ALIGNING vREALIZE OPERATIONS WITH BUSINESS OUTCOMES
Create New Value with Business-Oriented Reporting in vRealize Operations
# Table of Contents

Executive Summary ................................................................................................................... 5  
Introduction ................................................................................................................................. 6  
Solution ......................................................................................................................................... 8  
What Are Custom Groups? ........................................................................................................... 8  
What Are Super Metrics? ............................................................................................................. 9  
Defining Group Types ............................................................................................................... 10  
Creating Custom Groups ......................................................................................................... 12  
Creating Super Metrics .......................................................................................................... 21  
  - Quantity-Based Super Metrics .......................................................................................... 22  
  - Utilization-Based Super Metrics ....................................................................................... 23  
  - Performance-Based Super Metrics .................................................................................... 24  
  - Application Pool Super Metrics ....................................................................................... 25  
  - Binding Custom Groups and Super Metrics ................................................................................... 26  
  - Enabling Super Metrics ......................................................................................................... 27  
Building Custom Dashboards and Reports .............................................................................. 28  
Enhancing vRealize Automation Reporting ............................................................................ 31  
Authorizing Users and Providing Role-Based Access .............................................................. 32  
  - Configuring AD Authentication .......................................................................................... 33  
  - Creating a New Role .......................................................................................................... 33  
  - Managing User Groups ....................................................................................................... 35  
  - Sharing Custom Dashboards .............................................................................................. 37  
Automating Business-Oriented Infrastructure Reporting ......................................................... 39  
Conclusion .................................................................................................................................. 41  
References .................................................................................................................................. 42  
About the Author ....................................................................................................................... 42  
Acknowledgments ..................................................................................................................... 42
# Table of Figures

Figure 1: Typical vSphere Cluster-Level Reporting Structure Diagram ........................................ 6
Figure 2: Desired Business Reporting Structure Diagram ............................................................. 7
Figure 3: Custom Group Business-Level Reporting Diagram ........................................................ 8
Figure 4: Example Super Metric Function Diagram ..................................................................... 9
Figure 5: Group Types Diagram .................................................................................................. 10
Figure 6: Create Group Types .................................................................................................... 11
Figure 7: Create Custom Group .................................................................................................. 12
Figure 8: Custom Group Settings ................................................................................................ 12
Figure 9: Custom Group Object Type .......................................................................................... 13
Figure 10: Custom Group Criteria Set ........................................................................................ 13
Figure 11: Object Name-Based Custom Groups ....................................................................... 14
Figure 12: vSphere Cluster Relationship-Based Custom Groups ............................................... 15
Figure 13: vCenter VM Folders in vROps .................................................................................... 16
Figure 14: vCenter VM Folder Relationship-based Custom Group ........................................... 16
Figure 15: vSphere Tag-Based Custom Groups .......................................................................... 17
Figure 16: vRealize Infrastructure Navigator-Based Custom Group ........................................ 18
Figure 17: EPOps Agent-Based Custom Groups – Example 1: VMs ........................................ 19
Figure 18: EPOps Agent-Based Custom Groups – Example 2: Services .................................. 20
Figure 19: Create Super Metric Wizard ....................................................................................... 21
Figure 20: vSphere Cluster Summary Metrics Example ............................................................. 21
Figure 21: Binding Super Metrics to Custom Groups via Group Type ....................................... 26
Figure 22: Enabling Super Metrics in the Policy ....................................................................... 27
Figure 23: Business Unit Summary Dashboard Example ........................................................... 28
Figure 24: Business Unit Compute Analysis Dashboard Example .......................................... 29
Figure 25: Business Unit Storage Analysis Dashboard Example ............................................... 29
Figure 26: Business Unit Distributions Dashboard Example .................................................... 30
Figure 27: Business Unit Trends Dashboard Example ............................................................... 30
Figure 28: vRA MP Object Types and Metrics ......................................................................... 31
Figure 29: Privileged Access Diagram ....................................................................................... 32
Figure 30: Active Directory Authentication Configuration ...................................................... 33
Figure 31: Create User Role ....................................................................................................... 34
Figure 32: Assign Permissions To Role ..................................................................................... 34
Figure 33: Import Active Directory Groups .............................................................................. 35
Figure 34: Import Users and Groups ................................................................. 35
Figure 35: User Roles and Object Permissions .................................................. 36
Figure 36: Share Dashboards ............................................................................. 37
Figure 37: Share Custom Dashboard with User Group ....................................... 37
Figure 38: Stop Sharing Dashboards with Everyone Group .............................. 38
Figure 39: Example of Limited Access .............................................................. 38
Figure 40: vROps Alert Definition and Notification Construct .......................... 40
Figure 41: vROps Custom Groups and Policies Diagram .................................... 41
Executive Summary
vRealize Operations Manager (vROps) helps organizations monitor and analyze their virtual infrastructure, providing valuable performance and capacity planning tools. While vROps is great at mapping the hierarchical infrastructure relationships out-of-the-box (OOTB), there is a need for more in-depth business-oriented reporting based around logical business constructs such as services, applications, departments, groups, or any other type of logical business structure. Quantifying performance, utilization, and consumption at the logical business unit level is more important to business leaders than at the vSphere Cluster level. This is because in today’s world, services, applications, and business units can span multiple infrastructures from private, through hybrid, to public. Not only is business-oriented reporting more intuitive for a business to consume, it also makes the IT more transparent and aligned with actual business outcomes.

