

# TCO Study: Dell EMC VxRail vs. DIY HCI Using vSAN ReadyNodes Configuration

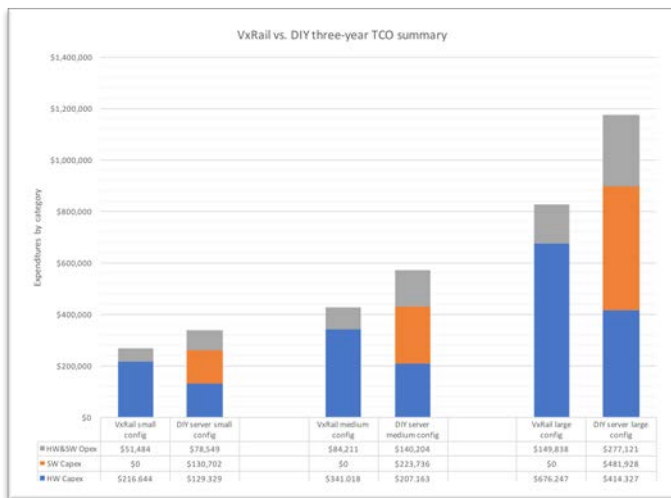
**Silverton Consulting, Inc. StorInt™ Briefing**



## Executive Summary<sup>1</sup>

This paper presents the results of a three-year total cost of ownership (TCO) study comparing Dell EMC™ VxRail™ appliances and an equivalent do-it-yourself (DIY) solution of standalone server hardware and software from the VMware vSAN ReadyNode™ (hardware compatibility list) configurations. For both options, we modeled total hardware capital expense, total software capital expense and operational expense for small, medium and large clusters over a three-year period. In fact, our TCO model shows VxRail configurations

- Have a **~21% to ~30% lower TCO** over a three-year period;
- Have **substantially lower serviceability costs** over a three-year period; and
- Have **no software licensing and maintenance costs**.



The results reveal that VxRail appliance hardware costs are higher than DIY alternatives. However, because VxRail comes bundled with VMware vSAN™ and other Dell EMC software, DIY server software and maintenance costs are significantly higher than VxRail, which includes them at no additional cost.

In addition, operational expenses for the DIY or standalone alternatives are much higher primarily due to VxRail's service organization, VxRail's out-of-box experience, VxRail Manager's upgrade and installation orchestration capabilities and other factors.

Together, the higher software costs and operational expenses for the DIY configuration more than offset the higher costs for the VxRail hardware.

For each cluster size, the TCO is higher for the DIY hyper converged infrastructure (HCI) alternative than the Dell EMC VxRail solution. As the study shows, the three-year TCO for the DIY small cluster is **\$70.5K (26.3%) higher** than the equivalent VxRail configuration, the DIY medium cluster is **\$145.9K (34.3%) higher** than the equivalent VxRail configuration and the DIY large cluster is **\$347.3K (42.0%) higher** than the equivalent VxRail configuration. This correlates to a ~20.8%, 25.5% and ~29.6% lower TCO for VxRail.

Finally, in the appendices that follow the paper, we discuss the TCO factors that make the VxRail hardware more expensive, the TCO factors that make the DIY HCI software more expensive and the differences in cost and time that cause the DIY HCI operational costs to be more expensive.

<sup>1</sup> R2.0 includes corrections to some calculations for total TCO summary and so that the Appendices now include calculations for additional nodes.

## Introduction

Over the last decade, converged infrastructure (CI) solutions have been used to implement virtualized infrastructure over a three-tier configuration that is packaged, sold and supported as a single entity. In place of three separate vendors supplying and supporting the three tiers, with CI, customers gain faster ordering, less problem-prone deployment and less administrator burden.

With the advent of software-defined storage, vendors began offering HCI, which collapses two of the three tiers in the CI offering above.

Dell EMC has been a clear leader in CI solutions since 2009 when they introduced their Vblock® systems from VCE™, a joint venture undertaken with EMC, Cisco Systems, Intel and EMC subsidiary VMware. VCE added VxRack™ (ScaleIO® based) to the portfolio in 2015. In 2016, EMC announced the VxRail, a VMware vSAN based HCI solution.

This paper discusses the Dell EMC VxRail HCI product family, along with hardware and software that can be purchased as DIY or standalone solutions. This paper then discusses a recent TCO study that compares these two solutions.

## Dell EMC VxRail solutions



Dell EMC currently offers five series of VxRail appliances that can be ordered for HCI:

- **G Series** – this general-purpose HCI appliance is a 2U/four-node chassis that supports both all-flash and hybrid (disk-flash) storage. It is best suited for a broad range of application activities.
- **V Series** – this virtualized desktop infrastructure (VDI)-optimized HCI appliance is a 2U/one-node chassis that supports optional graphics processing unit (GPU) acceleration for graphics-intensive desktop environments.
- **S Series** – this storage-optimized HCI appliance is a 2U/one-node appliance for IO-demanding applications such as Microsoft SharePoint, Microsoft Exchange and big data/analytics.

- **P Series** – this performance-optimized HCI appliance is a 2U/one-node chassis that supports heavy, performance-sensitive workloads such as online transaction processing (OLTP) database processing.
- **E Series** – this entry-level HCI appliance is a 1U/one-node chassis for small to midrange business environments.

All VxRail HCI clusters have a minimum of 3 nodes, which can be increased to 64 nodes. Customers can use their current VMware vSphere® licenses on VxRail appliances. All VxRail appliances come pre-installed, fully tested, configured and validated from the factory with appropriate HCI software, for example, VMware vSAN for storage and VMware vRealize Log Insight™.

Each VxRail single node appliance also includes integrated software with a 5VM license (G Series appliances come with 15VM license) for **Dell EMC RecoverPoint®** data replication or mirroring to support site disaster recovery requirements. Further, each VxRail appliance includes a **Dell EMC CloudArray®** 1TB local cache/10TB cloud based capacity license to extend VxRail data storage to public and private clouds.

In addition, VxRail comes pre-installed with **VxRail Manager** software. VxRail Manager provides cluster-level hardware and software management through a cluster-wide management dashboard that shows system health status, software upgrade availability and status, cluster expansion progress, etc.

