89 Fifth Avenue, 7th Floor

New York, NY 10003

www.TheEdison.com

@EdisonGroupInc

212.367.7400

White Paper

VCE VxRail ™ Appliance Cost and Maintenance Advantages

Printed in the United States of America

The information contained in this document is based on EMC provided materials and independent research and was aggregated for Edison Group, Inc. by the Edison Group Analyst team.

First Publication: May 2016

Produced by: Harold Kreitzman, Analyst; Barry Cohen, Editor-in-Chief

Table of Contents

Executive Summary

While there are significant potential benefits when an organization migrates to a hyper-converged system, true cost and real life experience are critical to the decision making process. In order to effectively establish a case for going to one platform vs. another, strong fact-based analytical methodologies and approaches are needed.

In this paper the case for Hyper-Converged Appliances, and in particular the EMC VCE VxRail Appliance, is made from both cost and measureable effort perspectives. Strict reliance on measurables was used in lieu of anecdotal observations or customer quoted benefits in order to provide realistic and repeatable analysis.

Specifically, the total cost of ownership (TCO), total cost of acquisition (TCA) and relative work efforts to install, initialize and maintain a VCE VxRail™ Appliance (VxRail) will be contrasted and compared to a Build Your Own (BYO) system.

Cost Perspectives

- **Total Cost of Acquisition** (TCA) - VxRail is respectively 8.5% less expensive than one equipped with a BYO solution.
- **Total Cost of Ownership** (TCO) - VxRail is respectively 30.7% less expensive than one equipped with a BYO solution.

VxRail cost advantage versus BYO comes primarily from personnel support and facilities.

Management Complexity Perspectives

- **Deployment** – BYO takes relatively 4.6 more time to set-up than VxRail.
- **Initial System Initialization and Configuration** – BYO takes 96 steps more and approximately 5 hours more than VxRail.
- **System Expansion** – BYO takes 73 steps more and over 2 hours more than VxRail. Potential chance for operational errors with VxRail is reduced via simplification of operational tasks.

Market Shift to Hyper-Converged/Converged Solutions

Over the past two years, the market has started to shift significantly from Build Your Own (BYO) systems to hyper-converged appliances. Some of the key reasons are as follows:

- **Reduced data center footprint** – the inclination to add server after server and storage unit after storage unit to support rapid expansion of virtual machine based systems has led to data center sprawl. Hyper-converged offers a more environmental friendly solution.
- **Simplify system management** – while there are perceived cost benefits for commoditized hardware, the management of these disparate systems is quite complex. As an organization's infrastructure grows, the complexity tipping point is reached where the cost savings on the equipment is overshadowed by the operational and support costs as well as the mean time to identify and resolve problems as they occur. Hyper-converged systems offer single-pane management.
- **Automated Operations** – hyper-converged systems provide an excellent platform for operational automation as it is self-contained, fully integrated and usually is from one vendor.
- **Rapid provisioning** – one of the main benefits of hyper-converged systems is the ability to provision rapid provisioning. The larger the organization, the more relevant this becomes.
- **Data Protection –** centralization of security and data handling policies leads to enhanced data protection.
- **Performance –** fully integrated processing, network, storage and software generally delivers higher performance than disparate systems.
- **VDI and evolving application workloads** –VDI, one of the key workload targets for hyperconvergence, is greatly benefited by the features and capabilities of hyper-converged systems
- **One vendor –** there are significant benefits in having "one-throat-to-choke". One service call, no finger pointing resulting in quicker resolution of issues as they occur.

The VCE VxRail Appliance is, according to EMC, "the only fully integrated and pre-tested VMware hyper-converged infrastructure appliance family on the market." This white paper discusses the cost of ownership advantages, VxRail delivers.

Selected Configurations

For the purposes of both the cost and management complexity analyses, Edison focused on configurations designed for mid-sized organizations. In order to ensure comparisons were appropriate, Edison chose equivalently sized solutions. Table 1 shows a breakdown of models selected for this study, as well as feature/functionality breakdown of each model.

