TCO ANALYSIS OF UPGRADING TO DELL POWEREDGE R720 SERVERS, MICROSOFT WINDOWS SERVER 2012, AND MICROSOFT SQL SERVER 2012

PERFORMANCE REPORT | **MIGRATION GUIDE**

Dell™ PowerEdge™ 12G servers with Microsoft® Windows Server® 2012

Up to **$64,035 lower** three-year TCO vs. a non-virtualized legacy solution

It used to make sense to run one workload on each server in your data center. Now that your older servers running Microsoft Windows Server 2003 and Microsoft SQL Server® 2005 are reaching end-of-life, it's time to make a choice: do you purchase new, single-workload servers as each legacy server fails, or do you upgrade your entire infrastructure using virtualization?

While it is possible to replace your servers with all new single-workload servers at once or replace them piecemeal as servers fail, consolidating your legacy single-workload servers onto a powerful virtualization platform such as the Dell PowerEdge R720 with Microsoft Windows Server 2012 will provide the maximum benefit to your bottom line. We found that replacing eight legacy servers with a single Dell PowerEdge R720 can deliver a $64,035 lower total cost of ownership (TCO) over three years compared to continuing to run your legacy servers, and can lower acquisition costs by 48.1 percent compared to replacing servers piece by piece as they fail.

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A PRINCIPLED TECHNOLOGIES TEST REPORT

Commissioned by Dell Inc.

CONSOLIDATING THROUGH VIRTUALIZATION

As your hardware and software become obsolete, the more expensive it is to keep your infrastructure running. Unexpected hardware failures create downtime that can affect your organization's ability to function. It's time to replace these legacy servers running outdated software with hardware and software to bring your data center in the future, but what's the best way to do so?

You could keep running your current infrastructure and hope for the best. Another option is to do a one-to-one replacement of legacy servers each running a single application as they break down, simply replacing them with new single-workload servers. A more efficient option is to consolidate your physical servers at once through virtualization, which can save data center space and reduce maintenance, power and cooling, and other data center costs. In our tests in the Principled Technologies labs, we tested the consolidation capabilities of the Dell PowerEdge R720 using Microsoft Windows Server 2012 Hyper-V™ and found that it could consolidate the workloads of eight legacy HP ProLiant DL360 G4p servers running Windows Server 2003 and SQL Server 2005 while delivering 412.4 percent better performance for each database workload.[1]

How much can you save?

To show the kinds of savings you can expect by virtualizing your legacy servers onto a Dell PowerEdge R720 with Microsoft Windows Server 2012 and SQL Server 2012, we look at the potential savings for a hypothetical 800-person business that runs eight 6-year-old HP ProLiant DL360 G4p servers with Windows Server 2003 and Microsoft SQL Server 2005, each running a single-database workload.

Figure 1 compares the total three-year cost of continuing to run the eight legacy servers to purchasing and running a new Dell PowerEdge R720 with Microsoft Windows Server 2012 and SQL Server 2012 software.

[1] http://www.principledtechnologies.com/clients/reports/Dell/R720_Consolidation_Performance_Server2012_SQL2012_1112.pdf

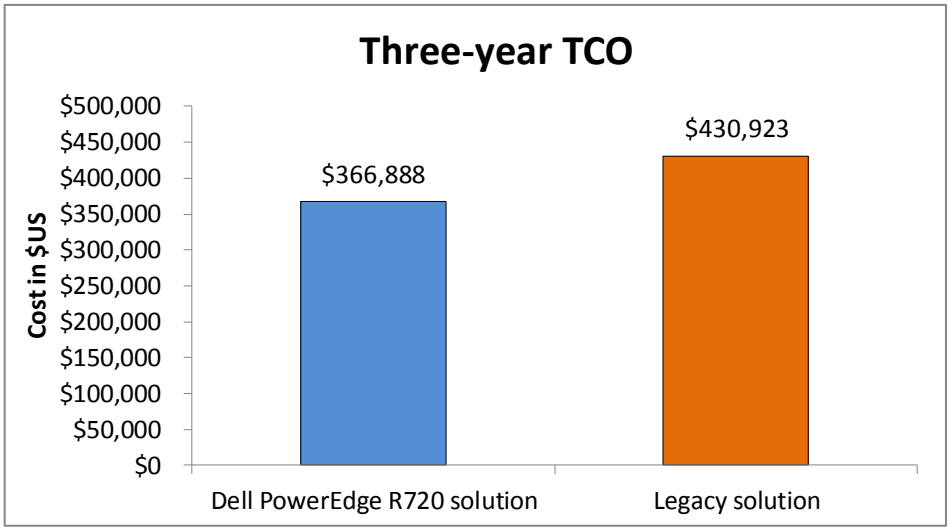

Figure 1: Three-year TCO comparison for the Dell PowerEdge R720 solution vs. continuing to run eight legacy HP ProLiant DL360 G4p servers.