vRealize Operations Manager is ready to answer this challenge. The software ensures managers and application owners can make better decisions, and it optimizes their workloads with minimal forethought and planning. vROps provides the tools needed to map out how the business structure relates to the underlying IT infrastructure and enables IT to create a more comprehensive business-oriented reporting solution that delivers new business value.
Introduction

Frequently, service, application, and business unit stakeholders will ask IT to provide reporting around their workload’s performance, utilization, and consumption as a whole. For example, a business owner may ask the following questions:

1. What is the VM Growth for Service X?
2. How many CPUs have been allocated to all VMs in Application Y and how much of the allocated CPU power are those VMs utilizing?
3. How much storage space are all VMs in Department Z consuming?
4. What are the poorly performing VMs in an Application Stack and why?

These questions are mostly about the underlying virtual infrastructure, but instead of being posed at a vSphere Cluster level, they are positioned around the logical business constructs. Traditionally, it has been very difficult for IT to answer these types of questions because typical Element Managers, including vCenter, used by IT, represent various objects in a very rigid hierarchical fashion that does not translate well to the elastic business structure. Many monitoring tools, including vROps by default, rely on this hierarchical inventory structure and base their reporting around it. For example, vSphere Cluster is a natural capacity container for compute and storage resources with which virtualization teams are intimately familiar. Naturally, then, vROps uses the vSphere Cluster construct to roll-up and report performance, utilization, and consumption at this level. This model works well for virtualization engineers as it aids in effective capacity planning, but it provides negligible value to the business stakeholders.

Figure 1: Typical vSphere Cluster-Level Reporting Structure Diagram
Another factor contributing to poor business reporting in IT is lack of metadata that can tie the various IT elements to their related business objects. The problem gets compounded with abstraction technologies and virtualization, which rely on complete separation for workload portability, resilience, and security.

vROps OOTB reporting around the hierarchical resource container model fails if VMs to be reported on are spread across multiple vSphere Clusters, or even worse if they are located in different physical datacenters, cloud providers, and are managed by separate vCenter instances.

A slightly different approach is necessary to address these challenges and empower business stakeholders with better information, and vROps is just the tool to do this. vROps enables IT to analyze the underlying infrastructure and present the information in a context consumable by business.

*Figure 2: Desired Business Reporting Structure Diagram*
Solution

vROps allows for the organization of VMs into logical groupings that represent the business structure needed to easily answer the questions posed earlier. Taking advantage of vROps features such as Custom Groups and Super Metrics, necessary logic can be built to quantify and answer the business questions being asked. These constructs abstract and decouple the performance, utilization, and capacity data from the underlying infrastructure, and massage it into business-relevant information, thereby creating new business value.

What Are Custom Groups?

Custom Groups are a special type of container in vROps that can be used to organize VMs into logical buckets, which mimic the business units, services, or applications. Wrapping these soft boundaries around the VMs is a crucial step in enabling vROps to understand the business structure of the organization.

Custom Groups can contain other Object Types (Resource Kinds) such as vSphere Hosts, Clusters, Datastores, etc. as well as a mix of different objects. However, this example will only focus on virtual machine-based Custom Groups as they are most relevant to the business reporting use case.

*Figure 3: Custom Group Business-Level Reporting Diagram*
What Are Super Metrics?

Super Metrics are derived metrics that can be used to measure performance, utilization, and consumption by different business units and applications, or in this case, the Custom Group into which the VMs are placed. Super Metrics contain simple algebraic formulas that allow vROps to measure various aspects of the Custom Groups, which contain business unit-related VMs.

At the most basic level, Super Metrics enable the ability to extend built-in metrics by adding new metrics that provide additional insight. This is especially important for Custom Groups as they only come with basic badge metrics. Having a set of more comprehensive predefined metrics is not optimal since Custom Groups can contain a mix of vastly different objects such as Hosts and Datastores. For example: CPU- and Memory-related metrics would not be applicable to the Datastores.

This is also where the not-so-obvious power of Super Metrics becomes clearly apparent. The Super Metrics employed to quantify Custom Groups use the concept of Relative Reference, or Depth, which allows vROps to look inside of a container/bucket, measure what is in it, and return the value at the container level rather than the object being measured. This ability sets vROps apart from other monitoring tools on the market as it empowers the user to create almost an infinite number of algorithms leveraging the built-in functions and collected time-series data, thus opening the door for unparalleled opportunity to create new business value.