With VxRail Manager, customer admins gain access to the VxRail web community, which includes recent articles and other content, and a VxRail cluster support display that shows last heartbeat status, allowing admins to open and monitor service requests or chat online directly with Dell EMC VxRail support. VxRail Manager simplifies the operation, monitoring and upgrade of VxRail cluster hardware and software by delivering a more automated lifecycle experience, and it is available only with the VxRail appliance.

## DIY HCI solutions

For point of comparison against VxRail, equivalent Intel X86 server hardware and storage can be purchased from other vendors as a self-selected, DIY HCI solution. In the TCO comparison below, our main goal is to ensure configuration equivalence with the VxRail solution. We used the Dell PowerEdge rack server website<sup>2</sup> to configure and price the server hardware, service/warranty and professional services (PS).

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<sup>2</sup> See: <http://www.dell.com/en-us/work/shop/franchise/poweredge-rack-servers?~ck=mn>

In addition, off-the-shelf vSAN ReadyNodes, available from Dell EMC and many other vendors, are a possible alternative to DIY configured servers. However, these solutions could not be altered much beyond their “certified” standard configurations nor do they include any of the integrated value-added SW, automation and single support capabilities. As such, off-the-shelf vSAN ReadyNodes were not used in our TCO comparison.

All cluster servers (VxRail and DIY configurations) had dual CPU, 256GB of dynamic random-access memory (DRAM), 2 400GB solid-state drives (SSDs), 2 3.8TB SSDs, dual hot pluggable power supplies and enhanced (2 10GbE) Ethernet links. VxRail used E460F, all-flash appliances. DIY servers used equivalently configured Dell R630 rack servers. Appendix A includes details on all major TCO expenses. Appendix B includes more information on the specifics of the VxRail and DIY server configurations used in the TCO comparison.

For our TCO comparison, we modeled three different-sized clusters:

- **Small** cluster consisting of 4 nodes;
- **Medium** cluster consisting of 8 nodes; and
- **Large** cluster consisting of 16 nodes.

These were the initial node configurations for the clusters. However, over the three years in the TCO study we added nodes to these initial configurations for every year of service to represent customer application/workload growth. We added one node per year for the small and medium clusters and two nodes per year for the large cluster. Thus, at the end of the three-year study, the small cluster had 7 nodes, the medium cluster had 11 nodes and the large cluster had 22 nodes.

Like VxRail, we assumed that the customer already has vSphere license(s) that can be used for the cluster. However, to match the VxRail software offerings, a DIY customer must also purchase an Enterprise vSAN license for each CPU in the configuration, three years of premium support, vSAN PS and other Dell EMC value-added software and support. While vSAN PS may not be necessary, VMware service or customer expertise would be needed to configure the vSAN cluster. We use vSAN PS as a stand-in for this configuration activity, but equivalent customer admin time would also suffice.

As discussed above, each VxRail single node appliance also comes with a 5VM Dell EMC RecoverPoint license and a Dell EMC CloudArray 1TB local cache/10TB cloud capacity license. To match these VxRail software licenses, DIY customers would need to either purchase the software from Dell EMC or obtain equivalent functionality elsewhere. In our TCO comparison, for four nodes DIY customers can purchase a 15VM Dell EMC RecoverPoint license (not equivalent to VxRail’s 5VM license per node but the closest incremental license available from Dell EMC) and a 3TB local cache/30TB cloud capacity Dell EMC CloudArray (also not equivalent to

VxRail's 1TB local cache/10TB cloud capacity per node license but the closest available). DIY customers must also purchase three-year, premium service and warranty for this Dell EMC software.

When pricing VxRail-equivalent servers, the Dell rack server website offered a 35% discount off list price on the server, storage and networking hardware but no discount on support, warranty, or PS. Alternatively, Dell EMC offered a 50% discount on VxRail server, storage and networking hardware; a 50% discount on the VxRail premium support and warranty; and a 25% discount on the PS. To be fair, we used the same discounts from list for the DIY hardware, warranty and PS that Dell EMC provided for VxRail hardware, warranty and PS.

We have no similar source for VMware vSAN discounting. However, given similar discounting for this class of product, we believe that vSAN licenses can be obtained at a 30% discount off list; vSAN three-year, four-hour service and warranty can be purchased at a 15% discount off list; and vSAN PS (to stand up the vSAN cluster) can be purchased at a 25% discount off list. Dell EMC RecoverPoint and CloudArray software licenses are both available with a 40% discount, and three-year, premium four-hour service is available at a 25% discount off list.

Please refer to Appendix B for details on list prices for VxRail appliances; DIY Dell servers; and VMware vSAN licenses, support and warranty, and PS.

Figure 1 shows the three-year TCO summary with hardware capital expense (Capex), software Capex and combined hardware and software operating expense (Opex) for both the VxRail and DIY HCI solutions using the small, medium and large configurations discussed previously. Below, we summarize the major cost differences between the VxRail and DIY server TCO. Appendix A includes details on all major TCO expenses shown in Figure 1.