While it costs money to purchase a new server and new software licenses for eight workloads, the Dell PowerEdge R720 solution makes up the cost quickly in other ways. Powering just one server instead of eight dramatically reduces energy costs and reduces the cost of system administration. Purchasing a new Dell PowerEdge R720 with Microsoft Windows Server 2012 also eliminates support costs, as they're still included, and can minimize lost productivity due to downtime, which would be high in an aging infrastructure.

Figure 2 summarizes the expected costs for operating the two solutions over three years. For details on how we arrived at these costs, see Appendix A.

	Dell PowerEdge R720 solution	Legacy solution	Savings with Dell solution
Purchase consolidated solution and avoid the costs of individual replacement servers			
Acquisition of hardware and software	$244,655	N/A	($244,655)
Lower data center expenses through consolidation			
Energy costs	$1,083	$8,988	$7,905
Data center space cost	$216	$864	$648
Port costs	$750	$6,000	$5,250
Subtotal	$2,049	$15,852	$13,803
Simplify IT with consolidated and more efficient hardware and software			
Support costs	N/A	$16,728	$16,728
System administration	$6,988	$64,287	$57,298
Database administration	$78,862	$93,714	$14,852
Subtotal	$85,850	$174,729	$88,878
Minimize lost productivity due to downtime			
Lost productivity due to downtime	$34,335	$240,342	$206,007
Total three-year TCO	**$366,888**	**$430,923**	**$64,035**

Figure 2: Summary of three-year TCO for the Dell PowerEdge R720 solution and continuing to run the legacy solution.

Avoid the additional cost of individual replacement servers

An environment with mission-critical workloads on obsolescent hardware and software isn't sustainable for much longer. During the three years of our cost analysis, software and hardware failures will likely force your hand to replace your older server hardware and software.

By failing to consolidate your legacy servers onto the new Dell PowerEdge R720 with Microsoft Windows Server 2012, you'll be forced to purchase eight individual single-workload servers either upfront or as the older servers fail. Taking this approach increases acquisition costs and would increase migration costs if you take a staggered approach to replacing servers, though for our analysis we assume that the business replaces all eight servers at the beginning of the analysis period.

For our comparison, we used 4-core single processor HP ProLiant DL320e G8 servers as the one-workload replacement servers. This server is a current model in the same processor family as the aging server we tested. See Appendix B for configuration information for the HP ProLiant DL320e Gen8 and Appendix A for the configuration information for the Dell PowerEdge R720 server. [2]

As Figure 3 shows, you could avoid up to $34,617 in server and operating system acquisition costs by replacing your end-of-life servers with one consolidated Dell PowerEdge R720 server with Windows Server 2012 instead of eight individual HP ProLiant DL320e G8 servers running Windows Server 2012. Your exact savings will vary depending on the specific server models and configurations you compare.

Acquisition costs	Dell PowerEdge R720 solution (running eight workloads)	Eight HP ProLiant DL320e Gen8 servers	Dell PowerEdge R720 savings
Hardware purchase and 3-year advanced support[3]	$16,545	$43,232	$26,687
Windows Server 2012 Standard Edition licenses [4]	$6,180	$12,360	$6,180
Migration costs[5]	$3,450	$5,200	$1,750
Training costs[6]	$5,000	$5,000	$0
Total acquisition costs	**$31,175**	**$65,792**	**$34,617**

Figure 3: Summary of acquisition costs for the Dell PowerEdge R720 solution and for new single-workload replacement servers.

[2] The HP ProLiant DL320e Gen8 server is priced at $4,227. Three-year advanced support in the form of HP 3y 4h 24x7 ProCare Service or 3 Year ProSupport and Mission Critical 4HR 7x24 Onsite Pack adds $1,177 for a server cost of $5,404. Windows Server 2012 licenses and 3-year Software Assurance at $1,545. Planning and setup costs bring the total to $8,224 per server.

[3] See Appendix A and Appendix B. Costs include hardware purchase and 3-year advanced support.

[4] HP solution requires 8 licenses - 1 per server. Costs include license plus 3-year Software Assurance. Dell solution requires 4 licenses, one for each pair of VMs.

[5] Costs include$3,200 ($400 per workload) for planning and $250 per server for setup. Dell has fewer servers so saves on server costs.

[6] Training costs for both solutions are the same.

SQL Server licensing savings

You would have to buy new SQL Server 2012 software for either single-workload or consolidated servers because the OEM versions of the older software versions on your aging servers aren't eligible for upgrade. SQL Server 2012 Enterprise Edition costs for the two server costs include license costs and three-year Software Assurance costs. We also include a $2,000 per-workload cost to migrate the workloads off the aging servers onto the newer servers and add in a $5,000 cost for staff training on Windows SQL Server 2012 features and capabilities. Migration and training costs are the same on both solutions.

