

**Server Consolidation with
IBM System x and BladeCenter Power by
Intel® Xeon® Processors:**

Lowering Total Cost of Ownership

*An Alinean White Paper
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EXECUTIVE SUMMARY

In today's challenging economy organizations are focusing more than ever on how they can reduce costs while maintaining operations. With tightened liquidity and an uncertain economic outlook, preserving capital and avoiding unnecessary expenditures is a popular short term financial tactic. This paper examines the old adage, "If it isn't broke, don't fix it." being firmly embraced by many CFOs. Even in this tough economy can IT modernization reduce operating costs and improve service levels without increasing current expenditures?

Many organizations are discovering that replacing older servers with more powerful and efficient servers can lower operating costs and improve responsiveness without jeopardizing current capital. This paper examines a recent server consolidation project by large retail company in the United States. This organization was able to reduce annual IT operating costs by modernizing their IT infrastructure and lower current cash outflows by leveraging attractive leasing options. By replacing a myriad of older x86-based servers from multiple vendors with the latest highly efficient IBM® BladeCenter® HS22 servers and scalable IBM System x3950 M2 servers powered by Intel® Xeon® processors the organization was able to significantly reduce datacenter energy costs, improve systems administration efficiency, increase service levels, and lower on-going hardware and software support costs.

Financial Overview

Over the years the organization had fallen victim to "server sprawl" by deploying new servers for each new application initiative. At the time of the consolidation they had 266 x86-based servers with 56 individual database instances. With a server consolidation project they were able to reduce their server count down to 19 (a 14:1 consolidation) by leveraging high-performance IBM System x3950 M2 and BladeCenter HS22 servers and implementing virtualization and clustering technologies.

The consolidation project was able to reduce annual operating costs by an impressive 29%, or \$804,000 per year. Based on an investment of \$980,592, the project yielded a 224% return on investment (ROI) over a three year analysis period. Table 1 below shows the total costs and savings by category over the three year analysis period.

| Three Year TCO Comparison | Original Server Environment | IBM Upgrade Configuration | Total Savings | |
|---------------------------|-----------------------------|---------------------------|--------------------|--------------|
| | | | | |
| Server Hardware | \$296,640 | \$369,768 | (\$73,128) | (24.7%) |
| Server Software | \$1,749,375 | \$1,529,387 | \$219,988 | 12.6% |
| Systems & DB Admin Labor | \$5,331,000 | \$3,993,000 | \$1,338,000 | 25.1% |
| Upgrade/Migration Costs | \$0 | \$156,500 | (\$156,500) | - |
| Energy Costs | \$942,221 | \$77,417 | \$864,804 | 91.8% |
| Total Costs | \$8,319,236 | \$6,126,072 | \$2,193,164 | 26.4% |

Table 1: Three Year TCO Comparison Chart

Note: The project was also expected to provide substantial benefits from reduced downtime and improved deployment times for new applications. These benefits are described below, but they have not been factored into the overall financial analysis.

Cash Flow Analysis

In order to preserve cash on hand the organization negotiated with both IBM and Microsoft® to spread upfront capital costs over a three year period. For the server hardware the organization entered into a three year lease with IBM Global Finance. For the software upgrade described below the organization signed a three year license and support volume purchasing agreement with Microsoft. Figure 2 below shows the three year cash flow comparison of the current operating costs with the new costs of the

consolidation. Not only was this organization able to lower annual operating costs, but they were able to reduce cash outflows at the same time.