## VxRail vs. DIY TCO comparison

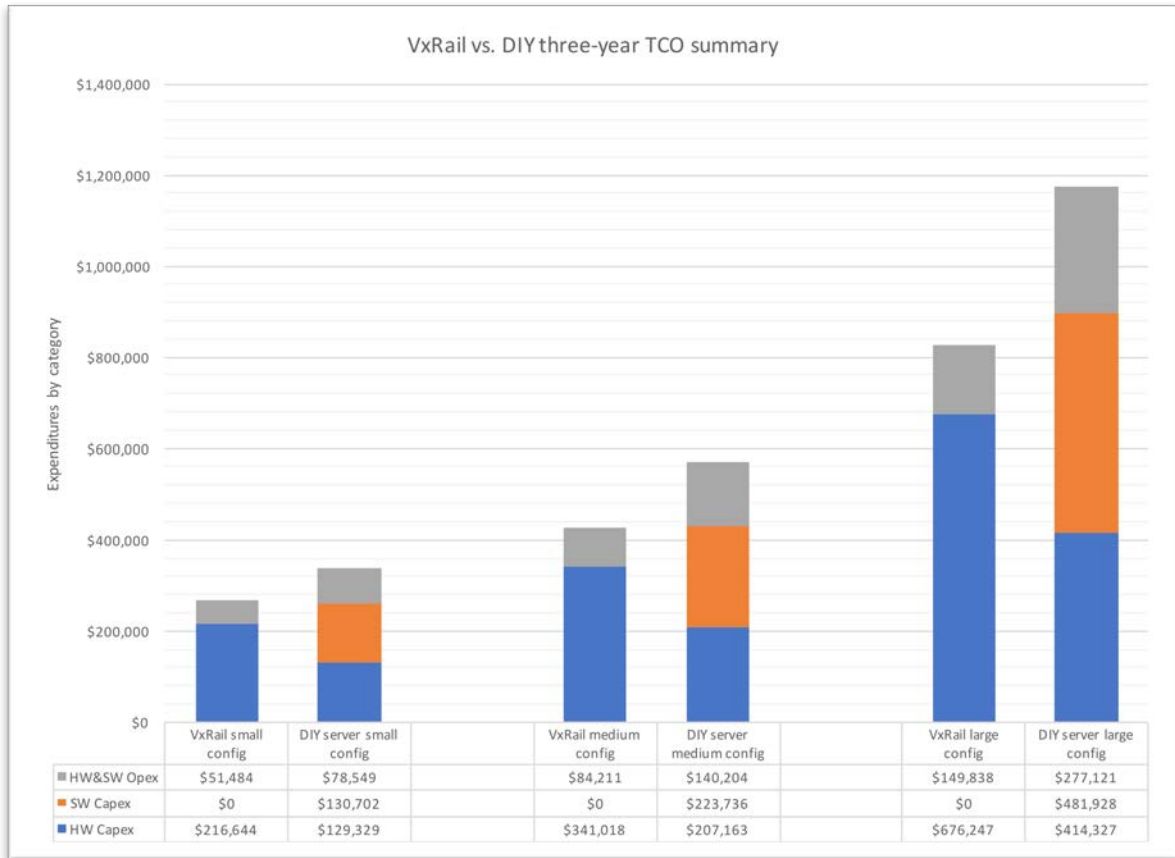


Figure 1 VxRail vs. DIY three-year TCO summary

The first major cost difference between the VxRail and DIY solutions is in hardware Capex. Hardware Capex includes VxRail appliance and DIY server acquisition costs; hardware three-year, premium four-hour service costs; and hardware PS costs. Hardware Capex also includes the cost for nodes, both those included in the initial cluster configuration and those added over the three-year period.

The VxRail E460F appliance lists for \$47.2K, and the equivalent DIY Dell R630 server lists for \$33.1K. The three-year, premium four-hour service and warranty lists for \$14.5K per node for VxRail and \$1.9K per node for the DIY alternative. For PS, there is no pure per-node cost for VxRail, but a four-node cluster PS lists for \$9.8K, and the equivalent DIY alternative lists for \$6.8K. In total, VxRail hardware discounted costs are **\$216.6K, \$341.0K and \$676.2K** for small, medium and large clusters, respectively, which were much higher than the DIY server hardware discounted costs of **\$129.3K, \$207.2K and \$414.3K**. For every cluster size, the VxRail hardware Capex is higher than that of the DIY server solution.

The next major TCO difference is in Software Capex, which is much more expensive for the DIY alternative than for VxRail. Recall that VxRail comes pre-equipped with Enterprise VMware vSAN licenses and Dell EMC RecoverPoint and CloudArray licenses for each node. In addition, vSAN, RecoverPoint and CloudArray service and warranty costs are bundled into the VxRail appliance service and warranty costs. Further, as vSAN comes pre-installed and configured with VxRail, no additional PS or operational expense is needed to stand up the vSAN cluster. RecoverPoint and CloudArray PS costs would be the same for VxRail and DIY clusters and wouldn't change the TCO comparison between the two solutions. As such, these PS costs are not included in the TCO study.

To stand up the vSAN cluster in software Capex, the DIY configuration must include costs for Enterprise vSAN licenses; vSAN three-year, premium four-hour service and warranty; and vSAN PS or customer equivalent. A VMware vSAN Enterprise license lists for ~\$5.5K per CPU, vSAN premium four-hour service lists for 25% of license costs per year and vSAN PS lists for \$20K per cluster.

For each of the four-cluster nodes in the DIY solution, a 15VM Dell EMC RecoverPoint license lists for \$18.6K, and a 3TB Dell EMC CloudArray cache license lists for \$6.8K. Dell EMC three-year, premium four-hour service and warranty for these two solutions lists for \$13.1K.

As a result, the DIY total software discounted costs are **\$130.7K, \$223.7K and \$481.9K** for the small, medium and large cluster sizes, respectively. These costs are significantly higher than VxRail software costs, which are **\$0K** (no cost) for all cluster sizes.

The final significant TCO difference between VxRail and the DIY alternative is the three-year Opex. The bulk of the Opex costs for both solutions is in admin day-to-day cluster monitoring. These costs don't differ substantially between the two solutions, as the hardware and software for both are substantially the same. The next category of Opex is admin service request (SR) call resolution time, which differs significantly between the two alternatives. Indeed, in Appendix A below we show that VxRail has a ~42% overall lower cost for SRs than DIY configurations. The last category of Opex is hardware and software installation and upgrade admin times, which also differ.

These differences are mainly due to VxRail's single-service solution vs. multiple vendors for the DIY solution, VxRail's out-of-the-box installation experience and VxRail Manager's orchestration capabilities. As a result, the Opex for VxRail is projected to be **\$51.5K, \$84.2K and \$149.8K** for the small, medium and large cluster configurations. Similar costs for the DIY environment are projected to be **\$78.5K, \$140.2K and \$277.1K**. These all represent direct labor costs to an organization – there are no discounts for admin time-based costs. For more Opex information, please refer to Appendix A.