Vendor	VxRail	Build Your Own
Hardware	VxRail 200 with 64 nodes: (16) HCIA Chassis w/ 1600 PS and Fan (Q- (64) HCIA Node 20core CPU 512GBMem (16) HCIA Field Install Kit 10GE SFP+	(64) Rack Server
Network	(03) 10 GbE Switch 48 Port (02) 1 GbE Switch 48 Port	(12) 10 GbE Switch 48 Port (12) 1 GbE Switch 48 Port (12) 16 GB FC Switch 48 Port
Software	(01) VxRail Bundled Software: VMware Virtual SAN Enterprise VMware VxRail Manager VMware vCenter Server VMware vRealize Log Insight EMC Secure Remote Support (ESRS)/VE EMC Recover Point for Virtual Machines (RP4VM) - 15 Full Licenses EMC CloudArray- 1 TB local cache/10 TB cloud storage License (128) VMware vSphere Enterprise Plus VMware vCenter Server	(128) VMware vSphere Enterprise Plus (01) VMware vCenter Server VMware vRealize Log Insight
Storage	(64) HCIA Disk Pack 1x400GB SSD 4x1.2TB HDD (DP-1X4SSD-4XHDD)	(01) SAN: 40 TiB Raw Flash 300 TiB other

Table 1: Selected Configurations

TCA and TCO Results

TCA and TCO Results

From a **Total Cost of Acquisition** (TCA) perspective, VxRail is 8.5 percent less expensive than an equivalent BYO solution.

From a **Total Cost of Ownership** (TCO) perspective, VxRail is 30.7 percent less expensive than the BYO solution.

VxRail cost advantage versus BYO comes primarily from personnel support and facilities. The full extent of the advantage is best seen in the comprehensive analyses of competing systems.

Methodology of TCA and TCO Analysis

Total cost models review the costs associated with the acquisition, installation, licensing, maintenance, and brick-and-mortar infrastructure needs of a complete solution. Keep in mind that a hyper-converged solution integrates the separate components found in the BYO solution. Therefore, component cost comparisons are shown in the aggregate. Within this study, discounted prices are used throughout. The cost components reviewed include:

- Server/processor licensing and maintenance
- Storage licensing and maintenance
- Network licensing and maintenance
- Software licensing and maintenance
- Facility costs including space, power, and equipment
- Support personnel costs

Total cost of acquisition reflects the out-of-pocket costs paid on Day One, and includes the purchase cost of all hardware, software, network, storage, plus the initial cost for the first term of any maintenance contracts, whether for one or multiple years. There is no accounting treatment and therefore no need to separate component costs into capital and/or operating categories.

Total cost of ownership is analyzed using a five-year timeline. All cost components are included as either capital costs or operating costs. Capital costs are those one-time costs included in the TCA analysis. Operating costs include all other spending to sustain

operations, including all maintenance, power, and space costs, and are included in the TCO analysis.

Methodology by Component

The following is a breakdown of the TCA/TCO methodology by component.

Hardware – The choice of hardware is based on comparable compute, network and storage requirements. Note, that the cost of hardware for hyper-converged systems includes some network, all server, all storage and some software costs.

Network – network components between hyper-converged and BYO vary. Edison took a pragmatic approach to network requirements. The VxRail configuration used in the study fits in one rack and therefore does not need end of row network equipment. BYO requires several racks and therefore requires top of rack and end of row network equipment.

Virtualization Software – for both platforms the costs for VMware and client operating systems and application software is not included or is considered to be the same. For hardware management on BYO each component, compute and storage, has its own management systems which have to be acquired and configured separately.

Storage – storage was chosen on the basis of equivalent raw storage capacity in a hybrid Flash and HDD infrastructure.

Facility – Consists of three sub-components: racks, data center space, and power

- The number of racks is determined by how much equipment is used by each platform, rounded up to the nearest full rack
- Data center space use is computed using the number of racks times 14.4 square feet, which is the amount of the space needed for the rack plus common access area. The cost of rentable square feet/year is based on the cost of datacenter space in New York, New York as of April 2016. Usable square feet is equal to 80 percent of rentable square feet
- Power is computed based on the cumulative power requirements of the equipment plus the power required to support the infrastructure. Using the Power Usage Effectiveness (PUE) measure (1.8), the infrastructure load is taken into account. The total wattage requirement is then multiplied by the national average for cost per Kwh, as per the Energy Information Administration.

Personnel – Hyper-converged systems require less personnel to support than BYO since hyper-converged takes up less space and has a decreased operational task load (as per CMCS studies referenced later in this document). Assuming three shifts, a minimum

requirement for support is three persons. For BYO, an additional hardware specialist per shift is needed to support the six racks of equipment.

TCA Results

TCA is based on day-one out-of-pocket costs. It does not include any costs associated with daily operations going forward. It does include the cost of year one maintenance and the first year of rent.