Three Year Cash Flow Comparison

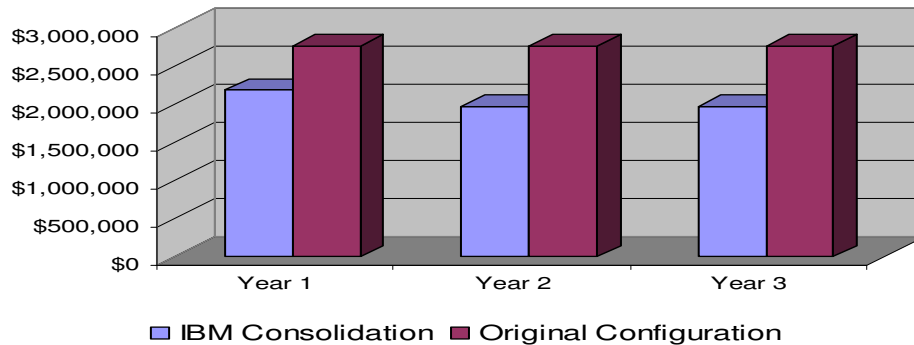


Figure 2: Three Year Cash Flow Comparison

SERVER CONSOLIDATION CASE STUDY

Server Hardware Configurations

For years the organization had been purchasing low priced commodity servers for each new application project they deployed. The thought was that these x86-based servers had sufficient processing power for their application requirements and they were inexpensive to purchase and deploy. Since new production servers were sized to accommodate peak workloads, overall system utilization was fairly low. This was not a major concern, though, due to the low cost of the hardware.

In addition to the production servers, development and test servers with similar architectures were generally purchased for individual projects. Many of these servers were configured for a specific project and would remain idle most of the time. The applications team needed environments that matched the production systems, and preferred to have the servers readily available rather than reconfiguring systems when maintenance or enhancement work was needed. Again, the philosophy was that the hardware was inexpensive. They didn't want to spend a lot of time reconfiguring systems and then diagnosing why the configurations didn't match.

Over the past few years the organization had deployed a variety of x86-based servers with one or two single or dual-core processors. Overall the organization was supporting 210 of these servers for multiple functions including departmental file and print, network routing, web applications and other applications. In addition the organization had deployed 56 database servers to support these applications. Thirty of the database servers were small two way dual-core systems, while the remaining 26 servers were larger four way dual-core systems. Table 3 below provides a summary of the various server types and counts. The (DB) designates database servers.

| Server Type | Server Count | Processors | Average Memory |
|--|--------------|------------|----------------|
| Dell PE 1800 (3.2 GHz) (1Chip / 1Core) | 50 | 1 | 2 GB |
| Dell PE 1950 (3.4 GHz) (1Chip / 2Core) | 35 | 1 | 2 GB |
| HP PL DL360 G3 (3.2 GHz) (2Chip / 2Core) | 85 | 2 | 4 GB |
| HP PL DL385 G2 (3.0 GHz) (2Chip / 4Core) | 40 | 2 | 4 GB |
| HP PL DL560 (2.8 GHz) (2Chip / 2Core) (DB) | 30 | 2 | 6 GB |
| HP PL DL580 G4 (3.0 GHz) (4Chip / 8Core)(DB) | 10 | 4 | 8 GB |
| Dell PE 6950 (2.0 GHz) (4Chip / 8Core) (DB) | 8 | 4 | 16 GB |

| | | | |
|--|------------|------------|----------------|
| HP PL DL585 G2 (3.2 GHz) (4Chip / 8Core)(DB) | 8 | 4 | 12 GB |
| Total All Servers | 266 | 499 | 1154 GB |

Table 3: Original Server Configurations

All of the servers ran Microsoft Windows Server® 2003, with a combination of Standard Edition and Enterprise Edition. The database servers all ran Microsoft SQL Server® 2005.

IBM Systems Configuration

The proposed IBM solution was sized to accommodate the aggregate workload requirements of the current environment with additional capacity for growth and considerations for the appropriate number of virtual machines per server. The server workloads were split into two groups; database servers and non-database servers. The database servers were migrated to a set of highly scalable modular IBM System x3950 M2 servers. The non-database servers were migrated to an easily extensible set of high-performance IBM BladeCenter HS22 servers.