Figure 4: Example Super Metric Function Diagram

Super Metric Description: Count number of VMs in a Business Service and store value at the corresponding Custom Group.

After defining the logical structures and measuring them, various Custom Dashboards, Views, and Reports can be built that answer the business questions posed earlier.
Defining Group Types

Before creating Custom Groups and Super Metrics, Group Types must be defined. Group Types are the glue that bind Super Metrics to Custom Groups and will help organize categories of groups in vROps. This step must be done prior to creating Custom Groups, because a Group Type is required during the Custom Group creation process, and it is difficult to change this later unless the group is cloned.

Think of Group Types in terms of categories similar to Objects Types (Resource Kinds), for example: Virtual Machines, Datastores, vSphere Hosts and Clusters. Just like built-in objects have metrics associated with them via the Object Type, Group Types do the same thing for Custom Groups.

*Figure 5: Group Types Diagram*
Typically, two or more Group Types are needed. One is needed to hold all of the business unit–related structures such as department, group, team, etc. Another one is needed to hold IT-related constructs such as applications, tiers, server roles, etc. In large and more complex environments, more Group Types can be defined if needed. However, while creating more Group Types will enable greater flexibility by providing more granularity, they come at a higher management overhead cost. Sometimes, keeping it simple can provide the right balance.

Another important factor that will come into play later during Custom Dashboard creation is the ability to filter by Group Type within the Widgets, similar to filtering by Object Type. This will be especially handy when different dashboards need to be constructed displaying different Group/Object categories depending on the dashboard audience.

New Group Types can be created by navigating to Content > Group Types and clicking Add Group Type.

*Figure 6: Create Group Types*
Creating Custom Groups

Once the Group Types are defined, Custom Groups based on different criteria sets can be created. The Custom Groups represent the logical business constructs such as services, applications, departments, teams, or any other type of logical business unit structure.

At their most basic level, Custom Groups are similar to SQL query SELECT statements with a WHERE clause, but created using a simple GUI. For example:

```
SELECT column_name
FROM table_name
WHERE column_name operator value;
```

New Custom Groups can be created by navigating to Environment and clicking New Group.

*Figure 7: Create Custom Group*

On the “New group” wizard, provide a descriptive Name, select one of the previously created Group Types, select a Policy that will apply to objects in this group, and click “Keep group membership up to date”. This last option ensures the group will dynamically include any objects (VMs) added after it has been created, providing a maintenance-free operation.

*Figure 8: Custom Group Settings*
Under Define membership criteria, in the Select the Object Type that matches all of the following criteria, find and select Virtual Machine under vCenter Adapter.

*Figure 9: Custom Group Object Type*

Below the Object Type, select one of the criteria set types that the Custom Group will be based on. Most groups will be based on an Object name matching some naming convention, a Property such as a vSphere Tag, or Relationship to a vSphere Cluster.

*Figure 10: Custom Group Criteria Set*

From here, the steps will vary depending on which option was selected for the criteria set type. Next is an examination of how to leverage each criteria set type.
One of the easiest methods of grouping a number of related VMs together involves leveraging the VM naming convention for the object name criteria set. For instance, suppose all of the database VMs in the environment have SQL, ORA, or DB in their names. Create a Custom Group and use those keyword patterns in the criteria set. This will find all VMs with those keywords and include them in the group. Check the “Keep group membership up to date” checkbox to keep the group populated with new VMs introduced to the environment after the group has been created. Similarly, in an environment with a VM naming convention standard, other keyword patterns emerge that naturally fit other applications, server roles, or business units.
Often, solutions like SQL, Oracle, SAP, and/or Exchange, etc. may be walled off in their own dedicated vSphere Clusters for licensing or performance reasons. This is a perfect criteria set for creating a Custom Group of VMs based on the relationship to their vSphere Cluster.
Another example of leveraging a Relationship criteria set involves the vCenter VM Folder structure now supported in vROps.

*Figure 13: vCenter VM Folders in vROps*

Often virtualization admins create folders in vCenter to organize different workloads by application or department to make management easier. This structure is exposed to vROps and can be used as a relationship criteria set for Custom Groups.

*Figure 14: vCenter VM Folder Relationship–based Custom Group*
Using vSphere Tags to organize VMs in a vCenter provides another mechanism that can be used to create criteria sets based on VM vSphere Tag properties. vSphere Tags in vCenter can be manually defined and assigned to VMs, or programmatically populated from an external source such as a CSV file, CMDB, or ITSM system using PowerCLI or vRealize Orchestrator.

Another important fact about vSphere Tags is that in the age of almost ubiquitous automation, tags should be assigned during the build process by the automation and orchestration engines, such as VMware’s vRealize Automation and Orchestrator. This solves the missing link between IT infrastructure and business constructs that are so frequently overlooked in many environments.