Component Cost	VxRail	BYO	Difference ($)	Difference (%)
Hardware	$2,914,267	$1,538,240	$1,376,027	47.2%
Network	35,363	1,000,215	(964,853)	-2728.5%
Virtualization Software	503,309	508,928	(5,620)	-1.1%
Storage	-	546,250	(546,250)	N/A
Facilities	52,550	208,929	(156,379)	-297.6%
Grand Total TCA	$3,505,489	$3,802,563	$(297,074)	-8.5%

Table 2: Total Cost of Acquisition Findings

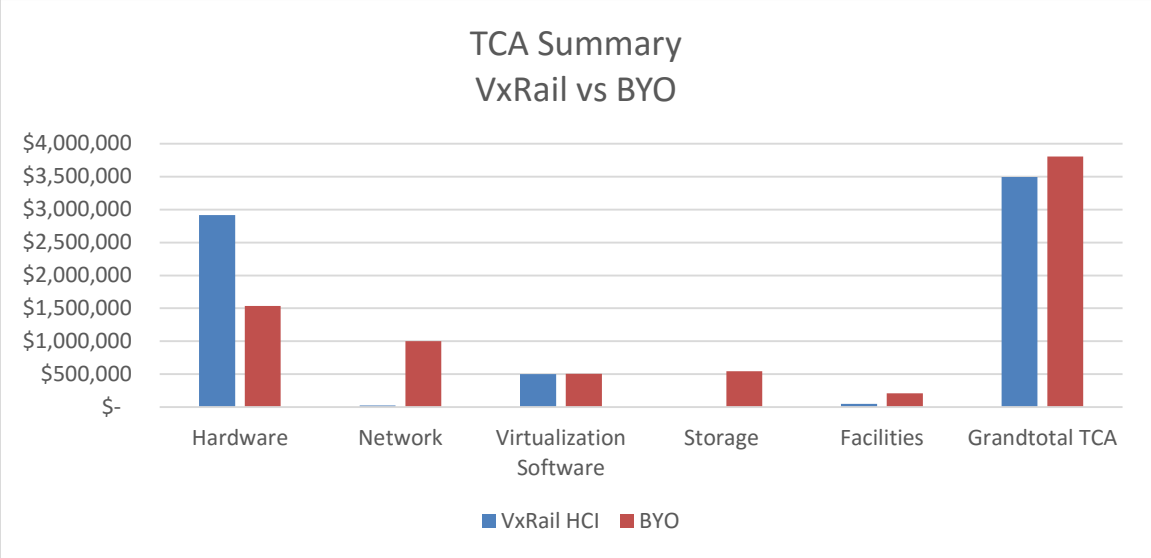


Chart 1: Total Cost of Acquisition Findings

TCA for VxRail is $297,074 lower than BYO, or 8.5% less. From a TCA perspective, reduced facilities cost coupled with reduced overall product cost puts VxRail at a lower acquisition cost.

TCO Results – Five Years

As mentioned above, the five-year TCO figure includes capital and operating costs.

TCO Cost Components				
Capital Cost	**VxRail**	**BYO**	**Difference ($)**	**Difference (%)**
Hardware	$2,534,145	$1,337,600	$1,196,545	47.2%
Network	30,750	944,100	(913,350)	-2970.2%
Storage	-	475,000	(475,000)	N/A
Virtualization Software	402,624	407,120	(4,496)	-1.1%
Facilities	-	-	-	N/A
Personnel	-	-	-	N/A
Subtotal CC	$2,967,519	$3,163,820	$(196,300)	-6.6%
Operating Costs	**VxRail**	**BYO**	**Difference ($)**	**Difference (%)**
Hardware	$1,900,609	$1,003,200	$897,409	47.2%
Network	23,063	280,575	(257,513)	-1116.6%
Storage	-	356,250	(356,250)	N/A
Virtualization Software	503,424	509,045	(5,621)	-1.1%
Facilities	262,752	1,044,646	(781,894)	-297.6%
Personnel	1,500,000	3,000,000	(1,500,000)	-100.0%
Subtotal OC	$4,189,847	$6,193,715	$(2,003,868)	-47.8%
Grand Total TCO	$7,157,367	$9,357,535	$(2,200,168)	-30.7%

