

Server Consolidation with Microsoft SQL Server on HP Integrity Servers:

A Financial Examination of Total Cost of Ownership

*An Alinean White Paper
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EXECUTIVE SUMMARY

With enhanced support for 64 bit addressing in Microsoft SQL Server 2005 and the impending release of Microsoft SQL Server 2008 organizations are beginning to investigate how they can leverage this new database to lower IT infrastructure costs and improve service levels for key applications. Some of the major themes surrounding the release of SQL Server 2008 include enhanced integration of key facilities such as security, rich data types, and improved performance and scalability. These capabilities can help lower costs by enabling organizations to more easily consolidate physical servers as well as database instances. Advances in multi-core 64bit servers, such as the HP Integrity servers featuring Intel Itanium II processors, provide the scalability and reliability required for the most demanding OLTP ERP applications as well as enterprise scale business intelligence data warehouses.

Recently Alinean, a leader in IT value measurement, teamed up with HP to assess the financial merits of consolidating SQL Server workloads on HP Integrity servers. This paper uses a real world customer case study to examine the relative costs and business advantages for consolidating SQL Server databases on HP Integrity business critical servers compared to standard multi-core x86 based servers. Although the performance and scalability of the latest x86 based servers have increased significantly and these servers have a much lower price performance ratio than business critical Integrity servers, this study found that when all costs were assessed the Integrity servers yielded a lower total cost of ownership over a three year analysis period.

The greatest advantages for the HP Integrity servers came from greater flexibility and simplified management. The study compared highly available clustered configurations with load balancing and automated failover for both the Integrity and x86 based server environments. While the clustering solution for the x86 based servers provides similar reliability to that of the business critical Integrity servers, the added cost and complexity of the high availability clustering software for the x86 based servers exceeded the cost difference in hardware between the platforms. Additionally, the Integrity platform enabled a greater consolidation of database instances and higher average utilization that helped lower its total costs.

TCO Results Summary

The study examined all costs associated with the acquisition and operation of the two alternatives over a three year analysis period. Hard (or direct) costs included hardware and software initial purchases, and annual maintenance, internal labor and professional services fees for installation, configuration, migration and on-going systems support, and facilities costs for power, cooling and datacenter floor space. Soft (or indirect) costs included employee productivity and revenue losses from downtime and opportunity costs related to business agility. Table 1 below shows that over the three year analysis period the HP Integrity solution yielded a 12.4% or \$800,692 lower total cost of ownership compared to the x86 based server solution.

TCO Comparison (Total Three Year Costs)	X86 Based Servers	HP Integrity Servers	HP Integrity Savings	Percentage Difference
Server Hardware	\$640,000	\$1,842,000	(\$1,202,000)	-187.8%
Server Software	\$4,000,445	\$2,714,248	\$1,286,197	32.2%
Network Equipment	\$163,125	\$26,100	\$137,025	84.0%
Administration Labor	\$1,552,500	\$1,035,000	\$517,500	33.3%
Facilities (Power & Space)	\$66,210	\$27,990	\$38,220	57.7%
Initial Implementation	\$42,750	\$19,000	\$23,750	55.6%
Total	\$6,465,030	\$5,664,338	\$800,692	12.4%