In our TCO summary we have not included costs to increase the DIY server Dell EMC RecoverPoint and CloudArray software licenses or service and warranties for the nodes added during the three-year period. No readily available license pricing was available at the one or two nodes added per year. Such costs would have increased the software Capex for the DIY alternatives.

In our cost comparison, the three-year TCO is **\$70.5K (26.3%) higher** than the equivalent VxRail configurations for the DIY small cluster, **\$145.9K (34.3%) higher** for the DIY medium cluster and **\$347.3K (42.0%) higher** for the DIY large cluster.

## Summary

As shown above, the overall TCO for the VxRail configurations is substantially lower than that for the DIY HCI configurations. This difference is primarily due to the bundling of VMware vSAN, Dell EMC RecoverPoint and Dell EMC CloudArray into VxRail, along with the lower operational costs inherent in VxRail packaged appliances, VxRail's out-of-the-box experience, VxRail's service solution and VxRail Manager's orchestration capabilities.

Although the hardware costs for VxRail were higher than those for the DIY server configurations, the software costs and additional operational expenses for the DIY alternatives more than offset these costs.

If you are considering buying DIY server hardware for HCI, think again. Our TCO study projects that your total costs for an HCI solution will be much higher with a DIY solution than with an equivalent VxRail configuration over a three-year period.

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*Silverton Consulting, Inc., is a U.S.-based Storage, Strategy & Systems consulting firm offering products and services to the data storage community.*



## Appendix A – VxRail vs. DIY TCO details

### Hardware and software Capex details

Figure 2 shows the Capex details for each alternative. Capex details are expressed in hardware and software components. Appendix B shows VxRail appliance and DIY server list pricing.

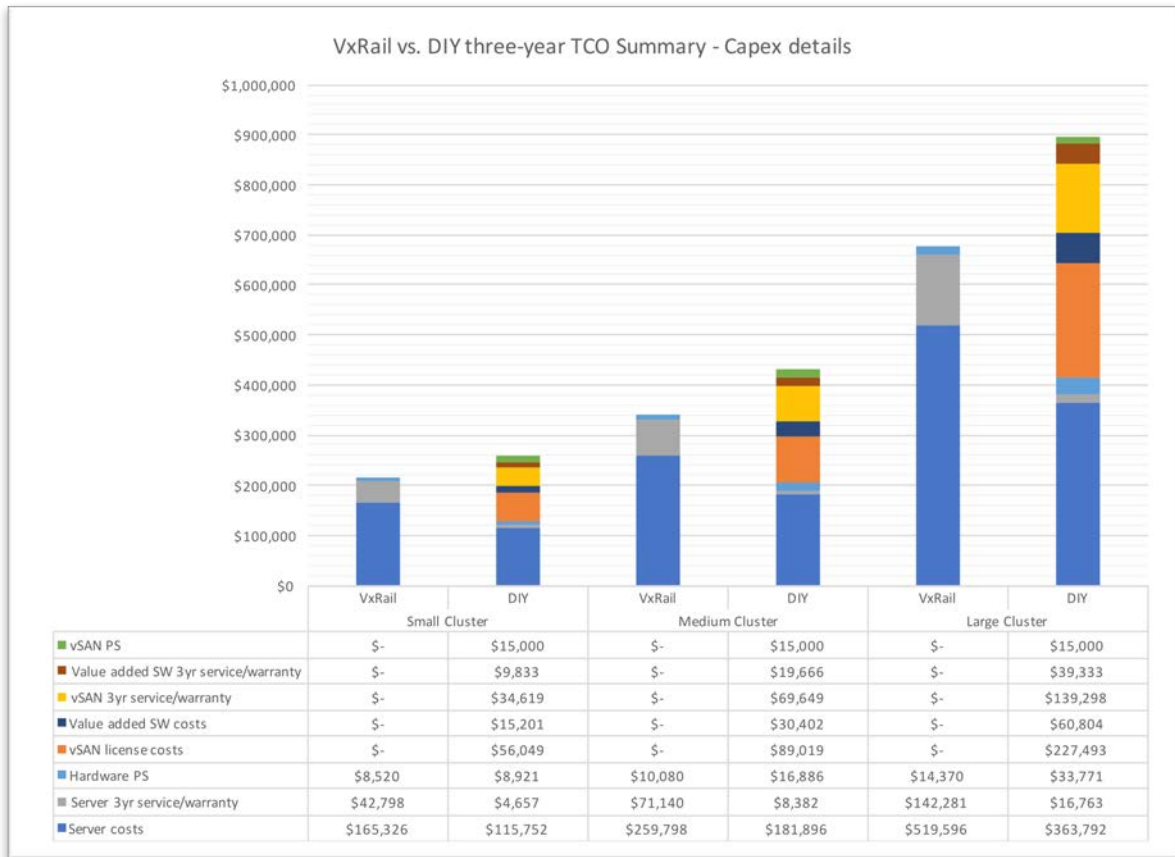


Figure 2 VxRail vs. DIY TCO Capex details

Hardware-oriented Capex is composed of the following costs:

- Server costs** – VxRail appliance hardware discounted costs are **\$165.3K**, **\$259.8K** and **\$519.6K** for the small, medium and large cluster configurations, respectively. Similar discounted costs for the DIY solution are **\$115.8K**, **\$181.9K** and **\$363.8K**. Recall that with VxRail, Dell EMC bundles the cost of VMware vSAN and other software licenses into each hardware appliance purchase. These costs are discounted 50% off list. Please refer to Appendix B to view list pricing on both VxRail and DIY hardware.

- **Server three-year premium service and warranty costs** – VxRail three-year premium service and warranty discounted costs are **\$42.8K, \$71.1K and \$142.3K** for the small, medium and large cluster configurations, respectively. Similar discounted costs for the DIY solution are **\$4.7K, \$8.4K and \$16.8K**. Recall that with VxRail, Dell EMC bundles the cost of VMware vSAN, Dell EMC RecoverPoint and CloudArray service and warranty into each hardware service and warranty purchase. These costs are discounted 50% off list. Please refer to Appendix B to view list pricing on both VxRail appliance and DIY server service and warranty details.
- **Hardware PS costs** – VxRail PS discounted costs are **\$8.5K, \$10.1K and \$14.4K** for small, medium and large cluster configurations, respectively. Similar discounted costs for the DIY solution are **\$8.9K, \$16.9K and \$33.8K**. These costs are discounted 25% off list. VxRail PS charges have a per-cluster and per-node component, whereas the DIY solution has only a per-node cost; as such, the VxRail is more expensive for the small and medium cluster and less expensive for the large cluster. Appendix B shows VxRail appliance and DIY PS list pricing.