Defining vSphere Tags in vCenter serves a dual purpose in this case as they can be leveraged by both vROps and vCenter alike when searching for VMs, not to mention various automation tools.

**NOTE:** While newer versions of vROps support vCenter Annotations, they can be easily converted to vSphere Tags in bulk.
Another tool that can be utilized to create Custom Groups for VMs is vRealize Infrastructure Navigator (vRIN), formerly known as VIN. vRIN is an Application Dependency Mapping (ADM) tool that scans VMs for services and ports being used by those VMs. Relationships are then created among VMs communicating with each other. This relationship data about VMs in turn can be fed into vROps via a Management Pack (MP) and mapped to the VM objects. Once in vROps, this new data about ports and/or services can be used as a Custom Group criteria set to populate it with VMs.

Besides leveraging vRIN data for Custom Groups, it can also be used in vROps to simply report on what types of applications are running in the virtualized environment if this information is not available in the organization's CMDB.
End-Point Operations (EPOps) Agent data and the relationships established between the VM, OS, and Services/Applications running on a VM can also be used as the criteria set for Custom Groups. In addition to using EPOps to determine VM group membership, the added application metric data can be used to create Super Metrics that will help monitor pools of actual application servers, not just VMs. That is a very powerful concept in itself as it allows for aggregating metrics from multiple application nodes and provides a summary.
Above is an example of what an application pool-based Custom Group would look like. Suppose there is an application stack with a pool of front-end web servers and the application owner would like to know how many total sessions are being handled by all the web servers, or which server has the worst response time. This may be very useful information when trying to keep an eye on the web farm utilization before making a scale-out decision. This concept can be extended to any application that is supported by the EPOps Agent, allowing the organization to go beyond the basic infrastructure and monitor various services as a single construct comprised of multiple servers and applications.

With a few examples of VM and application-based Custom Groups, the following section explains which Super Metrics are needed to answer the business-related questions mentioned earlier.
Creating Super Metrics

Super Metrics used for Custom Groups generally fall into three categories and align with the business-oriented goals to quantify performance, utilization, and consumption of resources by related VMs in Custom Groups.

To create a Super Metric, go to Content > Super Metrics > Add New Super Metric.

Figure 19: Create Super Metric Wizard

Next are examples of Super Metrics that provide business-related answers to the team and application managers.
Quantity-Based Super Metrics

Following is a discussion about which Super Metrics may be useful from a Custom Group perspective to a cloud/virtualization administrator or business unit owner. Please note that many Super Metrics in this category are very similar to the vSphere Cluster-level metrics found under the Summary section.

Figure 20: vSphere Cluster Summary Metrics Example

As mentioned earlier, a Custom Group is a container akin to a vSphere Cluster, therefore counting what is in the bucket is very natural. This is especially useful when management wants to know, for example, how many SQL VMs there are across all virtualized environments. Related questions arise, such as how many VMs are powered on vs. powered off, how many VMs are idle and/or oversized, etc. Following is a list of a few basic Super Metrics created for the previously defined Custom Groups:

1. Number of VMs:
   \[
   \text{count($\{\text{adapertype=VMWARE, objecttype=VirtualMachine, attribute=badge|health, depth=1}\})}
   \]

2. Number of Powered ON VMs:
   \[
   \text{count($\{\text{adapertype=VMWARE, objecttype=VirtualMachine, metric=sys|poweredOn, depth=1, where="==1"}\})}
   \]

3. Number of Powered OFF VMs:
   \[
   \text{count($\{\text{adapertype=VMWARE, objecttype=VirtualMachine, metric=sys|poweredOn, depth=1, where="==0"}\})}
   \]

4. Number of Idle VMs:
   \[
   \text{count($\{\text{adapertype=VMWARE, objecttype=VirtualMachine, attribute=summary|idle, depth=1, where="==1"}\})}
   \]
5. Number of Oversized VMs:
   count(${adaptertype=VMWARE, objecttype=VirtualMachine, metric=summary|oversized, depth=1, where="==1"})

6. Number of Stressed VMs:
   count(${adaptertype=VMWARE, objecttype=VirtualMachine, metric=summary|isStress, depth=1, where="==1"})

**Utilization-Based Super Metrics**

The utilization-based Super Metrics measure how many resources have been allocated and are being used by the workloads. Thus, the percentage of the allocated resources being utilized is easily visible, providing insight into what percentage of the allocated capacity is actually being used.