Figure 1: Three Year TCO Comparison Chart

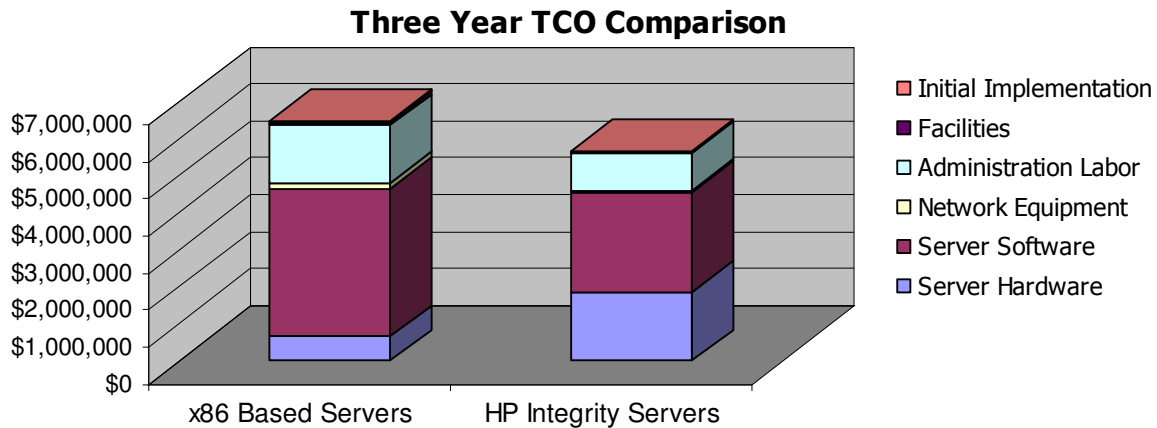


Figure 2: Three Year TCO Comparison Graph

THE CASE FOR SERVER CONSOLIDATION

With the introduction of highly scalable enterprise class Intel Itanium based servers there are several benefits of server consolidation. Organizations can now economically upgrade to much more scalable servers with greater processing power for high volume transaction processing applications and increased memory access for large decision support databases. Server consolidation provides an opportunity to leverage the flexibility of larger systems for multiple applications, which can significantly improve server resource utilization. Centralizing computing resources enables organizations to improve the efficiency of server management, as well as more easily leverage best practices and improve service levels.

Enterprise Class Scalability

The raw processing power of the latest Itanium II multi-core processors now rivals and even exceeds the performance of the fastest RISC based chips on the market. As Intel's largest partner HP has worked closely with the chip manufacturer to build its Integrity line of servers to maximize the efficiency of the Itanium II processors for real world application performance. The sx2000 chip sets available in the high end Integrity servers provide maximum memory and I/O bandwidth for the Itanium II CPUs.

These new 64 bit servers along with Microsoft Windows 2008 and Microsoft SQL Server 2008 provide near linear scalability for up to 64 cores and access up to 2 TBs of memory. This improved scalability means companies can now easily upgrade performance constrained 32 bit x86 based SQL Server instances without migrating to more costly RISC based platforms.

Improved Utilization

Increased scale and performance also means that multiple applications including databases can be combined on a single physical server. Traditionally, organizations often purchased unique servers for each new application requirement. These servers were sized for anticipated peak workloads. As workloads change over time, or actual processing requirements differ from original expectations, most servers end up with either very low average utilization rates or quickly exceeding available processing capacity. Placing multiple SQL Server databases on a single server platform allows administrators to balance available processing resources more evenly, and improve overall server utilization.

SQL Server databases can be consolidated on a single server by combining multiple instances, running multiple SQL Server instances on a single server or by running multiple instances in separate virtual machines. The HP Virtualization Machine or third party tools such as Parallels Virtuozzo Containers enable the execution of multiple Windows instances on a single physical server.

Manageability

Historically, two thirds of IT budgets have been spent on ongoing support and maintenance of computing infrastructures. Consolidating and centralizing operations and administrative activities provides substantial opportunity for leveraging skills and improving IT efficiency. Reducing the physical number of supported devices in an organization also lowers change management and problem diagnosis requirements. HP further simplifies systems management for Integrity servers by imbedding powerful utilities and integrating with enterprise systems management frameworks, such as HP OpenView.

Improved Service Levels

Systems availability can be enhanced through server consolidation by leveraging systems management best practices and upgrading to more reliable systems. The HP Integrity servers have been engineered from the ground up for mission critical levels of high availability with many levels of internal error checking and redundant components.

Today, service delivery means more than just reliability, availability and serviceability (RAS). It also includes consistent security and compliance management, which are much easier to enforce with centralized management. Windows Server 2008 has also been enhanced to support tighter integration with the Integrity and Itanium architectures to stream line code paths reducing ancillary interfaces and lowering potential security risks.