HP solution requires 32 Microsoft SQL Server 2012 licenses, 4 per server for the 4-core servers. Dell solution requires 16 licenses for the two processors in the system. As Figure 4 shows, you can save $192,480 for SQL Server 2012 Enterprise licenses licensed per core.

Acquisition costs for Microsoft SQL Server 2012 for two solutions that could support eight workloads	Dell PowerEdge R720 solution (running eight workloads)	Eight HP ProLiant DL320e Gen8 servers	Dell savings for all workloads
SQL Server 2012 Enterprise Edition (per core licenses)[7]	$192,480	$384,960	$192,480
Migration costs[8]	$16,000	$16,000	$0
Training costs[9]	$5,000	$5,000	$0
Total acquisition costs	**$213,480**	**$405,960**	**$192,480**

Figure 4: Microsoft SQL Server 2012 acquisition costs for Dell PowerEdge R720 solution compared to an alternative solution of eight servers configured to each run a single workload.

As Figure 5 shows, the Dell PowerEdge R720 solution saves a total 48.1 percent in acquisition costs over buying eight new HP ProLiant DL320e Gen8 single-workload server when upgrading both to Windows Server 2012 and SQL Server 2012. For complete details on how we arrived at the costs for acquiring the newer single-workload servers, see Appendix B.

[7] Requires: 4 license for each HP server and 16 licenses for the Dell server. Take advantage of additional features of Enterprise Edition. Includes 3-year Software Assurance.
[8] Includes $2,000 per workload for migration from aging server to new device.
[9] Includes $5,000 in training for a database administrator on new SQL Server 2012 features.

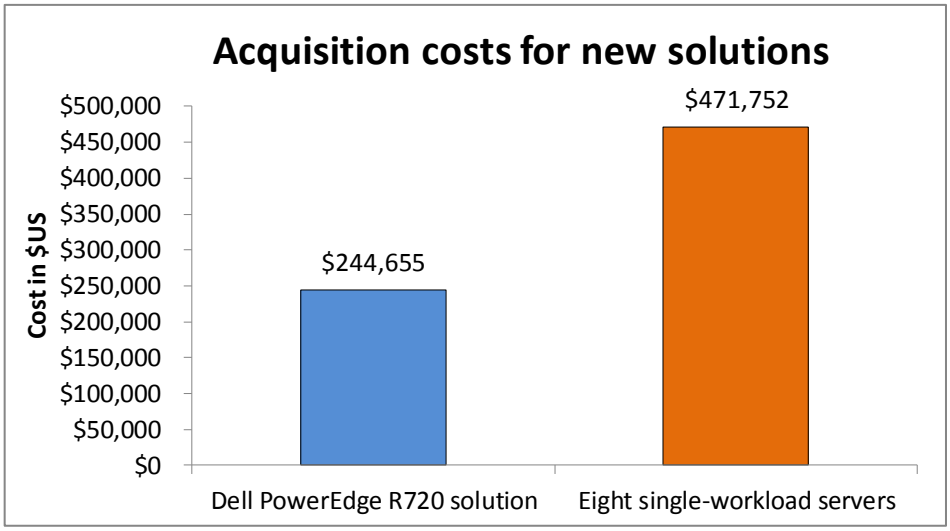

Figure 5: Acquisition costs, including Windows Server 2012 and SQL Server 2012 software, for the Dell PowerEdge R720 solution and eight new HP ProLiant DL320e Gen8 servers.

Because the Dell PowerEdge R720 solution uses only one server compared to eight single-workload servers, we expect that the total three-year TCO would show even more dramatic savings than running eight new single-workload servers, as its smaller data center footprint would bring savings in data center space, port costs, power and cooling costs, and more.

IN CONCLUSION

Continuing to run your existing infrastructure of 5-6-year-old servers running Windows Server 2003 and SQL Server 2005 is a risky bet. Not only does software support disappear, but aging servers begin to fail, driving up maintenance costs and increasing potentially catastrophic downtime.

While you may be hesitant to spend the capital to upgrade your infrastructure, replacing older servers with virtual servers on a single server platform can actually save you money over the next three years. We found that consolidating eight older servers onto a Dell PowerEdge R720 running Microsoft Windows Server 2012 and SQL Server 2012 could save up to $64,035 over three years, compared to continuing to run your current infrastructure. And that's a conservative estimate that assumes that none of your aging servers would fail over the next three years.

Choosing to replace your failing servers with new, single-workload servers, either all at once or as they fail, can nearly double the cost of virtualizing with the Dell PowerEdge R720.