1. CPU GHz Allocated to BU:
   sum(${adaptertype=VMWARE, objecttype=VirtualMachine, attribute=cpu|actual.capacity.normalized, depth=1})/1000

2. CPU GHz Demanded by BU:
   sum(${adaptertype=VMWARE, objecttype=VirtualMachine, attribute=cpu|demandmhz, depth=1})/1000

3. CPU GHz Used by BU:
   sum(${adaptertype=VMWARE, objecttype=VirtualMachine, attribute=cpu|usagemhz_average, depth=1})/1000

4. CPU % Demanded in BU:
   sum(${adaptertype=VMWARE, objecttype=VirtualMachine, attribute=cpu|demandmhz, depth=1})/1000

5. CPU % Used in BU:
   (${this, metric=Super Metric|sm_CPU_GHz_Demanded>/this, metric=Super Metric|sm_CPU_GHz_Used})*100

6. CPU Count in BU:
   sum(${adaptertype=VMWARE, objecttype=VirtualMachine, attribute=cpu|corecount_provisioned, depth=1})

7. CPU Count Recommended to BU
   sum(${adaptertype=VMWARE, objecttype=VirtualMachine, attribute=cpu|size.recommendation, depth=1})

8. CPU Count Reclaimable from BU:
   sum(${adaptertype=VMWARE, objecttype=VirtualMachine, attribute=cpu|wasteValue, depth=1})

9. Memory GB Allocated to BU:
   sum(${adaptertype=VMWARE, objecttype=VirtualMachine, attribute=mem|guest_provisioned, depth=1})/1048576

10. Memory GB Consumed by BU:
    sum(${adaptertype=VMWARE, objecttype=VirtualMachine, attribute=mem|consumed_average, depth=1})/1048576

11. Memory % Used by BU:
    sum(${this, metric=Super Metric|sm_Memory_GB_Consumed>/this, metric=Super Metric|sm_Memory_GB_Allocated})*100
12. Disk Space Provisioned to BU:
\[
\text{sum($\{adaptertype=VMWARE, objecttype=VirtualMachine, attribute=mem|consumed\textunderscore average, depth=1\}$)/1048576}
\]

13. Disk Space Used by BU:
\[
\text{sum($\{adaptertype=VMWARE, objecttype=VirtualMachine, attribute=diskspace|used, depth=1\}$)}
\]

14. VM Snapshots GB in BU:
\[
\text{sum($\{adaptertype=VMWARE, objecttype=VirtualMachine, attribute=diskspace|snapshot, depth=1, where=">0"\}$)}
\]

15. Disk Space % Used by BU:
\[
\left(\frac{\text{this, metric=Super Metric|sm_<Disk\textunderscore Space\textunderscore Used>}}{\text{this, metric=Super Metric|sm_<Disk\textunderscore Space\textunderscore Provisioned>}}\right) \times 100
\]

16. Total BU IOPS:
\[
\text{sum($\{adaptertype=VMWARE, objecttype=VirtualMachine, attribute=datastore|commandsAveraged\textunderscore average, depth=1\}$)}
\]

**Performance-Based Super Metrics**

The performance-based Super Metrics are intended to track and report any SLA breaches. For example, are there any VMs whose CPU Ready % is above a certain threshold? This can minimize the potential impact from poorly performing workloads, as well as track the SLA.

1. Highest VM CPU Contention %:
\[
\text{max($\{adaptertype=VMWARE, objecttype=VirtualMachine, attribute=cpu\textunderscore capacity\textunderscore contentionPct, depth=2\}$)}
\]

2. Highest VM CPU Ready % per Core:
\[
\text{max($\{adaptertype=VMWARE, objecttype=VirtualMachine, attribute=Super Metric|sm_<VM\textunderscore CPU\textunderscore Ready\%_per\_Core\_Super\_Metric>, depth=1\}$)}
\]

3. Highest VM CPU Co-Stop %:
\[
\text{max($\{adapterkind=VMWARE, resourcekind=VirtualMachine, attribute=cpu\textunderscore costopPct, depth=1\}$)}
\]

4. Highest VM CPU Swap Wait %:
\[
\text{max($\{adapterkind=VMWARE, resourcekind=VirtualMachine, attribute=cpu\textunderscore swapwaitPct, depth=1\}$)}
\]

5. Highest VM CPU IO Wait %:
\[
\text{max($\{adapterkind=VMWARE, resourcekind=VirtualMachine, attribute=cpu\textunderscore iowaitPct, depth=1\}$)}
\]

6. Highest VM Mem Swap In Rate (KBps):
\[
\text{max($\{adaptertype=VMWARE, objecttype=VirtualMachine, attribute=mem|swapinRate\textunderscore average, depth=1\}$)}
\]

7. Highest VM Mem Decompression Rate (KBps):
\[
\text{max($\{adaptertype=VMWARE, objecttype=VirtualMachine, attribute=mem\textunderscore decompressionRate\textunderscore average, depth=1\}$)}
\]
8. Highest VM Mem Ballooned (KB):
   \[\text{max}({\text{adaptertype}=\text{VMWARE}, \text{objecttype}=\text{VirtualMachine},}
   \text{attribute}=\text{mem|balloonPct}, \text{depth}=1})\]

9. Highest VM Disk IOPS:
   \[\text{max}({\text{adapterkind}=\text{VMWARE}, \text{resourcekind}=\text{VirtualMachine},}
   \text{attribute}=\text{virtualDisk|commandsAveraged_average}, \text{depth}=1})\]