CASE STUDY DETAILS

Background and Business Goals

Our study was based on the needs of a mid sized manufacturing company, which specializes in outdoors sports equipment and accessories. The company had grown significantly in recent years due to several acquisitions. The organization's strategic direction was to leverage economies of scale in its distribution channels and increase brand recognition by acquiring smaller companies with best in class products but languishing growth or profitability.

Several of the acquisitions over the past five years were of family owned businesses with rudimentary IT systems. As new operating companies had been acquired, they were integrated into a corporate financial application and tied into the sales and order processing systems. For the most part, individual supply chain management and manufacturing applications were left intact at the operating companies.

Although most of the acquisitions worked out well from a marketing perspective, the company had struggled to improve operational efficiencies. They had a myriad of applications spread across several locations, which were difficult to maintain and nearly impossible to integrate. System availability for critical servers varied by location and the lack of standard processes for backup or software upgrades created unnecessary business risks.

In order to reduce operating costs and improve service levels the organization conducted a study on consolidating 84 servers running various versions of Microsoft SQL Server. The goal was to bring as many of these databases as possible together into a single datacenter with standard practices for high availability and reliability.

Architectural Assessment

The company considered two options for consolidating the database applications. One choice was to set up a clustered configuration of several multi-core x86 based servers. An alternative approach was to set up a few scalable HP Integrity servers with workload balancing and automated failover.

A detailed technical assessment of the current workloads, database schemas, and growth requirements was performed to develop the system requirements for the target servers. Table 2 below shows the

recommended server configurations for the two alternatives. The x86 based server configuration called for a total of 25 servers with either two or four quad-core Xeon processors. The HP Integrity configuration called for four rx8640 Integrity servers with either twelve or sixteen dual-core Itanium II processors.

X86 Based Server Configurations	Servers	Processors per Server	Memory per Server	Purchase Price per Server
2 processor – Quad core – 8GB memory	15	2	8 GB	\$20,500
4 processor – Quad core – 12GB memory	10	4	12 GB	\$29,500
Total All Servers	25	70	240 GB	\$602,500

HP Integrity Server Configurations	Servers	Processors per Server	Memory per Server	Purchase Price per Server
rx8640 12 processor – Dual core – 48GB	2	12	48 GB	\$280,000
rx8640 16 processor – Dual core – 72GB	2	16	72 GB	\$380,000
Total All Servers	4	56	240 GB	\$1,320,000

Figure 3: Alternative server configurations

Although the quad-core Xeon processors have similar raw processing power as the dual-core Itanium processors¹ the customer could use slightly fewer Itanium processors due to the greater scalability of the Integrity servers. Based on the workload characteristics for the databases they would be able to consolidate more database instances on the more scalable Integrity servers and achieve slightly higher system utilization. They could consolidate the original 84 database instances down to 12 instances on the Integrity servers, while it would required 22 database instances for x86 based server configuration.

Server Hardware Investment

Obviously, a major factor in the analysis was the cost of the server hardware, since it represents a significant percentage of the initial purchase costs. However, many people often place too much emphasis on this factor without thoroughly considering the long term costs of managing and maintaining the systems over their entire lifespan. In our case the initial purchase costs for the x86 based servers were less than half of the costs for the HP Integrity servers, \$602,500 compared to \$1,320,000.

The annual hardware support costs for the servers differed significantly. Support was priced out for both configurations using 7 x 24 coverage with four hours response time. The Integrity support averaged \$43,000 per server per year, while the support for the x86 based servers was only \$500 per server per year.

In addition to the servers themselves additional Ethernet LAN and SAN equipment to integrate the servers with the client and storage networks was also needed. This equipment averaged \$4,500 per server for redundant dual port connections to both networks.

The total three year hardware investment for both configurations is shown in table 4.

¹ The comparison of appropriate x86 based and Integrity servers in this case study was based on a detailed assessment of the specific application requirements and workloads for our study participant. Comparable performance measures for Itanium and Xeon based servers can be obtained from the Transaction Processing Council www.tpc.org or the Standard Performance Evaluation Corporation www.spc.org. Both sites publish publicly available information on benchmark tests.