When it's time to update your infrastructure, the choice is clear. Virtualizing older servers with Microsoft Windows Server 2012 Hyper-V onto a Dell PowerEdge R720 and reaping the benefits of new SQL Server 2012 can save your company in maintenance, power and cooling, data center, licensing, and migration costs while delivering better performance than your current aging infrastructure.

APPENDIX A – CONSOLIDATING AND UPGRADING VS. KEEPING YOUR OLDER HARDWARE

For this analysis, we look at costs for an emerging business with 800 staff and eight 6-year old database servers running OEM software versions of Windows Server 2003 and Microsoft SQL Server 2005, each running a single workload. We used an HP ProLiant DL360 G4p server as our representative 6-year old server.

Dell PowerEdge R720 consolidation solution configuration and cost

Dell provided the Dell PowerEdge R720 server that we used in our tests. For this report, we use prices from the Dell Web site on September 10, 2011. The hardware price was $14,046 with a 3-year basic warranty repair plan. An advanced service plan – 3-Year Pro Support and Mission Critical 4HR 7x24 Onsite Pack adds $2,499. See Figure 6 for details of that configuration. The total hardware price, including support, was $16,545. Prices do not include taxes, or discounts.

Dell PowerEdge R720 configuration	
Hardware support services	3Yr Basic Hardware Warranty Repair: 5x10 HW-Only, 5x10 NBD Onsite
Installation services	No installation
Shipping	PowerEdge R720 shipping
PCIe riser	Risers with up to 6, x8 PCIe Slots + 1, x16 PCIe Slot
Embedded systems management	iDRAC7 Express
Select network adapter	Intel Ethernet I350 QP 1Gb Network Daughter Card
Chassis configuration	2.5" Chassis with up to 16 hard drives
Bezel	No Bezel
Power management BIOS settings	Power Saving Dell Active Power Controller
RAID configuration	RAID 0 for H710P/H710/H310 (1-16 HDDs)
RAID controller	PERC H710P Integrated RAID Controller, 1GB NV Cache
Processor	Intel® Xeon® E5-2680 2.70GHz, 20M Cache, 8.0GT/s QPI, Turbo, 8C, 130W, Max Mem 1,600MHz
Additional processor	Intel Xeon E5-2680 2.70GHz, 20M Cache, 8.0GT/s QPI, Turbo, 8C, 130W
Memory capacity	(8) 8GB RDIMM, 1,333 MHz, Low Volt, Dual Rank, x4
Memory DIMM type and speed	1,333 MHz RDIMMs
Memory configuration type	Performance Optimized
Hard drives	(16) 300GB 10K RPM SAS 6Gbps 2.5in Hot-plug Hard Drive
System documentation	Electronic System Documentation and OpenManage DVD Kit for R720
Internal optical drive	DVD ROM, SATA, Internal
Rack rails	ReadyRails™ Sliding Rails With Cable Management Arm
Power supply	Dual, Hot-plug, Redundant Power Supply (1+1), 750W

Dell PowerEdge R720 configuration	
Power cords	(2) NEMA 5-15P to C13 Wall Plug, 125 Volt, 15 AMP, 10 Feet (3m), Power Cord
Operating system	No Operating System
OS media kits	No Media Required

Figure 6: Configuration of the Dell PowerEdge R720 server.

In Figure 7, we calculate the acquisition and consolidation costs for the Dell PowerEdge R720.

Dell PowerEdge R720 solution	
Hardware acquisition and migration costs	
Dell PowerEdge R720	$16,545
Microsoft Windows Server 2012	$6,180
Migration (planning and server setup)	$3,450
Training costs	$5,000
Hardware subtotal	$31,175
Microsoft SQL Server 2012 acquisition costs	
Microsoft SQL Server 2012	$192,480
Database migration and staff training	$16,000
Training costs	$5,000
SQL Server 2012 subtotal	$213,480
Total acquisition cost	**$244,655**

Figure 7: Acquisition and consolidation costs

Energy cost comparison

To calculate energy costs we measured power under for the PowerEdge R720 and the legacy HP ProLiant DL360 G4p servers under load and while idle. We calculate costs based on average US commercial electrical cost for last year.[10]

At what we estimate is a typical load - running half idle and half under load - the two servers would consume almost identical power. Because the Dell PowerEdge R720 does work of eight older servers, it saves the energy costs of roughly seven of the older servers. Cooling costs add to those savings. It takes about the same amount of energy to cool the older servers as it does to power them. The Dell PowerEdge R720 has cooling efficiencies that should cut down on that ratio. So, one Dell PowerEdge R720 should have approximately 8 times lower power and cooling costs than the older servers it can replace. You might match the Dell's power and cooling savings one of the new

[10] http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_03

individual-workload servers but you would still be seeing close to 8x savings for the one Dell PowerEdge R720 vs. eight of those newer servers. Figure 8 compares the energy costs we estimate. Many categories show the calculations we used to determine costs, using letters to indicate the line of the corresponding cost.