Figure 2 also shows the details for software Capex. Software Capex is composed of VMware vSAN license costs, value-added software license costs, vSAN service and warranty costs, value-added software service and warranty costs and vSAN PS costs. These costs are much higher for the DIY option than for VxRail. For more information on list prices for vSAN software included in this TCO study, please refer to Appendix B.

Total software costs are detailed as follows:

- **VMware vSAN Enterprise license** – costs are computed on a per-CPU basis and list at \$5.5K per CPU. After discounts, the costs are **\$56.0K, \$89.0K and \$227.5K** for the small, medium and large DIY server clusters, respectively. Because vSAN licenses are bundled with the VxRail appliance, VxRail costs **\$0** for each cluster size. VMware vSAN Enterprise license prices are discounted 30% off list.
- **Integrated value-added software license** – costs are computed on a 15VM RecoverPoint and 3TB local cache/30TB cloud capacity CloudArray license per four-node basis. The software lists for \$18.6K and \$6.8K, respectively, and after discounts runs **\$15.2K, \$30.4K and \$60.8K** for the small, medium and large clusters, respectively. Recall that RecoverPoint and CloudArray licenses are discounted 40% off list. Because of Dell EMC VxRail software bundling, similar VxRail costs **\$0** for all cluster sizes.
- **VMware vSAN three-year premium service and warranty** – costs are computed on a per-license basis and list at 25% of the associated vSAN

license per year. Over three years, after discounts, the costs are **\$34.6K**, **\$69.6K** and **\$139.3K** for the small, medium and large DIY clusters, respectively. Again, similar VxRail costs are **\$0** for each cluster due to the bundling of VMware vSAN service and warranty costs into every Dell EMC VxRail appliance. vSAN service and warranty prices are discounted 15% off list.

- **Dell EMC integrated value-added software three-year premium service and warranty** – the two software solutions service and warranty per four nodes list for \$13.1K (costs are priced directly by Dell EMC). After discounts, the costs are **\$9.8K**, **\$19.7K** and **\$39.3K**. Again, similar costs for VxRail are **\$0** for all cluster sizes due to bundling. Value-added software service and warranty are discounted 25% off list.
- **VMware vSAN PS** – each cluster lists for \$20K. As discussed earlier, we have discounted vSAN PS costs by 25% off list; as such, vSAN PS runs **\$15K** for each cluster size. A VMware vSAN cluster configuration comes pre-installed and validated on the VxRail appliances from the factory, so similar costs for VxRail are **\$0** for each cluster size.

**Opex details**

Opex costs are divided into admin time to resolve a hardware service request (SR), admin time to resolve a software SR, admin time to resolve installation and upgrade SRs, admin time for day-to-day cluster monitoring and admin time to perform hardware and software installations and upgrades. Figure 3 shows the Opex details for each alternative.