Table 3: Total Cost of Ownership Findings

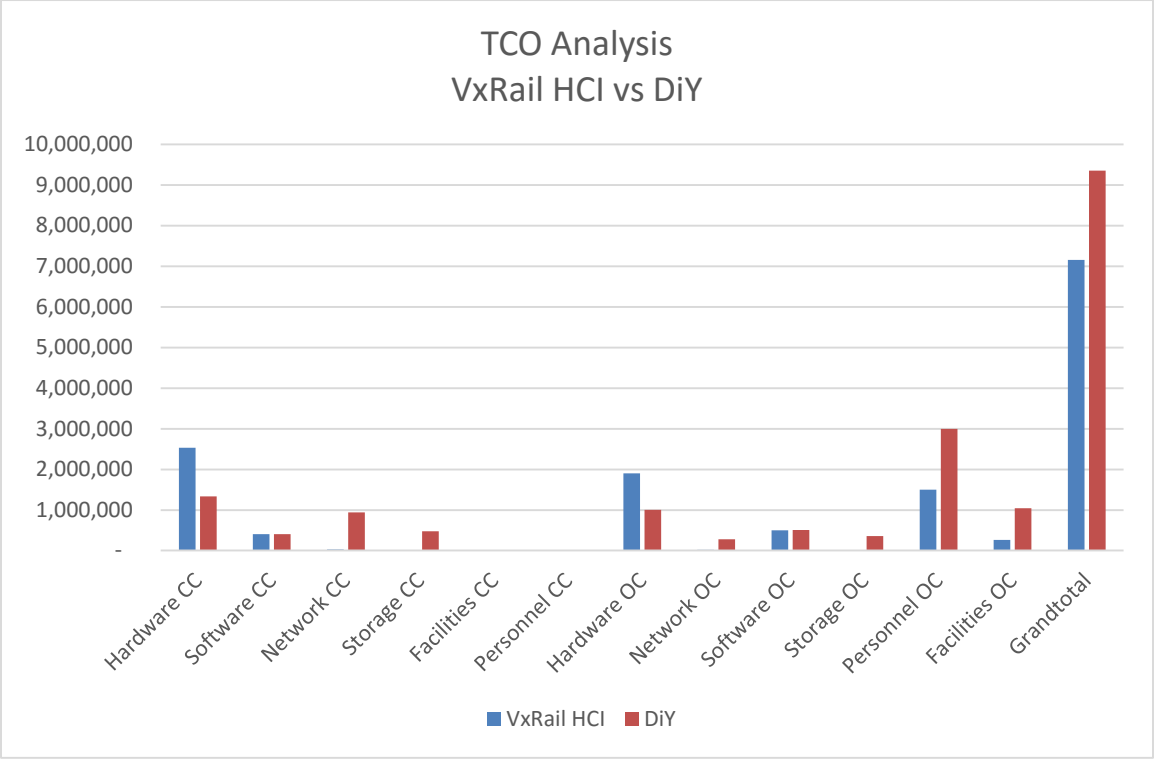


Chart 2: Total Cost of Ownership by Component

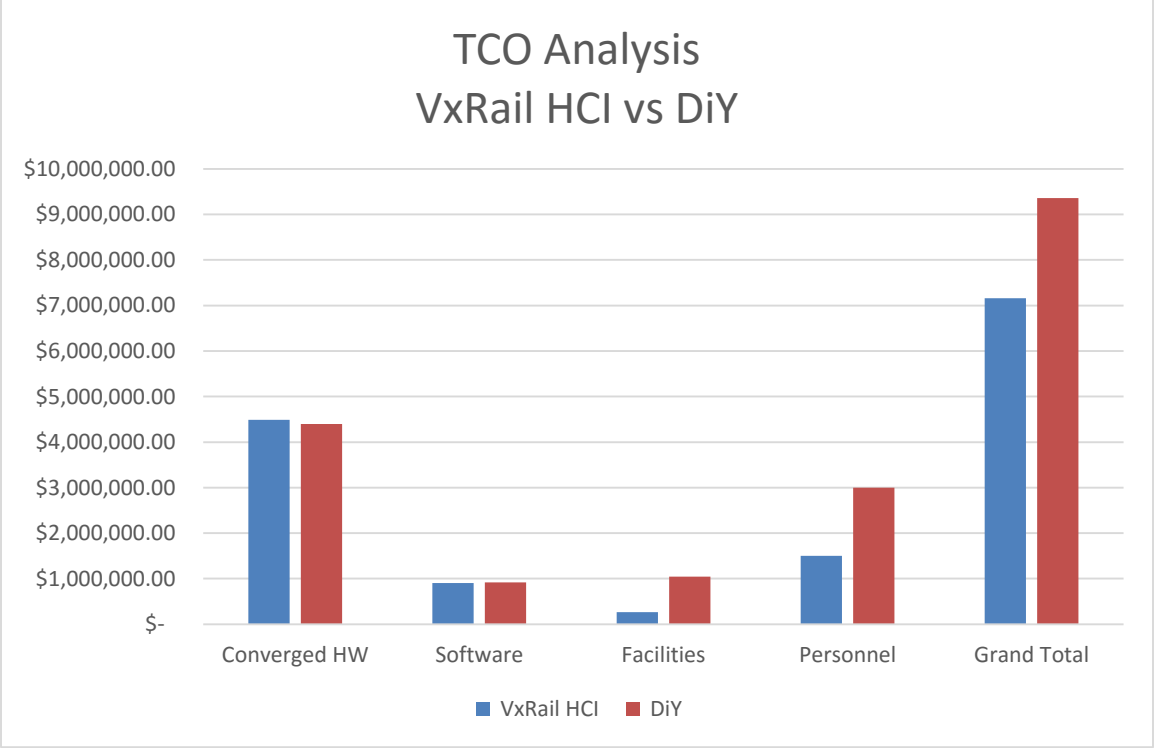


Chart 3: Total Cost of Ownership by Cost Area

TCO for VxRail is $2,200,168 or 30.7% less than BYO. The majority of the differences are in the operation of the two environments, specifically facilities (due to a smaller

footprint) and support personnel (due to a less complex environment, physically and operationally).

Management Complexity Analysis

One of the most touted advantages of hyper-converged appliances is simplified management. There are many aspects of datacenter operations where lower complexity is obvious and several where Edison's Comparative Management Cost Study (CMCS) methodology can be applied to quantify the differences. The most obvious area of difference is the physical requirements for the data center.

In the model we are using there are 64 compute nodes in 16 VxRail appliances installed within a single enclosure. The traditional Build Your Own (BYO) deployment has 64 2U Intel-processor based servers plus a hybrid storage array with Fibre Channel SAN. The deployment complexity, time, effort, space, power and cooling requirements, cabling for three networks (two Ethernet plus Fibre Channel) and power infrastructure required for deployment is much greater for the BYO platform than for the VxRail hyper-converged appliance.

Less obvious are the management complexity differences when comparing VxRail with the BYO platform. One may be able to conceptualize the difference, but management complexity is subtle. What's needed is a metric that can demonstrate the differences that can be used to understand the effects on cost of ownership.

Edison has developed this metric, calling it, "Comparative Management Complexity Study Methodology"[1]. With this approach, Edison has normalized the way the steps required for performing a task are measured so that the differences between user interfaces can be taken into account. Another factor affecting complexity is what Edison calls a context switch. This is defined as a required change from one user interface to another in order to perform a task. This switch can be to a different GUI management interface or management platform or to embedded CLI console or to an external shell – such as Putty.