Line		Dell PowerEdge R720 solution (running eight workloads)	Legacy solution
A	Number servers in solution	1	8
B	Cost per KWh	0.1022	0.1022
C	Hours in user per year	8766	8766
D	Per server estimate (W)	212	209
E	Cost per year per server [wattage x hours used ÷ 1000 x price per kWh = cost of electricity] (((C*D)/1000)*B)	$189.93	$187.24
F	Cooling efficiency multiplier	1.90	2.00
G	Cost per year per server for power and cooling	$360.86	$374.48
H	Cost per year per solution	$360.86	$2,995.84
I	Three year cost (H*3)	$1,083.00	$8,988.00
J	**Dell savings**		**$7,905**

Figure 8: Energy cost savings.

Data center expenses comparison

You will also see high day-to-day operating costs by continuing to run single-workload servers. Compared to their modern replacements, components in these older servers operate less efficiently and use more power, adding to energy costs for power and cooling. Eight servers also have higher data center space and data center port costs compared to a single consolidated server.

Data center space

The single Dell server takes up less rack space than the eight HP servers do. We assume the business charges users for datacenter space based on rack units used. We estimate a per rack unit rate of $36 dollars or $1,512 per 42u rack.

Line		Dell PowerEdge R720 solution (running eight workloads)	Legacy solution
A	Number servers in solution	1	8
B	Rack units per server	2	1
C	Rack units per solution (A*B)	2	8
D	Annual cost per rack unit for data center space	$36	$36
E	Annual cost for data center space	$72	$288
F	Three year cost (E*3)	$216	$864
G	**Dell savings**		**$648**

Figure 9: Data center space cost savings.

Network ports

We do not include the cost of switches in this solution. We assume that IT either charges back or budgets based on network ports. We assume a charge of $250 per port per year with each server having a single network port out. Figure 10 compares network port costs for the two solutions.

Line		Dell PowerEdge R720 solution (running eight workloads)	Legacy solution
A	Number servers in solution	1	8
B	Ports per server	1	1
C	Ports per solution (A*B)	1	8
D	Cost per port per year	$250	$250
E	Cost for solution ports (C*D)	$250	$2,000
F	Three year costs for ports (E*3)	$750	$6,000
G	**Dell savings**		**$5,250**

Figure 10: Network port cost savings.

Legacy server support costs

Post-warranty support is available from vendors or third-party providers. Post-warranty advanced support from the vendor for eight of the six-year old servers that we tested would cost $16,728 over three years.[11] Other support plans are available for less but would not provide the mission-critical support and quick response we assume these servers need.

Without vendor support agreements, your own staff takes on the entire burden of responding to hardware failures and performance issues, adding to management costs. Costs for them to diagnose, repair, and track down replacement parts for failed servers could match or exceed vendor support costs. When vendors stop offering support for aging servers, you may lose access to tools you need if your vendor stops issuing BIOS, firmware, or driver updates and support documentation updates.

Figure 11 shows the additional support cost for the legacy HP servers. The support costs for the Dell PowerEdge R720 were already included into the acquisition price.

[11] Calculated using the price of $697 per year per server for HP 1 year Post Warranty 6 hour 24x7 Call to Repair ProLiant DL360 G4 Hardware Support. Source: HP Small And Medium Business store at http://h30094.www3.hp.com/product.asp?sku=3394943

Legacy server support cost calculation		
A	Number of legacy servers	8
B	Support cost per server per year	$697
C	Support cost for solution per year	$5,576
D	Support cost for solution for three years	$16,728

Figure 11: Support costs for the legacy solution.

System and database administration cost comparison

Hardware, software, and practices influence server administrator efficiency. Your administrators' efficiency is highly dependent on how much automation you have implemented for routine administration tasks such as provisioning, monitoring, patching, maintenance, and performance tuning. Your aging infrastructure takes a toll on administrator productivity, and your administrators are not able to support as many servers or workloads as they could with newer hardware and software versions designed for more efficient manageability. The aging infrastructure also ties up administrator with monitoring components that are wearing out and responding to failures.

We assume the organization has partially automated management procedures that enable server administrators to manage 40 servers each and database administrators to manage 30 workloads each. Figure 12 shows the salaries we calculated for both positions.[12] We assume salary is 70% of total compensation.[13]

Line		DB administrator	Server administrator
A	Administrator salary - national average	$82,000[14]	$75,000[15]
B	Total compensation - administrator salary (B=A/.7)	$117,143	$107,143

Figure 12: IT salaries.

We calculated server administration costs at $64,286 over three years for the eight servers and database administration costs at $93,714 over three years for the eight workloads, $158,000 total for both staff (see Figures 13 and 14).