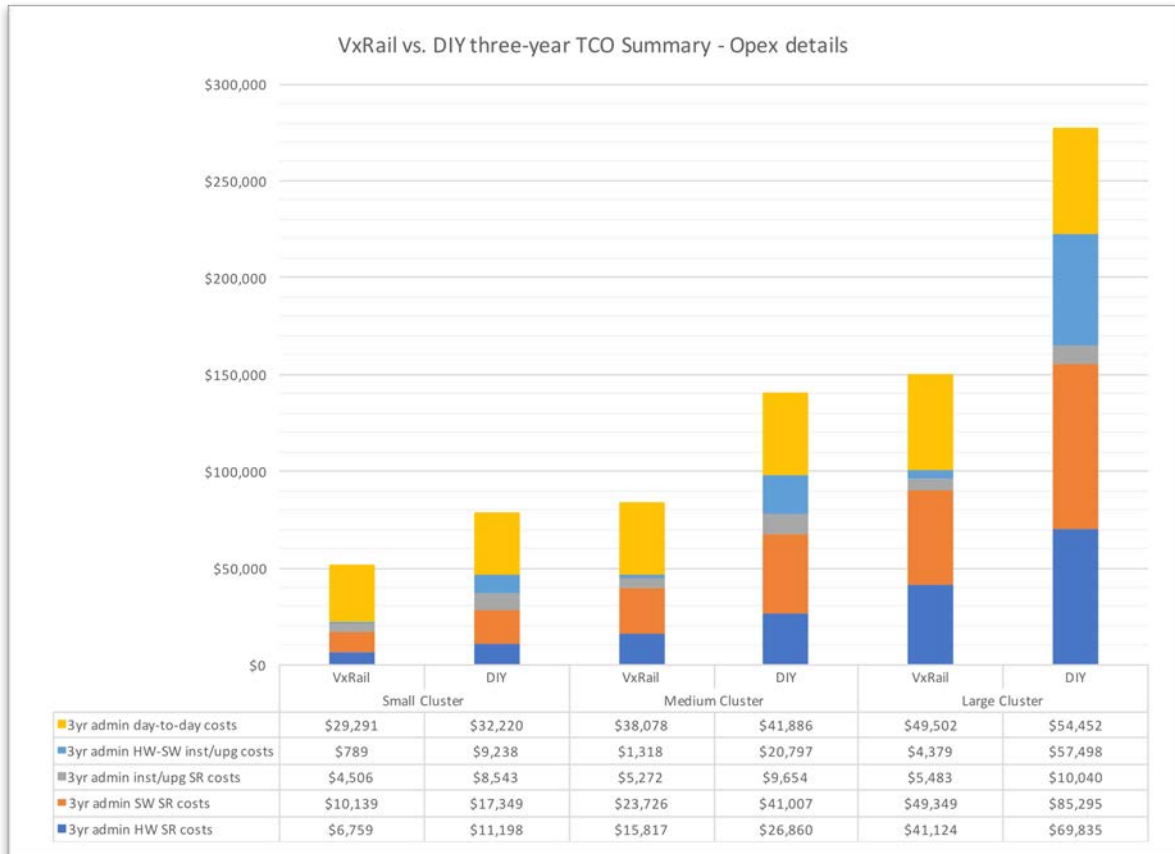


Figure 3 VxRail vs. DIY three-year TCO – Opex details

We used the same admin costs/hour for both VxRail and DIY alternatives. According to Google,<sup>3</sup> the “IT admin average salary USA” is \$60.1K. We add 30% on top of the base salary to compute the fully burdened (FB) small cluster admin cost to a business. We increase this FB admin cost by 30% for the medium cluster because it is larger, more complex and harder to operate than a small cluster. We again increase the medium cluster FB admin cost by another 30% for the large cluster for similar reasons. As such, yearly FB admin costs are \$78.1K, \$101.5K and \$132.0K for the small, medium and large clusters, respectively. We divide these costs by 2,080

<sup>3</sup> Google search on “IT admin average salary USA” as of April 26, 2017.

(52x40) to come up with admin costs/hour, which are ~\$38/hour, ~\$49/hour and ~\$63/hour for the small, medium and large clusters, respectively. These costs remained unchanged throughout the three-year TCO period.

Medium and large clusters sizes are managed by more experienced IT staff, and the hardware and software are essentially the same for both the VxRail and DIY clusters. As such, we also use the same number of SR requests for both the VxRail and DIY configurations based on calls per node per month of 60%, 50% and 40% for the small, medium and large clusters, respectively. We expect 2.4, 4.0 and 6.4 SR calls/month, or **108.0**, **162.0** and **259.2** calls over three years for the initial small, medium and large clusters, respectively.

To understand how much admin time SRs take, we divided these calls into hardware, software and installation/upgrade SRs. We split these SRs into 33%, 33% and 33% for the small cluster; 40%, 40% and 20% for the medium cluster; and 50%, 40% and 10% for the large cluster. Again, more experienced IT admins should have relatively fewer problems installing and upgrading the clusters. Although all the times below represent direct admin time, SR calls such as these could conceivably take place over multiple days or longer.

We used the following admin time assumptions for Dell EMC VxRail SR calls:

- An average hardware call on VxRail takes **five hours of customer admin time to resolve**. This time includes discovering the problem, isolating the problem to the cluster, calling support, explaining the problem, gathering diagnostic information, transmitting information to support, providing a test bed for potential fixes and implementing the final fix to resolve the problem.
- An average software call on VxRail takes **7.5 hours of customer admin time to resolve**, which is 1.5 times longer than a hardware call because there's more to discover, isolate, explain, diagnose and fix.
- An average installation/upgrade SR call on VxRail takes **3.3 hours of customer admin time to resolve**, which is about 66% of the time required for a hardware call. With less equipment/software to interact with, it's easier to discover, isolate and diagnose errors.

Since Dell EMC VxRail offers a single-service solution and the DIY solution has multiple vendors (Dell for servers and storage, VMware for vSphere and vSAN, Dell EMC for RecoverPoint & CloudArray, etc.), it is logical to assume customer admin times to resolve any SR are longer for DIY environments. As such, we multiplied the time to resolve a VxRail SR by **1.75X** to determine the customer admin time to resolve a DIY SR. For the DIY cluster, an average **hardware SR takes 8.8 hours**, a **software SR takes 13.1 hours** and an **install/upgrade SR takes 5.8 hours**.



Recall that admin costs for the medium and large cluster sizes are higher than those for the small cluster and that admin costs are not discounted, as they represent direct organizational expenses.

All the foregoing results in the following SR costs:

- **Hardware SR** costs in admin time over three years for Dell EMC VxRail configurations are projected to be **\$6.8K, \$15.8K and \$41.1K** for small, medium and large clusters, respectively. Similar costs for DIY configurations are projected to be **\$11.2K, \$26.9K and \$69.8K**.
- **Software SR** costs in admin time over three years for Dell EMC VxRail configurations are projected to be **\$10.1K, \$23.7K and \$49.3K** for small, medium and large clusters, respectively. Similar costs for DIY configurations are projected to be **\$17.3K, \$41.0K and \$85.3K**.
- **Installation and upgrade SR** costs in admin time over three years for Dell EMC VxRail clusters are projected to be **\$4.5K, \$5.3K and \$5.5K** for small, medium and large cluster configurations, respectively. Similar costs for DIY configurations are projected to be **\$8.5K, \$9.7K and \$10.0K**.

Consequently, VxRail has ~42% lower SR admin time cost for all cluster sizes than the DIY configurations.

The next category of Opex is hardware and software installation and upgrade admin time. All cluster software comes pre-installed on VxRail appliances, but for DIY servers, admins will need to download, install and configure all software on each node in a configuration.

When upgrading cluster software for VxRail, customers receive one packaged set of fixes/updates for all cluster software, with guaranteed compatibility with VxRail hardware rather than separate series of releases/updates for every installed software component. Further, with VxRail Manager software upgrades take just a single click for the whole cluster.

For the DIY solution, admins must check the software component being upgraded against other software and hardware compatibility matrices to verify that it can be used with the currently installed systems. The software upgrade process for the DIY cluster also depends on the component being updated. For an operational cluster, an admin may need to take a cluster node offline, install the software update, validate it and then bring the cluster node back online. If this effort is going to take a protracted period, the admin may wish to migrate data and workload off the cluster node and then migrate it back again when the process completes. Finally, the admin will again have to manually run this same software update process against every node in the cluster.

Another admin time consideration is hardware upgrades. Customers periodically run out of cluster performance, and the only way forward is to add more hardware to the cluster, which requires another order process. For VxRail configurations, admins can just order the additional hardware, and Dell EMC will guarantee hardware and software compatibility. For DIY configurations, admins will need to once again check hardware and software compatibility and will need to purchase additional VMware vSAN Enterprise, Dell EMC RecoverPoint and CloudArray cache licenses and service warranties for the new servers and software.