By consolidating the database servers to a more scalable clustered configuration, the organization conservatively expected to more than double system utilization from just under 18% to 45%. Based on the current workload, improvements in utilization and extra capacity for growth the organization purchased four IBM System x3950 M2 servers for production, and one additional unit for development and test. All servers were configured identically with eight six-core Intel Xeon X7450 processors and 48 GB of memory. Each server cost \$44,000. The servers were configured for high availability taking advantage of failover clustering in Microsoft Windows Server 2008 and Microsoft SQL Server 2008.

The IBM BladeCenter HS22 servers were also configured for high availability failover based on VMware® ESX HA Cluster software. Based on the workload of the current servers the organization purchased fourteen identical IBM BladeCenter HS22 servers. Each HS22 blade was configured with two Intel Xeon X5560 quad-core processors and 8 GB of memory. The new 5500 Series processors from Intel offer nearly double the performance compared to previous Xeon processors and enhanced energy efficiency. Each HS22 blade cost \$5,300. Additionally, the blades required one BladeCenter H chassis priced at \$4,000.

Table 4 shows the configuration and initial purchase costs for the IBM System x and BladeCenter servers.

| Server Type | Server Count | Processors | Memory | Price |
|--|--------------|------------|---------------|------------------|
| IBM BladeCenter HS22 (2.8 GHz) (2Ch / 8Co) | 14 | 2 | 8 GB | \$5,300 |
| IBM x3950 M2 (2.4 GHz) (8Ch / 48Co) | 5 | 8 | 48 GB | \$44,000 |
| Total | 19 | 68 | 352 GB | \$298,200 |

Table 4: Server Configurations

Table 5 below shows the three year cost comparison between the new IBM server investment and the annual operating costs for the current server environment. Note that not all of the current servers were covered under a hardware maintenance contract, while all of the new servers would be covered with an extended three year hardware warranty.

| Server Hardware Costs | Original Server Environment | IBM Upgrade Configuration | Total Savings |
|---|-----------------------------|---------------------------|-------------------|
| Number of Servers | 266 | 19 | 247 |
| Total Server Purchase Costs | \$2,043,500 | \$298,200 | n/a |
| Annual Hardware Maintenance Costs | \$98,880 | \$23,856 | \$75,024 |
| Total Three Year Server Hardware Costs | \$296,640* | \$369,768 | (\$73,128) |

Table 5: Three Year Server Hardware Cost Comparison

*Note: Three year costs for the Original Server Environment only include annual maintenance costs, since initial purchase costs are sunk costs.

Software Licensing

In addition to the upfront costs for new servers, the consolidation also required the organization to restructure their software licensing. Originally, the organization had purchased individual Windows Server and SQL Server licenses for each new server. Over time the organization had negotiated an enterprise volume licensing agreement with Microsoft to leverage the scale of their investment. However, individual software licenses were still acquired for each new server. Table 6 below shows the license counts, list prices, and annual support for the operating system and database software for the original servers. The pricing listed below represents list prices for server-based licenses with appropriate Client Access Licenses (CALs). The prices do not reflect the organization's specific discount levels.

| Software Package | Licenses | Average Price | Annual Support |
|--|------------|--------------------|------------------|
| Windows Server Standard Edition | 240 | \$1,599 | \$400 |
| Windows Server Enterprise Edition | 26 | \$5,599 | \$1,400 |
| Total Windows Licenses and Support | 266 | \$529,334 | \$132,334 |
| SQL Server Standard Edition | 30 | \$5,999 | \$1,500 |
| SQL Server Enterprise Edition | 26 | \$62,430 | \$15,608 |
| Total SQL Server Licenses and Support | 56 | \$1,803,164 | \$450,791 |
| Total Software Licenses and Support | | \$2,332,498 | \$583,125 |

Table 6: Annual software support costs for original servers

With the new consolidation the organization would be running multiple virtual machines on a smaller number of physical servers. The new architecture would require the conversion of traditional server-based licenses to processor-based licenses of both Windows Server and SQL Server. Table 7 below shows the license counts, list prices and annual support for the new server configuration.