We assume that the data center staff provides hardware maintenance to servers that are out of their vendor warranty period at a cost roughly equal to that of a

[12] We looked up national average salaries on indeed.com and estimate salary as 70% of total compensation. We calculated total annual compensation for a database administrator at $117,143 and for a system administrator at $107,153. We use those values in our cost per workload and per server calculations.

[13] http://swz.salary.com/SalaryWizard/systems-administrator-Salary-Details.aspx?hdcbxbonuse=off&isshowpiechart=true&isshowjobchart=false&isshowsalarydetailcharts=false&isshownextsteps=false&isshowcompanyfct=false&isshowaboutyou=false

[14] http://www.indeed.com/salary?q1=SQL+Server+Administrator&l1=

[15] http://www.indeed.com/salary/System-Administrator.html

current advanced support agreement. For the HP server, we assume that in-house support will cost about the same as a HP ProCare for the newer models in the same family as the original server. This is $1,177.00 for HP 3y 4h 24x7 ProCare Service for the HP ProLiant DL320e Gen8 LFF NHP Server described in Appendix B. The Dell PowerEdge R720 server is under warranty so we assume negligible in-house maintenance costs for it. We estimated the time staff members could save by using the administrative tools that the Dell PowerEdge 12G server and the Microsoft software packages offer.

We estimate a modest increase in server and database administrator efficiency of 15 percent. We apply that percentage savings to the cost per workload per year. Figures 13 and 14 show how we calculated systems and database administration cost savings.

Line		Dell PowerEdge R720 solution (running eight workloads)	Legacy solution
A	Percentage efficiency improvement over original server count	115%	100%
B	Number servers per server administrator	46.00	40.00
C	Server administration cost per server per year	$2,329.19	$2,678.57
D	Number servers in solution	1	8
E	Cost per solution for server administration per year	$2,329	$21,429
F	Three-year costs	$6,988	$64,286
G	**Savings for Dell solution (difference of two items in F)**		**$57,298**

Figure 13: Systems administrator time savings calculations.

Line		Dell PowerEdge R720 solution (running eight workloads)	Legacy solution
A	Percentage efficiency improvement over original workload count	115.00%	100.00%
B	Number workloads per database administrator (For consolidated solution, original workload count times A)	35.65	30
C	SQL Systems Administration cost per workload per year (total compensation from previous table divided by B)	$3,286	$3,905
D	Cost for all workloads per year (8 workloads times C)	$26,287	$31,238
E	Three-year costs (D*3)	$78,862	$93,714
F	**Savings for Dell solution (difference of two items in E)**		**$14,852**

Figure 14: Database administrator time savings calculations.

Productivity and downtime cost comparison

Failures occur more often on older servers which can result in the loss of user productivity. We calculate lost end user productivity for 500 users, with the assumption that not all users are affected every time. We estimate the cost of one hour of downtime across all users and estimate the hours of downtime saved with the Dell PowerEdge R720 solution. We estimate an average end-user salary of $45,230 and calculate an hourly rate based on 1,976 hours per year. The cost for one hour per user per year is 500 users times that amount. Figures 15 and 16 show this calculation.

Line	End user productivity savings calculations	Cost
A	Average user salary	$45,230
B	Number of users	500
C	Hours per year working	1,976
D	Average user salary per hour (D=A/C)	$22.89
E	Cost of one hour per workload for all users per year (E=D*B)	$1,430.60

Figure 15: End user productivity savings calculations.

Line	Productivity costs	Dell PowerEdge R720 solution (running eight workloads)	Legacy solution
A	Productive hours lost per year per solution	1	7
B	Number of workloads	8	8
C	Cost per hour of lost productivity per workload	$1,430.60	$1,430.60
D	Cost per workload per year	$1,430.60	$10,014.23
D	Cost of lost productivity per year	$11,444.84	$80,113.87
E	Three year cost (D*3)	$34,334.51	$240,341.60
G	**Dell savings**		**$206,007**

Figure 16: End user productivity costs calculations.

Other potential business costs

What could be the highest costs of aging servers and software is also the least predictable – regulatory or contractual penalties or lost revenue because of downtime, underperformance, or data loss. These consequences add to the cost of doing business.

Downtime repercussions –If mission-critical systems fail, downtime costs can be go well beyond the user productivity costs we've already discussed. Costs can continue well after recovery as you add in costs of lost business, costs to restore customer confidence lost during downtime, and fines and penalties if downtime causes a highly regulated workload to fall into non-compliance with availability requirements. Costs could range from six digit or even larger fines or penalties to immeasurable lost business.

Higher risk of data loss– Disk failures and software failures, both of which increase in frequency with aging hardware and software can cause costly loss of data. Costs include administrator or user time to recover data and sometimes post-failure costs of lost customers, lost revenue, of regulatory penalties due to data retention failures.