10. Highest VM Disk Latency (ms):
    \[\text{max}({\text{adapterkind}=\text{VMWARE}, \text{resourcekind}=\text{VirtualMachine},}
    \text{attribute}=\text{datastore|totalLatency_average}, \text{depth}=1})\]

11. Highest VM Network Packets Dropped:
    \[\text{max}({\text{adapterkind}=\text{VMWARE}, \text{resourcekind}=\text{VirtualMachine},}
    \text{attribute}=\text{net|dropped}, \text{depth}=1})\]

12. Highest VM Network Usage Rate (KBps):
    \[\text{max}({\text{adaptertype}=\text{VMWARE}, \text{objecttype}=\text{VirtualMachine},}
    \text{attribute}=\text{net|usage_average}, \text{depth}=1})\]

**Application Pool Super Metrics**

Providing a list of application-specific Super Metrics is more difficult as each application has a different set of metrics used as the base input. Following are suggestions based on MS IIS. This logic can be extrapolated and applied to other applications. The key point is that working with the specific service or application subject matter experts will help identify the Key Performance Indicators (KPIs) and thresholds important to assessing service health by the stakeholders.

1. Number of Sessions
2. Average Response Time
3. Highest Response time
4. Etc.

**NOTE:** This is by no means an exhaustive list of all possible Super Metrics. These are merely suggestions of the most common Super Metrics encountered in a typical environment. Many more Super Metrics can be created to answer various business questions and provide valuable insight.

**NOTE:** Please see the reference section of this white paper on how to create Super Metrics. This white paper only provides general Super Metric examples that can be created for Custom Groups.

**NOTE:** Super Metric naming convention is an individual preference, but the recommendation is to establish a convention and follow it. This makes it much easier to find, group, and filter Super Metrics later while using them.
Binding Custom Groups and Super Metrics

After defining the Super Metrics and Custom Groups, the next step involves binding them together. This process tells vROps for which objects to track Super Metrics, and where all the previous work of creating Group Types, Custom Groups, and Super Metrics comes together into a cohesive definition.

To bind the Super Metrics to their Custom Groups via their associated Group Type, select each Super Metric in the list and add each Group Type defined at the beginning of this process.

*Figure 21: Binding Super Metrics to Custom Groups via Group Type*
Enabling Super Metrics

Before Super Metrics can start collecting any data about the Custom Groups, they must be enabled in the policy.

Go to Administration > Policy > Policy Library, and then select and edit the policy that will track the new Super Metrics. On the Edit Monitoring Policy pop-up window, go to Collect Metrics and Properties, find Super Metrics created previously, and enable them.

**Warning:** Only enable Super Metrics for the respective Object Type. Enabling Super Metrics for All Object Types will collect extraneous data not relevant to most objects, use more disk space, clutter the user interface, and have a potential performance impact. For example, there is no need to capture CPU-related Super Metrics for Datastores.

*Figure 22: Enabling Super Metrics in the Policy*

With these useful business-oriented Super Metrics defined, enabled, and bound to a business unit-based Group Type, the next step involves using them in custom dashboards and reports.
Building Custom Dashboards and Reports

Well-designed Custom Dashboards should strive to provide all relevant information in a single pane-of-glass, be intuitive and easy to use, and offer all relevant information to satisfy a use case without having to navigate further. The goal should be to empower the user to make better business decisions without having to look for information in multiple places or master the intricacies of a product.

Well-designed Custom Dashboards are the culmination of forethought and planning, and combine all previously touched-on elements into a cohesive story that paints a picture and informs the user. These dashboard examples show how to put the newly defined Business Unit–based groups and Super Metrics to good use.

*Figure 23: Business Unit Summary Dashboard Example*

The Business Unit Summary dashboard can be used by business unit and application owners, as well as by operation teams. It provides summarized reporting at the container-level along with a breakdown of individual VMs and their infrastructure components. This powerful dashboard allows the user to go top-down, from a high-level Business Unit container summary at the top, to low-level virtual machine details below, all in a single pane-of-glass.
The BU Compute Analysis Dashboards provides a statistical analysis of Virtual Machine CPU and Memory Demand. The dashboard breaks down CPU and Memory Demand by Percentile as well as calculates CPU and Memory Demand Standard Deviation for each virtual machine.

The BU Storage Analysis Dashboard provides statistical analysis of virtual machine Disk IOPS and Latency. The dashboard breaks down IOPS and Latency by Percentile, plus it calculates IOPS and Latency Standard Deviation for each virtual machine.
The BU Distributions Dashboard provides the ability to see the breakdown of various types of systems in a Business Unit.