| Software Package | Licenses | Average Price | Annual Support |
|--|----------|--------------------|------------------|
| Windows Server Datacenter Edition | 68 | \$2,999 | \$750 |
| SQL Server Enterprise Edition | 40 | \$24,999 | \$6,250 |
| Total Software Licenses and Support | | \$1,203,892 | \$300,973 |

Table 7: Total software license and support costs for new IBM servers

Under the Microsoft volume licensing agreement the organization was given a \$678,000 credit toward the upgrade costs for the new processor-based licenses.¹ With the upgrade credit the new software license fee for the Microsoft Windows Server and SQL Server upgrade came in at \$525,892. By reducing their annual support costs by approximately \$280,000, comparing their previous costs of \$583,125 with the new lower fee of \$300,973, the organization recouped this additional license fee in just two years.

In addition to the Microsoft operating system and database software, the organization also purchased VMware vSphere Enterprise Edition virtualization software for the BladeCenter servers. The virtualization software cost \$2,245 per processor, totaling \$62,860 in upfront licensing fees. Annual support averaged \$400 per license or \$11,200 per year. Table 8 below shows the annual software cost comparison between the original environment and the new consolidated configuration including transfer credits for the Microsoft software.

¹ Microsoft volume licensing agreements are negotiated on a case by case basis. Consult your Microsoft account executive or qualified business partner for specific upgrade options for your environment.

| Software License and Support Costs | Original Server Environment | IBM Upgrade Configuration | Annual Savings |
|---|------------------------------------|----------------------------------|-----------------------|
| Number of Servers | 266 | 19 | 245 |
| Total Number of Processors | 499 | 68 | 431 |
| Windows Server License Costs | \$0 | \$125,932 | n/a |
| Windows Server Annual Support | \$132,334 | \$50,983 | \$81,351 |
| SQL Server License Costs | \$0 | \$399,960 | n/a |
| SQL Server Annual Support | \$450,791 | \$249,990 | \$200,801 |
| VMware vSphere License Costs | n/a | \$62,860 | n/a |
| VMware vSphere Annual Support | n/a | \$12,572 | (\$12,572) |
| Total License Fees | \$0 | \$5,88,752 | n/a |
| Total Annual Support | \$583,125 | \$313,545 | \$269,580 |
| Total Three Year Software Costs | \$1,749,375 | \$1,529,387 | \$219,988 |

Table 8: Three Year Software License and Support Cost Comparison

Systems and Database Administration Labor Costs

In addition to better leveraging capital investments in server hardware and software through improved utilization, the organization also sought to increase systems management efficiency through standardization. Although the x86-based servers were historically inexpensive to purchase and deploy, they proved to be rather expensive to support and maintain over time. Since servers were purchased and deployed for specific applications they were configured for those unique projects. There were no standards for system configurations and patches and upgrades would be applied inconsistently based on individual application requirements and reactively in response to issues.

These practices led to low perceived costs for new system deployments but rather high costs for operations and systems maintenance. The organization was continually questioning why they were spending so much time fighting fires and why they had difficulty responding in a timely manner to routine change requests. The organization had a total of six systems administrators and two full time database administrators for their 266 server environment for an average of 45 servers per systems administrator.

By moving to a clustered virtualized environment the organization was planning on shifting from their reactive ad-hoc administrative practices to standardized processes for maintaining consistent system images. They projected that the new consolidated systems could be managed with only three systems administrators. They planned to reassign the other three administrators to new application development projects. With an average fully burdened annual salary of \$105,000 per administrator the organization expected to reduce systems administration costs by \$315,000 per year by consolidating and imposing standard best practices.

