of end-users especially, who are often eager to take advantage of what appears to be an endless amount of virtual resources, a reporting mechanism is a useful way to demonstrate that virtual resources are not free, and thus curb the potential for resource sprawl. This holds additional benefits of eliminating potential security holes as well.

It is true that a majority of organizations are increasingly looking to the cloud for benefits like cost savings, speedy application performance, and less infrastructure management. However, that same majority of organizations will continue to maintain an on-premises data center in which virtualization is and will remain king. Thus, as a virtualization administrator, whether by intent or by accident, you should look to these three keys to optimization to best capitalize on both new technologies introduced by the cloud and hybrid IT—such as Functions as a Service (server-less), containers, micro-services, public cloud services, etc.—and manage your virtual environment so that it effectively and efficiently delivers a quality experience to your end-users, while exceeding the expectations of your business stakeholders.

REPORTING KEYS

Reports require two key meaningful ingredients: (1) intended audience and (2) context. Remember that reports are a means to an end. And that end needs to result in a successful outcome for you, the creator of the report.

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A virtualization report could be as easy as one that shows all the VMs in the virtual data center. A more advanced report could show new VMs created since last point in time. This would allow a virtualization admin to manage the change in resource allocation in their data center. These sets of reports are more for IT operational process.

The next step could show VMs with operating systems that require updates or operating systems that were no longer supported. Another would be showing capacity thresholds and the associated performance data that show contention in the virtual data center. These reports provide decision- makers with the data required to justify spend decisions or make the case for more budget.

These examples highlight the need to understand the end-goal such that the target audience and the meaningful context can be identified, gathered, and presented.

THE REPORTING JOURNEY

Reporting is a straightforward journey that shouldn't be overcomplicated. The story will start with details of virtual data center and key performance indicators. It will evolve into a journey of how to get what is needed to expand the delivery capabilities of the virtual data center. With agility, availability, and scalability at the heart of the virtual data center show, reporting is the justification for optimization and automation success. **Who and what matters as well as an end-goal?** Audience and context matters. Reporting ultimately seeks a decision that needs to be made. No more, no less.

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CLOSING STATEMENTS

The IT O.A.R. (pronounced like oar), represents actions that an IT professional needs to perform in order to guide a hybrid data center through its entire lifecycle. "O" is for optimization as one delivers more efficacy with the resources afforded them. "A" is for automation as one delivers more scale in the services being integrated and delivered. "R" is for reporting as one delivers the news of efficiency and effectiveness of optimization and automation actions. Combining all three provides any IT professional with the means to navigate the digital transformation era and the burden that it's bringing to bear on IT ops.

Automation without optimization consideration will lead to work being done without purpose. Optimization and automation without reporting will lead to not getting credit for the work getting done correctly, as well as informing decision-makers of the proper course of action to take. The better one O.A.R.s, the better the data center transformation journey and hybrid IT evolution will be for them and their organization.

I WILL END WITH MY SEVEN TIPS FOR A LONG IT CAREER:

1. Do what you love and love what you do. Be passionate about IT, technologies, and people.

2. Know and do your IT. There is no substitute for experience and know-how.

3. Don't be afraid to fail. My greatest successes have followed failures. Character is built from failures and how you handle them.

4. Don't strive for perfection. Perfection limits innovation by setting an arbitrary and unnecessary ceiling. Innovation is unbounded!

5. Build your trusted network of techie friends, peers, colleagues, and resources. Know who you can trust. Return that trust by keeping that trust.

6. Strength and honor cannot be emphasized enough. Policies, processes, and people in charge change, but your principles should never waver.

7. Remember those who have helped you grow and those who have stood in your way. Be thankful for both of them.

ABOUT THE AUTHOR

Kong Yang is a Head Geek at SolarWinds with over 20 years of IT experience specializing in virtualization and Cloud management. He is a VMware® vExpert™, Cisco® Champion, and active contributing thought leader within the virtualization and Cloud communities.

GOOD MORNING.
GOOD AFTERNOON.
GOOD NIGHT.

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