The BU Trendlines Dashboard provides the ability to see the Workload growth as well as the CPU, Memory, Storage, and Network resources consumption trending over time.
Enhancing vRealize Automation Reporting

The Management Pack for vRealize Automation (vRA) extends operational management capabilities of the vRealize Operations Manager platform to provide tenant-aware operational visibility of the infrastructure supporting private clouds to cloud provider administrators. In addition to the 3 OOTB dashboards, this MP extends operational management platform, analytics and custom dashboarding capabilities of vROps to vRA’s cloud constructs like Fabric Groups, Tenants, Business Groups, Reservations, etc.

The management pack provides many metrics and properties associated with vRA objects OOTB; however, the concepts explained in this white paper can be used to enhance the management pack functionality. Super Metrics similar to those for Custom Groups can be created to track additional information about vRA-related objects. Additional dashboards can be designed to provide more detailed information around vRA objects to specific stakeholders, further extending vROps functionality and reach.

Figure 28: vRA MP Object Types and Metrics

See the reference section for additional vRA Management Pack documentation.
Authorizing Users and Providing Role-Based Access

With the Custom Groups, Super Metrics, and custom dashboards ready, it is time to provide secure access to the business unit members. The objective is to streamline the experience for the users by providing only the information they need, while minimizing the number of clicks and ensuring privileged access.

Figure 29: Privileged Access Diagram

When this process is completed, the experience should be such that when the users log in, they are taken to the BU Summary dashboard and can only see the Custom Groups and Objects they have permissions to view. In effect, this will make the BU Summary dashboard just a reusable shell for any combination of Custom Groups and User Groups, thus simplifying ongoing support. With solely a single dashboard to maintain, it is much easier to make changes in the future that will be available to all users.
Configuring AD Authentication

vROps provides flexible options to authenticate users including Local, vCenter, SSO SAML, and Active Directory (AD). This example focuses on using Active Directory as it is the most prevalent directory service in today’s enterprise.

Enabling AD integration is a relatively simple process in vROps and can be accomplished under Administration > Authentication Sources > and clicking Add. Fill in all required fields, click Test to validate and then OK to save.

Figure 30: Active Directory Authentication Configuration

Creating a New Role

To simplify the user experience by providing only a single dashboard to view, all administrative and content creation functions must be disabled. To accomplish this, a special user role must be created with very limited privileges. This role will be even more restrictive than the Built-in Read Only one.
Go to Administration > Access Control > Roles and click add. Provide the name for the new role on the Create Role window and click OK.

Figure 31: Create User Role

Once the role has been created, select it and click Permissions. On the “Assign Permissions To Role” window, select the following permissions and click Update:

1. Administration > Login Interactively
2. Content > Dashboard Management > Read and View Dashboards Page
3. Environment > View Dashboard Home Page

Figure 32: Assign Permissions To Role
NOTE: This screenshot does not show all permissions needed due to size.

Managing User Groups

With AD integration and User Roles in place, the next step involves setting up access for users and groups. vROps supports both local users and groups, and can import users and groups from corporate directories. This example showcases importing AD Security Groups since they reduce the management burden in vROps and are popular in enterprise settings by allowing users to leverage their existing AD accounts.

To import an AD Group, use the Import Group command in Administration > Access Control > User Groups.

Figure 33: Import Active Directory Groups

On the Import User Groups wizard, select the directory configured previously in the Configure AD Authentication subsection and search for group(s) to be imported. Select groups to import and click Next.

Figure 34: Import Users and Groups
On the Roles and Objects step, select the role (BU RO Role) created earlier in the “Created New Role” subsections, and check the “Assign this role to group” checkbox. Click Custom Groups, under the Selected Objects expand the Group Type (Business Unit) created previously, and then select the Custom Group(s) the users in the imported group should have permissions to view. Select the Propagation checkmark next to the group name in order to allow users access to objects that are members of the custom group. Then click Finish.

*Figure 35: User Roles and Object Permissions*

With AD Authentication configured, the user Role created, User Groups imported, and Custom Group permissions set, this completes the process of providing secure access to Business-Oriented Infrastructure Reporting with vROps.
Sharing Custom Dashboards

With everything in place, the last task that remains involves sharing custom dashboards with the imported AD Groups from the previous step. This is a rather trivial step that is necessary in order to expose content to the authorized users.

To share dashboards, go to Content > Dashboards > Actions > Share Dashboards.

*Figure 36: Share Dashboards*

On the “Share Dashboard” wizard, locate the dashboard to be shared on the left side, select it, drag it onto one of the imported AD Groups, and let go. When successful, the Dashboards Assigned column will display the number of shared dashboards with that group, and the dashboard Shared icon will not be crossed out. Click Save to apply the new configuration.

*Figure 37: Share Custom Dashboard with User Group*
In addition to sharing the BU Summary dashboard, all dashboards should be unshared with the Everyone group. This will further reduce the Dashboard List menu options.

*Figure 38: Stop Sharing Dashboards with Everyone Group*

The end-result should be a clean, streamlined, and unobstructed access dashboards shared with the user groups. All other navigation options and dashboards are hidden providing simple and focused view for the end user.