Additionally, the organization also expected to save \$131,000 per year by reducing help desk calls related to system outages and performance issues.

| Server Administration Labor Costs | Original Server Environment | IBM Upgrade Configuration | Annual Savings |
|--|------------------------------------|----------------------------------|-----------------------|
| Database Administrators | 2 | 2 | 0 |
| Average Annual DBA Salary | \$115,000 | \$115,000 | \$0 |
| Systems Administrators | 6 | 3 | 3 |
| Average Annual Sys Admin Salary | \$105,000 | \$105,000 | \$315,000 |

| | | | |
|-------------------------------------|--------------------|--------------------|--------------------|
| Help Desk Staff | 14 | 12 | 2 |
| Average Annual Help Desk Salary | \$65,500 | \$65,500 | \$131,000 |
| Annual Administration Costs | \$1,777,000 | \$1,331,000 | \$446,000 |
| Total Three Year Admin Costs | \$5,331,000 | \$3,993,000 | \$1,338,000 |

Table 9: Three Year Server and Database Administration Labor Costs

Accelerated Application Deployment (Agility Benefits)

The organization also expected that moving to a virtualized environment would enable them to accelerate the deployment of new application initiatives. Previously when new servers were purchased for individual projects, it took an average of nine weeks to size, purchase, install and configure new server resources. Now with a pool of virtual servers, resources could be allocated in hours. The virtualized environment also provided flexible capacity, which reduced the need for extensive sizing efforts to ensure that servers were purchased with sufficient resources for application needs.

By decoupling specific application requirements from physical server characteristics the organization was able to set up and reconfigure application environments much more rapidly and make much better use of computing resources. This resulted in shorter application deployment times, which meant that new applications could be rolled out faster and start delivering value to the business quicker.

Energy Costs and Environmental (Green) Impact

With the current focus on global warming and fluctuating energy costs the organization was interested in ways it could reduce energy consumption in its datacenter. This was particularly important because the organization had projected that it would soon run out of available power and cooling capacity for their current datacenter. Like many companies the organization had ample floor space in the datacenter for additional equipment, but they were reaching limitations on both electrical power and the ability to maintain required temperatures.

The proposed server consolidation project was projected to reduce energy requirements for the target servers by an impressive 92%, saving 3,000,000 kWatts per year or \$288,268 in electricity costs annually. In addition, the reduction in power requirements was projected to extend the useful life of the datacenter by at least two years. In fact, the significant reduction in power consumption led the organization to believe that it might be able to stabilize energy requirements and avoid a datacenter expansion indefinitely. Table 10 below shows the significant reduction in energy consumption and costs from the server consolidation.

| Annual Energy Consumption | Original Server Environment | IBM Upgrade | Annual Savings |
|---|-----------------------------|-----------------|------------------|
| Server Count | 266 | 19 | 247 |
| Average Power Consumption for All Servers (Watts) | 149,700 | 12,300 | 137,400 |
| Annual Operating Hours | 8760 | 8760 | n/a |
| Data Center PUE Factor* | 2.5 | 2.5 | n/a |
| Annual Power Consumption (kWatts) | 3,278,430 | 269,370 | 3,009,060 |
| Average Price per kWh | \$0.0958 | \$0.0958 | n/a |
| Annual Power and Cooling Costs | \$314,074 | \$25,806 | \$288,268 |
| Average CO2 Emissions (lbs/kWatt) | 1.341 | 1.341 | n/a |
| Annual CO2 Emissions (lbs) | 4,396,375 | 361,225 | 4,035,149 |

Table 10: Annual Energy Consumption and Cost Comparison

* PUE – Power Usage Effectiveness is the measure of energy required by the data center as a whole for each unit of energy delivered to servers. This measure includes cooling and other data center equipment.

Finally, from an environmental perspective, the reduction in energy consumption for power and cooling would result in a decrease of approximately 2,018 tons of CO2 per year, or the equivalent of eliminating the emissions of 336 cars per year. (On average cars produce 6 metric tons of CO2 per year.)

Upgrade / Migration Costs

In performing their financial evaluation of the project the organization wanted to be sure to include all costs including the internal labor and external professional services required for the consolidation effort. Because the server architectures and software stacks remained the same, the migration costs were relatively minimal. The organization spent a total of \$48,000 on professional services to assist with the installation and configuration of servers and for consultation and tuning of the virtual machine cluster configuration and SQL Server databases. Internally the organization spent a total of 1750 hours on planning, sizing, server configuration, application migration, system validation and tuning activities. The majority of this time was spent on testing and validation to insure that applications were migrated successfully. Using an average fully burdened hourly rate of \$62.00 for internal IT staff the organization assessed internal labor for the project at \$108,500 for a total of \$156,500 for migration costs.