Hardware upgrades for VxRail and DIY configurations come in two types: add nodes to the cluster or add storage to nodes in the cluster. We assume that there is **one storage capacity upgrade per node per year** for the small and medium configurations and **two storage capacity upgrades per node per year** for the large configuration. We also assume there is **one node added per cluster per year** for the small and medium configuration and **two nodes added per cluster per year** for the large configuration. For VxRail capacity upgrades, we assume it takes on average **0.5 hours of admin time** per upgrade per node and VxRail cluster node additions take on average **0.5 hours of admin time** per node.

We also assume that there are **four software upgrades** per node per year. For the VxRail cluster, we believe each software upgrade will take on average **0.5 hours of admin time per cluster** (note this is a per cluster admin time, not a per node time for VxRail).

For DIY configurations, admins need to check hardware and software compatibility for each upgrade, order the hardware and software from different vendors, install and configure software for each added node, initialize the storage media, etc. As such, we multiplied all these admin times by **2X**. In addition, unlike VxRail Manager-orchestrated software upgrades, admins will need to repeat the software upgrade process for each node in the cluster for DIY configuration software upgrades. As such, we multiplied the VxRail admin time by the number of nodes in the cluster to compute the DIY software upgrade times.

As a result, the three-year hardware and software installation and upgrade admin costs for the VxRail environment are projected to be **\$0.8K, \$1.3K and \$4.4K** for the small, medium and large clusters, respectively. Similar costs for the DIY configuration will likely run **\$9.2K, \$20.8K and \$57.5K**.

The final category of Opex is associated with day-to-day monitoring of the node cluster. We believe the process will take place on average every business day across the three-year duration of this TCO. We also assume that this activity takes **0.5 hours/day/cluster** for software monitoring and **0.5 hours/day/cluster/day** for hardware monitoring for the VxRail environment. We multiply these times by **1.1X** for the DIY configuration, as the systems are essentially the same as VxRail,

providing a modest improvement in cluster-level management above the base level of support in the DIY server management software. As a result, the day-to-day admin monitoring time costs for VxRail are projected to be **\$29.3K, \$38.1K and \$49.5K** for the small, medium and large configurations, respectively. Similar costs for the DIY environments are projected to be **\$32.2K, \$41.9K and \$54.5K**. Again, as these are admin costs, there are no discounts.

## Appendix B – Hardware and software detailed cost information

### DIY Dell rack server website quote<sup>4</sup>

The following screen shot from Dell’s PowerEdge rack server website shows a quote for the hardware, and service and warranty costs for the PowerEdge R630 rack server.

**My Cart**

Cart **Saved Item**

Print Cart | E-mail Cart | Continue Shopping

Unsaved carts expire after 30 minutes. Save Cart | Secure Checkout

Summary View | Detail View

**Description**

**PowerEdge R630 Rack Server**

Date & Time: April 26, 2017 3:45 PM CST

SYSTEM COMPONENTS	Qty	Unit Price	
PowerEdge R630 Rack Server	1	\$36,200.00	
Limited-Time Offer: Save big on PowerEdge Server OS and CALs. Expires Thursday, May 04, 2017. <a href="#">View Details</a>			
Save 34% on select PowerEdge R630 through Dell Small Business Special Offer. <a href="#">View Details</a>			
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No interest if paid in full within 90 days on all PowerEdge servers! Only valid on purchases using Dell Business Credit. <a href="#">View Details</a>			
<b>Catalog Number:</b>	<b>4 PE_R630_1337_A</b>		

Module	Description	Show Details
PowerEdge R630	PowerEdge R630 Server	
Trusted Platform Module (TPM)	Trusted Platform Module 1.2 FIPS Common Criteria	
Chassis Configuration	Chassis with up to 10, 2.5" Hard Drives, 3 PCIe Slots	
Shipping	PowerEdge R630 Shipping - 10/24 Drive Chassis	
Processor	Intel® Xeon® E5-2620 v4 2.1GHz,20M Cache,8.0GT/s QPI,Turbo,HT,8C/16T (85W) Max Mem 2133MHz	
Additional Processor	Intel® Xeon® E5-2620 v4 2.1GHz,20M Cache,8.0GT/s QPI,Turbo,HT,8C/16T (85W) Max Mem 2133MHz	
Processor Thermal Configuration	2 CPU up to 120W	
Memory DIMM Type and Speed	2400MT/s RDIMMs	
Memory Configuration Type	Performance Optimized	
Memory Capacity	(8) 32GB RDIMM, 2400MT/s, Dual Rank, x4 Data Width	
RAID Configuration	No RAID for H330/H730/H730P (1-24 HDDs or SSDs)	
RAID Controller	PERC H330 RAID Controller	
Hard Drives	(2) 400GB Solid State Drive SAS Write Intensive MLC 12Gbps 2.5in Hot-plug Drive, PX05SM	
Hard Drives	(2) 3.84TB Solid State Drive SAS Mix Use MLC 12Gbps 2.5in Hot-plug Drive, PX04SV	
Embedded Systems Management	IDRAC8 Express, integrated Dell Remote Access Controller, Express	
Internal Optical Drive	No Internal Optical Drive for 10 or 24 HDD Chassis	
Rack Rails	ReadyRails™ Sliding Rails With Cable Management Arm	
Bezel	Bezel 10/24 Drive Chassis	
Power Management BIOS	Power Saving Dell Active Power Controller	

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- Dell Business Credit
- Credit/debit cards
- PayPal
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- Dell gift cards

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<sup>4</sup> Dell server price quote obtained April 26, 2017, using Dell PowerEdge rack server’s configurator, see: [http://www.dell.com/en-us/work/shop/productdetails/poweredge-r630/pe\\_r630\\_1337\\_a](http://www.dell.com/en-us/work/shop/productdetails/poweredge-r630/pe_r630_1337_a)