Underperformance – Your workloads may have grown to exceed your aging servers' capacity and are asking for more performance than these servers can deliver. A server that is under-provisioned for its workload or has a component that is maxed out won't deliver the performance your users need and cuts into their productivity. If your customers access your servers directly or depend on quick turnaround on reports or analysis, slow performance in your servers or software can cause customer dissatisfaction and potential loss of business. Our tests show that the Dell PowerEdge R720 matched the workloads of eight aging HP ProLiant DL360 G4p servers and delivered 412.4 percent faster performance, delivering a cure to underperformance.

APPENDIX B – THE COST OF NOT VIRTUALIZING

In this appendix, we discuss the cost comparison for hardware, operating system, support, migration, training, and SQL Server licensing for the Dell PowerEdge R720 solution and for replacing legacy servers with eight new single-workload servers.

We looked up prices for the HP ProLiant DL320e Gen8 server on the HP Web site to use in calculating the costs of the individual replacement servers. Price for this configuration was $4,227. HP 3y 4h 24x7 ProCare Service adds $1,177 for a per server cost of $5,404.

We selected the lowest priced Gen8 model of an HP ProLiant DL300 family server. The six-year-old server we tested was in that family. We consulted our expert lab technicians for recommendations for a configuration that would perform well with a single copy of our tested workload. They recommended 8GB memory, two disk drives without RAID or four if we wanted to configure RAID, and a modern processor. We selected the lowest priced Intel Xeon processor E3 family chip available with the server, assuming that the enterprise would opt for the higher performance of this quad-core processor. We included four SAS drives to allow for RAID 10, included a redundant power-supply-enablement kit to provide for power redundancy, and added an HP Dedicated ILO Management port kit. Figure 17 details the configuration of this server.

HP ProLiant DL320e Gen8 LFF NHP server configuration
4-Core Intel® Xeon® Processor E3-1220v2 (3.10GHz, 69 Watts)
HP 8GB (2x4GB) Dual Rank x8 PC3L-10600 (DDR3-1333) Unbuffered CAS-9 Low Power Memory
HP Embedded 4-Port B120i SATA Controller
HP 4-Bay Large Form Factor Drive Cage
4 x HP 450GB 6G Non-Hot Plug 3.5 SAS 15,000rpm Dual Port Hard Drive
RAID 1 drive set (requires matching 2 hard drives)
HP Smart Array P222/512 FBWC 6Gb 1-port Int/1-port Ext SAS Controller (Supports 4 internal devices)
HP 460W Common Slot Gold Hot Plug Power Supply
HP Gen8 Redundant Power Supply Enablement Kit
HP Dedicated iLO Management Port Kit
2 HP 1.83m 10A C13-UL US Power Cords
HP 1U LFF BB Gen8 Rail Kit
HP Warranty - 1 year, 24x7, 4 Hour Response, Hardware Support, Onsite Service

Figure 17: Configuration of single-workload replacement servers that we use in our cost analysis.

Hardware and support cost comparison between the Dell PowerEdge R720 and competing single-workload servers

Below, we show how we calculated the cost comparison between upgrading and consolidating your infrastructure to a Dell PowerEdge R720 server vs. replacing each server with a newer single-workload server. Figure 18 shows the comparison of hardware plus 3-year support between the two solutions.

Line		Dell PowerEdge R720 solution (running eight workloads)	Eight single-workload servers
A	Hardware plus 3-year advanced support	$16,545	$5,404
B	Number of servers	1	8
C	Hardware cost (C = A*B)	$16,545	$43,232
D	**Dell savings**		**$26,687**

Figure 18: Hardware cost savings.

Windows Server 2012 Standard Edition cost comparison

Save up to $6,180 in Windows Server Standard Edition purchase and Software Assurance costs by consolidating 8 workloads onto a single Dell PowerEdge R720 server instead of migrating to eight one-workload servers. Each Windows Server 2012 license covers two processors and up to two VMs. To calculate license count, divide processor count and VM count by two and round up. The larger of those is your license count. Each single-workload server would need one Windows Server 2012 Standard Edition License plus 3-year SA for its single processor and zero VMs. The two-processor Dell PowerEdge R720 server requires four Windows Server 2012 Standard Edition licenses plus 3-year SA to support 8 VMs (8 VMs divided by 2). Figure 19 shows the cost comparison for Windows Server 2012 Standard Edition licenses across both solutions.

Line		Dell PowerEdge R720 solution (running eight workloads)	Eight single-workload servers
A	Price per license for Windows Server including 3-year SA	$1,545	$1,545
B	Number of servers	1	8
C	Number of processors per server	2	1
D	Number VMs	8	0
E	Number Windows Server 2012 Standard licenses (E = The greater of C or D divided by 2. Round up result.)	4	1

Line		Dell PowerEdge R720 solution (running eight workloads)	Eight single-workload servers
F	Cost per server for Windows Server licenses (F = A*E)	$6,180	$1,545
G	Cost for all Windows Server licenses (B*F)	$6,180	$12,360
H	**Dell savings**		**$6,180**

Figure 19: Windows Server 2012 cost savings.