System Deployment

In the present study, Edison compared a subset of administrator tasks for deploying and managing hardware and software in a VMware vSphere environment. The difference between deploying the physical hardware was not measured. However, the rule of thumb estimate is it takes about a half hour to install a device into an enclosure including power and network cabling and cable management.

[1] The methodology is detailed in the appendices.

Therefore, installing the 16 VxRail appliances into a single enclosure would take about 8 hours. In addition, enclosure preparation including installation of PDUs and TOR switches would add an additional two hours. The VxRail enclosure has to be connected to the rest of the environment: this will take about a half hour. Therefore, installing the entire EMC VxRail environment in this comparison would take about ten and one half hours.

Installation of the BYO system, with 64 Servers and a hybrid storage array would require 32 hours for the servers, plus four hours for the storage system (assuming an array of several components and inter-device cabling.) In addition, installation of PDUs and TOR switches in each of six enclosures would require 12 hours. Finally, the TOR switches in each enclosure must be attached to the end-of-row enclosure where storage (in this instance) and core switches reside. We're estimating an additional two hours for this task.

The comparison of time required merely for installing the hardware is about 10 1/2 hours for VxRail versus 46 hours for BYO: about one fourth the time.

Chart 4: Relative Deployment Effort

System Initialization and Configuration

Once the hardware is installed and connected, it needs to be initialized and configured for use. Edison compared the time required to initialize a VxRail appliance consisting of four compute nodes and storage with performing the same tasks with four servers plus a storage array. The initialization included the tasks required to result in a configured vSphere virtual data center including installation and configuration of the storage array, all the compute nodes, VMware virtual networks, vCenter and so forth.