TPC focuses on application workload measures. The most relevant benchmarks for SQL Server workloads would be the TPC-C for OLTP workloads and the TPC-H for decision support workloads. SPEC focuses more on server and processor computational performance. The CPU2006 CINT (Rate) benchmark is a good measure of a system's ability to processes integer operations, which is central to database applications.

Three Year Hardware Cost Summary	X86 Based Servers	HP Integrity Servers
Server Hardware Costs	\$602,500	\$1,320,000
Server Hardware Maintenance (Three Years)	\$37,500	\$522,000
Total Three Year Server Hardware Costs	\$640,000	\$1,842,000
LAN & SAN Network Equipment	\$112,500	\$18,000
Network Equipment Maintenance (Three Years)	\$50,625	\$8,100
Total Three Year Network Equipment Costs	\$163,125	\$26,100

Table 4: Three year hardware cost summary

Software Licensing

The study focused on the initial licensing and annual maintenance costs for four primary software components; the Operating System, Database, Systems Management, and High Availability Clustering Software. Since the organization was moving from 32 bit implementations to 64 bit configurations new Operating System and Database software licenses were required for all new servers. The x86 based systems were configured with Microsoft Windows Server 2008 Enterprise Edition and Microsoft SQL Server 2008 Enterprise Edition. The HP Integrity systems were configured with Microsoft Windows Server 2008 Datacenter Edition and Microsoft SQL Server 2008 Enterprise Edition. The Windows Server operating system for the x86 based servers is licensed on a per server basis. All other software is licensed on a per processor basis.

The Systems Management software consisted of modules for configuration and patch management, performance and availability monitoring and backup and recovery. The price per processor averaged \$1200 for all servers.

The most significant difference between the alternatives came from the requirements for supporting high availability through clustering. This capability is built into the HP Integrity systems and is available at no additional charge. To achieve this same support on x86 based servers required additional software. The clustering software chosen for the x86 based servers costs \$6,800 per processor, which worked out to cost almost as much as the hardware itself. Overall, the software for the x86 based servers cost \$774,817 more than the equivalent software for the HP Integrity servers, almost making up for the difference in hardware costs. When the cost for software support over three years is combined with the initial purchase price, the added cost for software for the x86 based servers exceeds the difference in the hardware costs for the alternative configurations.

X86 Based Server Software	Licenses	Price per License	Total License Purchases	Three Year Support
Windows Server 2008 EE	25	\$3,999	\$99,975	\$65,985
SQL Server 2008 EE	70	\$24,999	\$1,749,930	\$1,154,955
Systems Management Software	70	\$1,200	\$84,000	\$55,440
High Availability Clustering Software	70	\$6,800	\$476,000	\$314,160
Total All Servers			\$2,409,905	\$1,590,540

HP Integrity Server Software	Licenses	Price per License	Total License Purchases	Three Year Support
Windows Server 2008 DE	56	\$2,999	\$167,944	\$110,844
SQL Server 2008 EE	56	\$24,999	\$1,399,944	\$923,964
Systems Management Software	56	\$1,200	\$67,200	\$44,352
Total All Servers			\$1,635,088	\$1,079,160