Settings	
Power Cords	(2) NEMA 5-15P to C13 Wall Plug, 125 Volt, 15 AMP, 10 Feet (3m), Power Cord, North America
Power Supply	Dual, Hot-plug, Redundant Power Supply (1+1), 1100W
System Documentation	No Systems Documentation, No OpenManage DVD Kit
Operating System	No Operating System
OS Media Kits	No Media Required
Advanced System Configurations	UEFI BIOS Setting
Shipping Information	US No Canada Ship Charge
Network Daughter Card	Intel X520 DP 10Gb SR/SFP+, + I350 DP 1Gb Ethernet, Network Daughter Card, with SR Optics
Service	ProSupport Plus: 3 Year Mission Critical 4Hr On-site Service
Deployment Services	No Installation
Remote Consulting Services	Declined Remote Consulting Service
Server Accessories	SFP+, SR, Optical Transceiver, Low Cost, 10Gb-1Gb
<b>TOTAL: \$23,666.80</b>	

Total Price	
Sub-total	\$23,666.80
Shipping & Handling*	--
Tax	--
<b>Total Price<sup>1</sup></b>	<b>--</b>
In the event that you are subject to a tax holiday, you will not be charged tax. <a href="#">Learn More</a>	

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<sup>1</sup>Dell Business Credit: OFFER VARIES BY CREDITWORTHINESS AS DETERMINED BY LENDER. Offered by WebBank to Small and Medium Business customers with approved credit. Taxes, fees, shipping and handling charges are extra and vary.

snCM14



## VMware vSAN Enterprise license quote for a four-node cluster with two CPUs per node

The following screen shot<sup>5</sup> from VMware's vSAN TCO sizing tool provides the basis for the license and service and warranty costs used in the model for the VMware vSAN software.

The screenshot shows the VMware vSAN TCO and Sizing Calculator interface. The 'TCO Inputs' tab is selected, and the 'License & Storage Solutions' sub-tab is active. The 'vSAN License' section shows the following configuration:

Parameter	Value
vSAN License Type	Enterprise Per-CPU License
VMware License Discount	0%
Total List Price Per-CPU	\$5,495.00
vSAN Licenses Required	8

A note below the table states: \* If you want to change to regional pricing go to the advanced section and modify the license costs.

The 'Service and Support' section shows the following configuration:

Parameter	Value
Include support in calculations?	Yes
VMware Production License Support Period	3 Year
VMware SnS Discount	0%
Total Support Cost for Cluster	\$29,014

The 'Current/Alternative Storage Solution Configuration' section is partially visible at the bottom, showing 'Storage Solution Type' set to 'All Flash Array (Up to 120K IOPS, Max 16TB)'.

<sup>5</sup> VMware's vSAN TCO sizing tool home is at <https://vsantco.vmware.com/vsan/SI/SIEV>, but the Enterprise license costs can be found at <https://vsantco.vmware.com/vsan/TI/TILS> as of 6 June 2017.



## Dell EMC VxRail price quote

The following is a Dell EMC list price quote for a single E460F VxRail appliance and enhanced three-year service and warranty.



176 South Street  
HOPKINTON MA 01748  
USA

Item	Description	Qty	UOM	Total List Price (USD)
<b>Sold To:</b>				
CUST REQUEST 1003334795				
<b>Bill To:</b>				
CUST REQUEST 1003334795				
<b>Ship To:</b>				
CUST REQUEST 1003334795				
SOUTH ST HOPKINTON MA 01748 USA				
SOUTH ST HOPKINTON MA 01748 USA				
SOUTH ST HOPKINTON MA 01748 USA				
<b>SYSTEM</b>				
	<b>VXRAIL 4.0 E460F ALL FLASH</b>			
SYS6301U1N10DAF	VXRAIL E460F NODE 10X 2.5 DRIVE SLOTS ALL FLASH	1	EA	
TPM1.2MODULE	VXRAIL TPM 1.2 MODULE	1	EA	
PRE52620V408C21	VXRAIL PROCESSOR E5-2620 V4 8 CORE 2.1GHZ (1ST)	1	EA	
PRE52620V408C2	VXRAIL PROCESSOR E5-2620 V4 8 CORE 2.1GHZ (2ND)	1	EA	
MEMDIMM32GB	VXRAIL MEMORY 32GB 2400 MHZ RDIMM	8	EA	
NIC2X1E2X10ESFP	VXRAIL NIC 2X1GBE PLUS 2X10GBE SFP	1	EA	
CAPSSD384TB1WPD	VXRAIL CAPACITY SSD 3.84TB 1WPD	2	EA	
SSD400GB10WPD25	VXRAIL CACHE SSD 400GB 10WPD 2.5 INCH	2	EA	
M-EMDL-ENHW-3Y	ENHANCED HARDWARE SUPPORT 3 YEAR	1	EA	
<b>Hardware Sub-total</b>				<b>\$47,236.00</b>
<b>Hardware Warranty and Maintenance Sub-total</b>				<b>\$14,171.40</b>
VXR-HCIA-MGR-DE-40	VXRAIL MANAGER V4.0	1	EA	
456-111-959	RECOVERPOINT FOR VM FOR 1-NODE VXRAIL	1	EA	
M-ENHSW-D3-001	ENHANCED SOFTWARE SUPPORT	1	EA	
<b>Software Sub-total</b>				<b>\$0.00</b>
<b>Software Warranty and Maintenance Sub-total</b>				<b>\$0.00</b>
PS-BAS-RPVML	RECOVERPOINT FOR VMS IMPLEMENTATION ASSISTANCE	1	EA	
PS-BAS-HCIAINS	INSTALLATION FOR VXRAIL SINGLE APPLIANCE	1	EA	
<b>Services Sub-total</b>				<b>\$9,030.00</b>
<b>Hardware Sub-total</b>				<b>\$47,236.00</b>
<b>Software Sub-total</b>				<b>\$0.00</b>
<b>Prepaid HW Maintenance Sub-total</b>				<b>\$14,171.40</b>
<b>Prepaid SW Maintenance Sub-total</b>				<b>\$0.00</b>
<b>Services Sub-total</b>				<b>\$9,030.00</b>
<b>Configuration Total</b>				<b>\$70,437.40</b>