*Figure 39: Example of Limited Access*
Automating Business-Oriented Infrastructure Reporting

What if the organization consists of hundreds or thousands of Business Units and needs to provide secure access only to specific workload owners? Creating all of these corresponding Custom Groups, importing AD Groups, and assigning permissions can be a time consuming process. To address this issue, various automation options exist, from simple one-off PowerShell scripts to fully automated vRealize Orchestrator (vRO) workflows. Both options rely on vROps Rest API calls with various degrees of integration and complexity, depending on a specific environment and needs.

Here are the high-level steps need to automate this process:

1. Automation solution prerequisites that can be completed manually as they only require initial setup (one-off scripts can also be used to automate some parts of this):
   a. Define Group Types
   b. Create or Import Super Metrics
   c. Bind Super Metrics to Group Types
   d. Enable Super Metrics
   e. Build the Custom Dashboards

2. The following steps should be fully automated with vRO workflows so that various systems can be kept in sync:
   a. Tag VMs in vCenter (optional)
   b. Create Custom Groups
   c. Create User Groups
   d. Import Users from AD Security Groups
   e. Assign User Roles to Custom Groups
   f. Assign Object Permissions to Custom Groups
   g. Share Custom Dashboards with User Groups

Automation is a very powerful concept in itself, but it is beyond the scope of this white paper.

NOTE: VMware offers Professional Services that can help organizations design, implement, and automate solutions described in this White Paper.
Alerts and Notifications

Any monitoring and reporting solution would be incomplete without a robust Alert and Notification subsystem. vROps provides a lot of flexibility and granularity in this area. Alert Definitions can be created using Symptoms based on collected metrics, properties, and events. Symptoms can use Dynamic or Hard Thresholds that can be preset in definitions and overwritten in Policies for specific workloads. Wait and Cancel Cycles can be used to smooth over peaks, reducing false positives. Logical conditions can be used to combine multiple Symptoms to create smart Alert Definitions that can consider a complex web of issues before triggering an alert. Alert Definitions can be categorized by their severity to allow prioritization of issues and problems.

Recommendations can be customized to provide problem resolution guidance for the operations staff. Hyperlinks can be embedded in the Recommendations linking to Knowledge Base articles or internal company wikis.

Finally, Notifications can push the triggered Alerts to various external systems and notify the users when problems occur. vROps Notifications can be pushed via SNMP traps to an event monitor, SMTP to a team distribution email box, or Rest API to an IT Service Management (ITSM) system. The integration with ITSM via the vROps REST API opens a door for bidirectional communication between the two systems, allowing Alerts to become Tickets. Tickets can be tracked and when resolved, a call back to vROps can be made to cancel the Alert, completing the problem management lifecycle.

*Figure 40: vROps Alert Definition and Notification Construct*
Policies

Policies provide much more than just the ability to enable select metrics as described in the Enable Super Metrics subsection. Different Service-Level Agreements (SLAs) can be configured to provide more targeted monitoring for various types of workloads such as production, test, and development. This enables an organization to have distinctive sets of Alerts and Thresholds, as well as use different Capacity Management models depending on the Workload tracked. In essence, policies provide numerous ways of fine-tuning almost all aspects of vROps, making it a very flexible monitoring and reporting solution for any enterprise.

Figure 41: vROps Custom Groups and Policies Diagram

Conclusion

vRealize Operations Manager, straight out of the box, does a great job at providing infrastructure analytics; however, it does not automatically provide performance, utilization, and consumption around business units, applications, and services. IT can use vROps Custom Groups and Super Metrics to solve this problem. With these tools, IT can build a logical representation of a business. IT can use the same set of analytics they are already familiar with to answer real-world business questions and better align IT with business-oriented outcomes.
References

[1] VMware vRealize Operations Manager Documentation

https://vmwmanagement.files.wordpress.com/2012/01/vcops_super_metrics_in_vsphere_environment_v1_0.pdf


https://blogs.vmware.com/management/vrealize-operations


[6] VMware vRealize Infrastructure Navigator Documentation

[7] Leveraging VMware vRealize Infrastructure Navigator – Blog

[8] VMware Professional Services Organization (PSO)
http://www.vmware.com/professional-services.html

About the Author

Peter Tymbel is a Senior Consultant with VMware Software Defined Datacenter (SDDC) Professional Services practice. He holds a degree in Computer Science from Webster University in St. Louis and various industry certifications. His work focuses on helping VMware customers operationalize their SDDC investment. He publishes a blog on various vROps related topics at vbulosity.com.

Acknowledgments

I would like to sincerely thank Mark Gandler for providing the customer use case and sparking the inception for many ideas that ultimately lead to the solution and this white paper. Special thanks to Julie Brodeur, Max Drury, Jeremiah Fowler, Gary Boy, Jason Gaudreau, and Neeraj Gandhi for reviews and contributions to the paper. I also would like extend thanks to my manager Christopher Dorencz for support in my writing endeavors.