Service Level Improvements

As noted earlier, the ad-hoc systems management practices led to frequent system outages and performance issues impacting both internal employee productivity and external facing revenue generating applications. The organization measured a total of 310 hours of downtime for production systems for the year prior to the consolidation. They estimated that this resulted in over 6,000 hours of lost employee productivity or just over \$203,000 per year. Potential revenue losses were estimated at an additional \$850,000 per year due to system downtime.

In the first few months after the consolidation the organization was able to reduce downtime by up 80%. Although this represented a significant benefit for business units, the IT department elected to exclude these softer (indirect) savings from their financial analysis.

CONCLUSION

During times of economic growth the focus for IT is often to deploy new applications as fast as possible to take advantage of market opportunities. This drive for innovation may satisfy crucial business imperatives, but ad-hoc growth in the datacenter may also increase on-going IT operational costs. This paper shows that now, during this economic downturn, it may be the ideal time to evaluate whether modernizing your IT infrastructure and practices can lower costs, improve efficiency and potentially reduce cash outflows.

As our case study illustrates, advances in server hardware technology and virtualization now enable significant server consolidation and real cost savings. By reducing the number of physical servers deployed by over 90% our study participant was able to reduce energy consumption 92%, which lowered costs, extended the useful lifespan of their datacenter and reduced the organization's impact on the environment. Lowering server counts and imposing standard best practices also reduced systems administration requirements and improved service levels. Implementing a virtualized server environment leveraging the IBM BladeCenter HS22 servers improved overall resource utilization and positioned the organization for rapid deployment of new applications.

Perhaps one of the most impressive aspects of this consolidation project was that the organization was able to lower operating costs and improve service delivery while reducing current cash outflows. By leveraging hardware leasing options and multi-year software purchasing contracts, the consolidation projected was able to reduce expenses in year one by \$585,000 and lower IT operations costs for subsequent years by \$800,000.

EXPLORE FOR YOURSELF

As illustrated in this case study the latest IBM System x and BladeCenter servers powered with the new energy efficient Intel Xeon 5500 series processors offer tremendous opportunity for reducing energy consumption, shrinking your data center footprint and lowering operational costs. Alinean has developed an easy to use Server Consolidation TCO Calculator that will allow you to explore these potential savings for your unique environment. Learn how you can achieve similar benefits with a payback in a little as three months. Get your customized report at:

http://www.ibm.com/systems/migratetoibm/whyibm/campaigns/sconevaltool_intel.html

ABOUT ALINEAN

Since 1994, the Alinean team has been the pioneering builder of tools to help quantify and improve the ROI and TCO of IT investments. Alinean was named for the Spanish word for "Align", matching the Alinean mission as the leading developer of analytical tools to help IT vendors, consultants and IT executives align IT investments with business strategies.

The Alinean team has over a decade of experience in the practical development and application of ROI and TCO methodologies, models and tools to optimizing IT investment decision making. In 1994, the Alinean team formed Interpose, the original pioneers of ROI tools, developing analytical software for over 50 major IT vendors and consulting companies worldwide, and creating the industry standard TCO Manager and TCO Analyst software. Interpose was sold to Gartner in 1998, where the team continued their developments and marketing of ROI and TCO software tools. The original team reunited to form Alinean in 2001, once again becoming the leading pioneers and developers of ROI sales and analytical tools. Current customers include leading IT solution providers such as HP, IBM, Dell, Intel, Symantec, NetIQ, EMC, SAP, Oracle, SBC, and Microsoft, as well as leading consultancies and Global 1000 companies.

Additional information about Alinean and helpful ROI educational resources can be found at

<http://www.alinean.com>.