Table 5: Three Year Software License and Support Cost Comparison

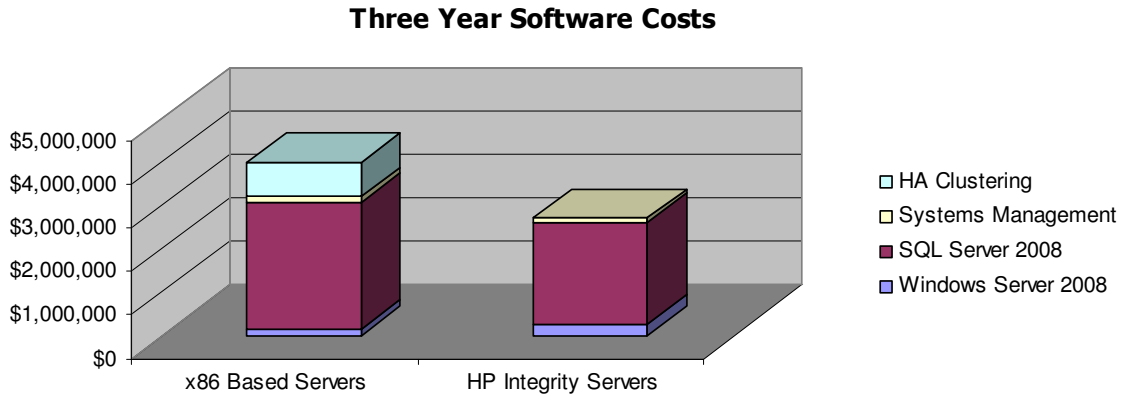


Figure 6: Three Year Software License and Support Cost Comparison

Server and Database Administration Labor Costs

One of the biggest benefits of server consolidation comes from improving the efficiency of server operations and administration. When servers are purchased in an ad-hoc fashion based on varying business needs by multiple departments, it results in a myriad of hardware and software configurations with skills spread across the company and no single set of best practice procedures.

By centralizing and consolidating the 84 databases the organization expected to reduce server and database administration costs by roughly \$500,000 per year or the equivalent of five head count. Because most of this staff was spread out in various locations and they performed a variety of functions, the organization did not anticipate eliminating any of the actual positions. They expected to be able to shift these people's time over to other more pro-active IT functions including report creation and data analysis.

Going forward the organization expected that it would require two and half staff (or full time equivalents FTEs) to manage the 25 x86 based servers and two DBAs to manage the 22 databases instances for this configuration. Alternatively, the Integrity configuration only required two systems administrators for the four servers and one DBA for the 11 database instances. Using an average fully loaded annual salary of \$115,000 for both the systems and database administrators this resulted in a \$172,500 lower annual labor cost for the Integrity solution.

The Integrity solution also had slightly lower initial installation costs. Due to the complexity of configuring the clustering software and the greater number of physical servers the x86 based server configuration was expected to cost \$32,400 for 180 hours of external professional services assistance, and \$10,350 for an equivalent number of hours of internal labor. The Integrity solution installation only required 80 hours of time for both external and internal labor resulting costs of \$14,400 for professional services and \$4,600 for internal labor.

Server and Database Administration Labor Costs

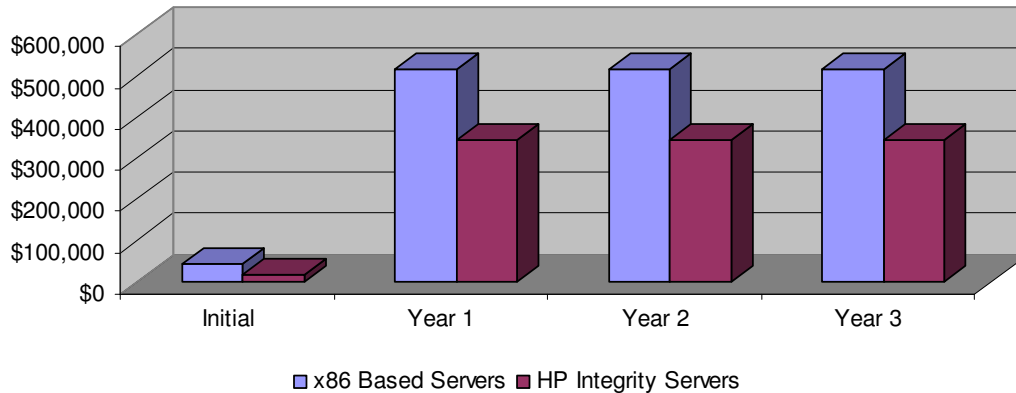


Figure 7: Initial and Annual Server and Database Administration Cost Comparison

Facilities Costs

With increased focus on rising energy costs and concerns for global warming many organizations are looking to server consolidation as a way to lower costs and reduce carbon emissions. Newer servers are certainly more energy efficient than older generations of equipment, but the monetary savings in facilities costs from server consolidation tend to be over shadowed by larger cost factors such as hardware, software and labor.