Migration cost comparison

We assume a one-time staff cost of $400 for migration planning, $250 per server for hardware setup, and $2,000 per workload to install software and migrate the workloads. Migration estimates and are based on our experiences working with the databases in this test. Planning and migration costs would be similar for the two solutions; hardware setup would add $1,750 for the additional seven servers in the single-workload solution. Estimates do not include porting complex applications.

Line		Dell PowerEdge R720 solution (running eight workloads)	Eight single-workload servers
A	Planning costs	$400	$400
B	Setup costs	$250	$250
C	Migration costs	$2,000	$2,000
D	Number workloads per solution	8	8
E	Number servers	1	8
F	Planning costs (A*D)	$3,200	$3,200
G	Server setup costs (B*E)	$250	$2,000
H	Migration costs (C*D)	$16,000	$16,000
I	Total (I = F+G+H)	$19,450	$21,200
J	**Dell savings**		**$1,750**

Figure 20: Migration cost savings.

Training costs

We assume that the server administration staff you need to train is comfortable with Windows Server 2008 with Hyper-V and has experience virtualizing workloads with that product. We estimate costs of $5,000 to train one server administrator member on Windows Server 2012 and $5,000 to train one database administrator on Microsoft SQL Server 2012. For this comparison of acquisition costs we assume you'd migrate to Windows Server 2012 and SQL Server 2012 for both the consolidated Dell PowerEdge R720 or the single-workload servers option.[16] You wouldn't need more than a single server administrator and a single database administrator for either option, so both options would incur the same cost. Figure 21 presents these costs.

Line		Dell PowerEdge R720 solution (running eight workloads)	Eight single-workload servers
A	Training costs for Windows Server 2012	$5,000	$5,000
B	Training costs for Microsoft SQL Server 2012	$5,000	$5,000
C	Total (C = A+B)	$10,000	$10,000
D	**Dell savings**		**$0**

Figure 21: Training costs.

SQL Server 2012 Enterprise Edition

SQL Server 2012 Enterprise Edition is licensed per core and requires a 4-core minimum per processor. The single-workload servers with a single 4-core processor would require four licenses each at a cost per server of $48,120 for the license and three-year Microsoft Software Assurance. The Dell PowerEdge R720 server with two 8-core processors would require 16 licenses. For all eight workloads, licensing the newer HP ProLiant DL320e Gen8 server solution would cost $384,960, twice as much as license costs for the Dell, which would save $192,480. Figure 22 shows a detailed comparison of how we calculated the SQL licensing costs for each solution.

[16] We include the 2012 software versions as part of the consolidated Dell PowerEdge G12 solution. If you instead opted for individual replacement servers, you would probably need to purchase those software versions because they'll soon be the only versions available from your OEM. You would then have the option of using your downgrade privileges to instead run older software versions. If so, you'd save on training and migration costs, but lose out on the much greater operating cost savings due in part to the easier manageability of the newer software versions.

Line		Dell PowerEdge R720 solution (running eight workloads)	Eight single-workload servers
A	Price per license for Microsoft SQL Server 2012 including 3-year SA	$12,030	$12,030
B	Number servers	1	8
C	Cores per processor	8	4
D	Number processors per server	2	1
E	Number Microsoft SQL Server 2012 Enterprise licenses per server (Greater of (4 or C) * D)	16	4
F	Total cost for Windows Server licenses (F = A*E)	$192,480	$48,120
F	Hardware cost (C = A*B)	$192,480	$384,960
G	**Dell savings**		**$192,480**

Figure 22: Microsoft SQL Server cost savings.

ABOUT PRINCIPLED TECHNOLOGIES

Principled Technologies, Inc.
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We provide industry-leading technology assessment and fact-based marketing services. We bring to every assignment extensive experience with and expertise in all aspects of technology testing and analysis, from researching new technologies, to developing new methodologies, to testing with existing and new tools.

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We provide customized services that focus on our clients' individual requirements. Whether the technology involves hardware, software, Web sites, or services, we offer the experience, expertise, and tools to help our clients assess how it will fare against its competition, its performance, its market readiness, and its quality and reliability.

Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for over 20 years. As journalists, they published over a thousand articles on a wide array of technology subjects. They created and led the Ziff-Davis Benchmark Operation, which developed such industry-standard benchmarks as Ziff Davis Media's Winstone and WebBench. They founded and led eTesting Labs, and after the acquisition of that company by Lionbridge Technologies were the head and CTO of VeriTest.