The table below presents a high-level overview of what tasks are required for both systems. Note that in BYO there are thirteen (13) separate manually executed tasks vs. one for VxRail.

VxRail	BYO
Initialize First Appliance	Initialize Storage System
	Install ESXi Interactively -Host 1
	Install ESXi Interactively -Host 2
	Install ESXi Interactively -Host 3
	Install ESXi Interactively -Host 4
	Install vSphere Client
	Install vCenter Appliance
	Configure vCenter Appliance
	Create Datacenter
	Add Hosts to vCenter
	Create Cluster
	Attach Storage
	Create Distributed Switch

Table 4: Manual Installation and Connection Tasks

The table below shows the difference in time and complexity (number of steps) required. These efforts are all for the deployment of the first appliance or a similar size BYO cluster.

	VxRail		BYO	
Task	Time (hh:mm:ss)	Steps	Time (hh:mm:ss)	Steps
Task/Category	Initialization			
Test Results for Area	0:15:30	15	5:12:00	111
Client Advantage (Competitor - Client)	4:56:30	96		
Client Advantage % (Competitor - Client/ABS(Competitor))	95%	86%		

Table 5: Initial System Initialization and Configuration Tasks

System Expansion

The next comparison Edison performed was expanding the deployment. In our testing, we only added a second appliance in comparison to adding an additional four compute nodes and adding them to the datacenter in vCenter. The effort of configuring additional appliances or adding the remaining BYO hosts can be extrapolated.

Adding an additional appliance is a very simple one step task that took only five minutes. It merely required expanding the settings from the first appliance. Adding an addition four servers and connecting to the network and to vCenter and so forth

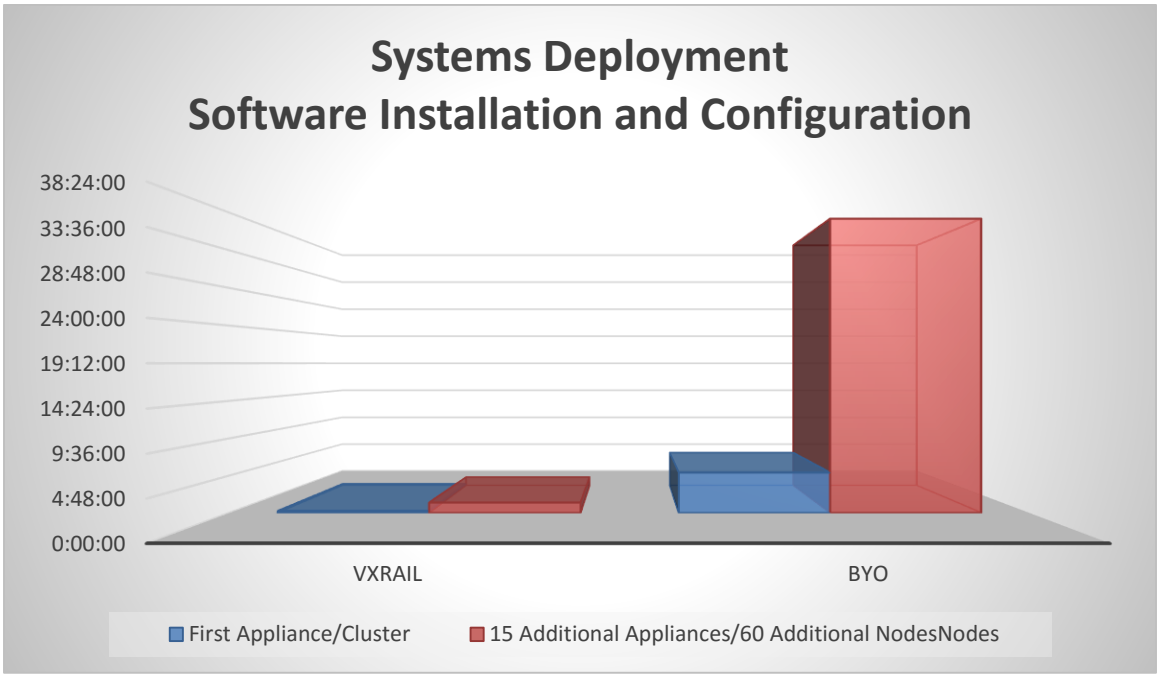
required 74 steps and took over two hours. To expand to the full size of our TCO comparison would require adding 56 additional servers to the cluster requiring about 7 times the time and 74 times the complexity of adding the first batch of additional servers.