From a monetary perspective server consolidation is much more valuable in extending the life of the data center rather than directly lowering electrical costs. Many organizations are rapidly approaching capacity limitations in their data centers, including physical space as well as electrical and cooling capacity. These organizations simply can't add additional processing capabilities without consolidating and removing existing equipment. In these situations server consolidation becomes a necessary strategy for satisfying growing computing requirements without undertaking expensive data center expansion costs.

In our case replacing 84 legacy servers with 4 energy efficient HP Integrity servers reduced electrical consumption by nearly 90%, saving roughly \$90,000 per year. The Integrity servers were also more than twice as efficient as the alternative proposed x86 based servers. The four Integrity servers required just under 135,000 kWatt hours per year while the 25 x86 based servers required nearly 330,000 kWatt hours. At a cost of 10¢ per kWatt hour for electricity the Integrity solution cost \$25,650 per year for power and cooling, while the x86 based server option cost \$62,700.

Annual Power and Cooling Costs

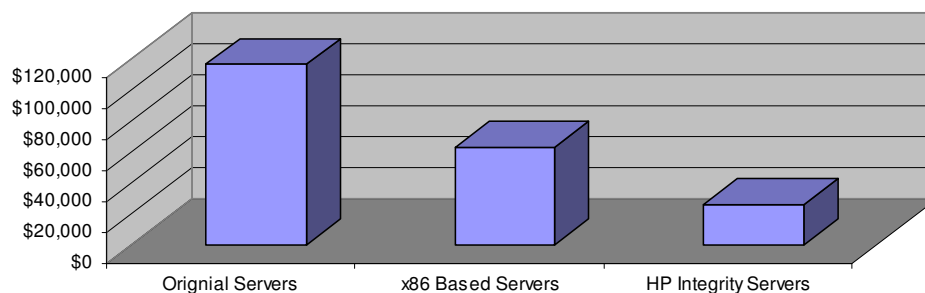


Figure 8: Annual Power and Cooling Cost Comparison

The 25 x86 based servers also required one more rack of floor space in the data center. Using 18 square feet per rack including aisles and space for air flow and \$65 per year per square foot for data center space the x86 based server solution costs \$3,510 per year, while the Integrity solution costs \$2,340.

Availability Impact

In addition to the hard cost savings of server consolidation, another major benefit is the improvement of service levels and systems availability. The latest HP Integrity servers are built from the ground up for enterprise class high availability. The study modeled the costs of downtime from both lost employee productivity and customer facing revenue generating applications for planned system maintenance and unplanned outages. The business impact of revenue losses were calculated by multiplying the revenue losses by the company's incremental net margin. Figure 9 below shows the distribution of the average of downtime costs for the original environment and the comparison of downtime costs for the HP Integrity solution. The HP Integrity solution was projected to reduce the costs of downtime by an impressive 80%.

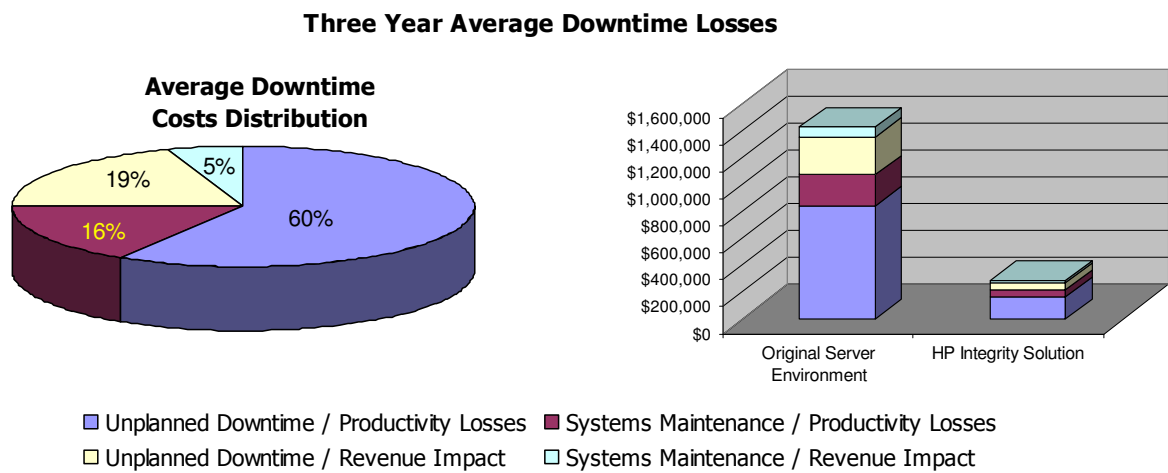


Figure 9: Three year average costs of downtime

The difference in expected availability between the HP Integrity server solution and x86 based server solution has not been factored into the TCO comparison of these options.

Agility

Another significant business benefit of server consolidation and virtualization is increased flexibility, which can accelerate IT projects. With the traditional practice of sizing, procuring, configuring, and installing server resources for each new computing project, the end-to-end server provisioning processes can often take from twelve to thirty six weeks in many organizations. By contrast, utility computing facilities can now provision server instances on large partitioned servers in a matter of hours with end-to-end fulfillment times dropping to mere days. This means that business applications can be brought on-line faster, delivering value to the organization quicker. The study participant was able to reduce server provisioning times from twelve weeks on average to four days with the HP Integrity solution. The faster time to market resulted in an average benefit of over \$150,000 per year.

Again, the difference in benefits from improved agility between the two alternatives has not been included in the TCO comparison.

CONCLUSION

With the introduction of Intel's latest 64 bit multi-core Itanium II processors the HP Integrity line of servers now rival and even exceed the scalability and performance of high end Unix/RISC enterprise systems. This means that customers can easily upgrade to the more scalable Integrity systems without costly migrations to alternative architectures. In addition, the highly reliable and more powerful HP Integrity servers are an excellent platform for consolidating the historical sprawl of SQL Server implementations. With their greater processing capacity and support for Microsoft Virtual Server Environments customers can safely run many instances of SQL Server on a single HP Integrity server.

The study clearly showed that consolidating SQL Server databases on HP Integrity servers not only minimized risk, but also reduced the total costs of operations. Although the HP Integrity servers have a higher initial purchase price than x86 based servers, the longer expected useful life span of the HP Integrity servers and the ability to achieve higher average utilization rates on the Integrity servers through virtualization negates much of this difference in initial purchase prices. In addition, the high availability capabilities built into the Integrity servers eliminate the need for costly and complex clustering software. The study showed that the lower software costs for the HP Integrity solution more than compensated for the higher hardware costs.

Although server consolidation enables organizations to improve resource utilization, much of the true value comes from increasing IT efficiency, improving service levels and enhancing flexibility. By consolidating and centralizing resources organizations can better leverage valuable IT staff, and more consistently implement best practices, thus lowering overall systems management requirements and significantly improving systems availability. Additionally, leveraging a virtualized environment allows organizations to reallocate resources based on changing requirements, and quickly provision new services to meet business needs. Server consolidation on a truly scalable platform, such as the HP Integrity line of servers, not only can deliver positive economic advantages in the short term, but can position organizations for lower operating costs, and improved service delivery for years to come.

TCO Comparison (Total Three Year Costs)	X86 Based Servers	HP Integrity Servers	HP Integrity Savings	Percentage Difference
Server Hardware	\$640,000	\$1,842,000	(\$1,202,000)	-187.8%
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Facilities (Power & Space)	\$66,210	\$27,990	\$38,220	57.7%
Initial Implementation	\$42,750	\$19,000	\$23,750	55.6%
Total	\$6,465,030	\$5,664,338	\$800,692	12.4%

Figure 10: Three Year TCO Comparison Chart

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>.