	VxRail		BYO	
Task	Time (hh:mm:ss)	Steps	Time (hh:mm:ss)	Steps
Task/Category	Expansion			
Test Results for Area	0:05:20	1	2:26:30	74
Client Advantage (Competitor - Client)	2:21:10	-73		
Client Advantage % (Competitor-Client/ABS(Competitor))	96%	99%		

Table 6: System Expansion

Adding an additional 14 VxRail appliances would require about 1 1/4 hours and 14 additional steps. Therefore, initialization of our entire test environment from initialization of the first appliance or cluster through the total of 16 appliances or 64 servers plus storage would require about 1 1/2 hours for VxRail and more than 18 hours for the BYO environment.

The graphic illustrates the time differences for the full scale deployments described above.



Everyday tasks

Most day-to-day management tasks in VMware environments are performed in VMware vCenter. Rather than impose an additional management console, VxRail is designed so that Admins can do their work from within the familiar vCenter management client. There are however, a few tasks that can be performed within the VxRail management interface: among these are creating and cloning of VMs.

Edison compared the effort in creating a new VM and installing a client OS using VxRail manager with doing the same activity manually in vCenter. In vCenter this process is comprised of several tasks: create and configure a VM, install the client OS. The process required five steps and took about 15 minutes. Because EMC manager has in effect scripted the process with VxRail the process took a single step and just under 6 minutes.

Hardware maintenance is also a regularly performed administrator task, though the specific maintenance tasks only occur occasionally. An example of this is replacing a failed drive. In a traditional BYO environment, in most cases this entails the context shift of going to the storage array management console (or contacting the storage administration team) and performing the array specific series of steps that enable the removal and replacement of the failed drive. With VxRail, the process is performed within the VxRail management console with no need to access a separate console. The actual drive replacement, not counting rebuild time and the walk to the array, takes about the same time for both platforms – about six minutes. The difference is the number of steps required, three for VxRail and at least five for the BYO environment.

Unique feature

In our testing, Edison found one feature that appears to be very unique and one that many VMware admins might appreciate. This is the ability to shut down a cluster with a single click. With this click all the VMs are elegantly shut down, HA and DR temporarily, the hosts are put into maintenance mode and the whole system is shut down. Think about the effort involved in having to do this manually for dozens or hundreds of VMs.

Shutting down a VMware cluster is a very rare occurrence, but it is something that may need to be done in order to allow major data center repairs – fix a ceiling, replace a CRAC, update the electrical infrastructure or disaster prevention. (For example, a hurricane is coming and there might be major, long term power outages. Shutting down the system might be the best way to protect the systems for an imminent disaster. Being able to do this with one click can bring peace of mind to the entire team.

Conclusion

The results from both the cost analyses and the management complexity studies provide significant motivation to pursue not only hyper-converged appliances, but specifically EMC's VCE VxRail Hyper-Converged Appliance offering.

Cost Perspectives

- **Total Cost of Acquisition** (TCA) - VxRail is respectively 8.5 percent less expensive than one equipped with a BYO solution.
- **Total Cost of Ownership** (TCO) - VxRail is respectively 30.7 percent less expensive than one equipped with a BYO solution.

VxRail cost advantage versus BYO comes primarily from personnel support and facilities.

Management Complexity Perspectives

- **Deployment** – BYO takes relatively 4.6 more time to set-up than VxRail.
- **Initial System Initialization and Configuration** – BYO takes 96 steps more and approximately 5 hours more than VxRail.
- **System Expansion** – BYO take 73 steps more and over 2 hours more than VxRail.

In conclusion, when evaluating your TCA/TCO costs and management complexity between a Build Your Own solution or buying a purpose-built Hyper-Converged VCE VxRail offering should be part of your final solution set.

Appendix

Comparative Management Cost Methodology

For purposes of this study, the methodology is defined as a product manageability cost evaluation process whereby the two products in question are compared against a set of task-oriented objective and subjective metrics in order to derive an accurate set of analytical results. The outcome of this study determines the Comparative Management Cost (CMC) incurred by managing and operating either of these products in a production environment. The methodology employed to conduct this comparison consists of the following elements:

- **The Study:** The study is the baseline checklist of standard database administration tasks routinely performed, which are quantitatively and qualitatively compared in order to objectively determine, on a task-by-task basis, which product is superior. This is measured primarily in terms of ease of administration and secondarily (for certain tasks only) in terms of system speed of execution — the wall clock time it takes for the system in question to complete a job once it has been submitted by a DBA. The function of this study is to apply a set of quantitative metrics, developed by Edison Group, to a list of tasks typically regarded as qualitative in nature, in order to derive a meaningful set of CMCS statistics that can reveal the real difference in **management costs for the two products in question.**
- **Tasks:** A task is defined as a complete logical activity, composed of one or more steps, all of which effect a significant alteration on the state of the database that accomplishes a specific work goal. Each task is measured for time and complexity. Time and complexity, as measured in the study, are defined as follows:
- **Time:** Defined as the amount of time it takes to perform a given task. For certain (asynchronous) tasks, when a job can be run in the background so that the administrator can use the time for accomplishing other tasks, time is measured strictly in terms of the time it takes the them to perform the steps to configure, initiate, and submit a given task.

  For other (synchronous) tasks in the study that demand the administrator's full attention and prevent the accomplishment of other tasks (as in performing a hot recovery operation on a live database), time is measured to include both the time it takes for an administrator to configure/execute the task in question as well as the time it takes the system to complete the task.

- **Complexity:** For the purposes of this study, complexity is measured using a proprietary metric devised by Edison Group. It is defined as the number of system-affecting steps it takes to complete a given task, where a step is defined as a task component that effects a change of state to the database. Creating a tablespace or a view is an example of a step.
  - Because not all steps have the same inherent complexity, each step is further broken down into increments to account for the difference. An increment is a decision point that the user must make to complete a step. Increments are technically defined as a part of a step that will have a measurable effect on the state or execution path of that step in the task process, but which in and of itself does not affect a change upon the underlying database state until the step being executed is complete. For example, selecting Basic vs. Advanced Install and clicking the Next button in an installation wizard screen is an increment and not a step, which effects an incremental change on the flow of the database installation process but does not change the state of the database.
- Complexity is then measured in terms of number of steps, but taking into account the following factors:
  - The number of increments it takes to complete each step.
  - Whether or not instrumentation for a given step is GUI-based or requires the use of a command line/scripting interface.
  - Whether or not the task requires a context switch between multiple interfaces in order to be completed. If a context switch exists, then additional steps will be added to the total step count for a given task.
  - The above factors affect the complexity calculation as follows:
  - The primary measure is steps. If a step has many increments, it is considered several steps. The metric allows each step 5 increments, and thereafter we add steps for each additional 5 increments rounded up. So if a step has between 0–5 increments, it remains unchanged; if it has between 6–10 increments, it is increased by 1; between 11–15 increments, it is increased by 2; and so on. We decided to do this because, while increments are secondary to steps in determining complexity, they do modify the relative complexity of a given step in the course of completing a task. In other words, steps with a low number of increments are simple, and steps with a high number of increments are complex.
  - The other modifiers (instrumentation and context switching) occur very infrequently in the products under review, but they were significant enough a factor that we needed to account for them in some meaningful way in order to

generate a measure of complexity that accurately reflects our experience of using the two products.

Regarding instrumentation, if an operation could be executed entirely within a GUI interface, then the complexity/step value for that task would remain unmodified. If, on the other hand, a step required the use of a command line interface, this would increase the step count. For a simple single-line command operation, the step count was increased by 1, whereas if the operation required the user to write a script, the step value was increased by 2 or more, depending on how much work was required to write the script in question.

Lastly, we come to the matter of context switching. If a context switch was encountered during the course of completing a given task, then 2 or more steps were added to the step count for that task. The possible addition of more than 2 steps was allowed for as a judgment call on the part of the analyst performing the task under consideration. The reason tasks containing context switches were penalized is that we regard the complexity of understanding the dependencies of relating and performing a single operation in two different environments in order to complete a single task as inherently more complex than performing a similarly complex task in a well-integrated environment, where all the operations can be accomplished in one place.

The workload for this CMCS was reduced to the basic set of atomic maintenance operations that effectively fulfill all fundamental database administration procedures. The reasoning behind this approach is that enterprise-class database configuration and administration is a non-trivial matter; we therefore set out to develop a (relatively) simple yet comprehensive evaluation process, establishing a CMCS methodology benchmark that we feel is realistic in its technical assessment, yet accessible to the large audience of non-technical decision makers who will read this document.