

# Building an intelligent infrastructure for SAP with HP Integrity Servers

Updated: October 2006

Author: Brad Porter, Porter Consulting



## Table of Contents

Executive summary .....	2
Meeting the business needs of the enterprise.....	2
Challenges faced by enterprise IT .....	2
SAP Performance .....	2
System requirements for effective SAP implementation.....	3
Moving to newer versions of SAP.....	<a href="#">45</a>
SAP's Adaptive Computing—Breaking down rigid architectures .....	5
Critical selection criteria for enterprise servers .....	6
The intelligent infrastructure opportunity: HP Integrity server solutions .....	7
Manageability, high availability and the Adaptive Enterprise.....	13
Cost considerations of a transition to a new IT platform.....	14
Additional resources.....	15

## Executive summary

Many enterprises today are faced with explosive data and application growth. These firms are searching for the best architecture to manage data and resources, “do more with less,” and enable their SAP implementation to run most effectively.

This paper provides an overview of how implementing SAP on HP Integrity server solutions can help enterprise firms reduce IT costs and enhance ROI, regardless of operating system or database releases.

## Meeting the business needs of the enterprise

Today’s global economy has created unprecedented business challenges. For many enterprise firms the fast-paced business day is 24 hours long, and maintaining the firm's competitive edge has become increasingly difficult. IT departments face the challenges of providing the technology solutions to support the ever-increasing demands of the business.

Based on feedback from many enterprise customers, HP has been hearing that CIOs want to:

- Respond more quickly to their fast-changing business environment
- Solve business challenges with innovative IT solutions
- Meet customer demand for higher service levels
- Introduce greater flexibility to their IT environment
- Reduce IT support and maintenance costs and overall TCO
- Improve resource utilization and RoIT<sup>i</sup>

## Challenges faced by enterprise IT

Certain technology challenges have arisen for many, if not most, enterprise IT departments, such as the need to:

- Provide for increased performance;
- Provide support for 64-bit applications;
- Consolidate IT resources to reduce costs; and
- Replace legacy servers in an effort to lower costs.<sup>ii</sup>

Other surveys have also found that server utilization in enterprise firms is often less than 20 percent, and many CIOs have recognized the need to increase current server utilization to improve ROI.<sup>iii</sup>

## SAP workload demands

Examination of a number of SAP customer performance situations has indicated that the nature of the workloads experienced by customers varied considerably at different times during the day and on certain days of the week or month. It also became apparent that the system must be sized to accommodate unpredictable peak workloads (typically, peak workloads are not transactional in nature).

This is what the picture looks like for most customers:

- *Daily workloads*
  - At any point in time there are usually transactions executing but these often consume only use 10 to 20 percent of the total processing capacity.
  - Most days customers are running on low system usage unless they have an important and beefed up SAP APO process. APO usually will run at night and will use considerable resource bandwidth, especially with regard to memory and I/O. Not being able to meet the APO process deadlines will lead to severe manufacturing disruptions and lack of optimization with dramatic cost management effects.
  - More and more we also see SAP BW activity in daily workloads.
- *End-of-month processing*
  - During end-of-month processing heavy batch loads commence and BW demand becomes overwhelming—often resulting in system processing peaks and sleepless nights for administrators. BW and heavy batch processing are almost always analytical or at least query-based, taking up considerable processing resources. Add APO to the equation and the scenario is difficult at best.

The conclusion is simple: most peak workloads occur during the end-of-month processing and they are almost always query- or analysis-related.

## System requirements for effective SAP implementation

### SAP on HP-UX and HP Integrity

HP and SAP have worked together to fine-tune HP-UX kernel parameters for all database and SAP application instances, allowing them to operate on a single OS Instance. This enables the ability to do SAP instance and database (Oracle, SAP, or other) consolidation onto a single server or partition, significantly saving on management and cost, and improving scalability. This is what IBM customers like to refer to as the “UNIX mainframe.”

When the database and SAP instances are implemented on a single OS instance, the consolidation has little impact. The only consideration factor is that the HP-UX kernel parameters need to be properly set; to distinguish between additive and maximum size related parameters. Specific HP-UX parameters are set, when multiple DB and SAP instances should be implemented on a single OS-Instance.

### Advantages when running SAP on Windows with HP Integrity

- No 4 GB dynamic memory limit, especially useful at the database level where bottlenecks are rarely transactional but batch driven (and chiefly query related).
- Much higher scalability not only for memory but also for CPUs and I/O.
- Enhanced configurations possible with HP Integrity servers providing highly scalable functions and HP ProLiant servers with outstanding price/performance.

### Some potential challenges to consider

- Restricted cluster solutions due to SAP limitations (web application server related).
- No examples of scalable application stacking in production imply that only scale-out is available today. Nevertheless some tools like WSRM are clearly a future direction for Microsoft.

As noted earlier, all 32-bit operating systems and applications have hard operational limitations between 1.7 and 2.8 GB for the amount of memory that can be allocated for each process. So, as a rule of thumb, 64-bit systems are mandatory for real world SAP server consolidation on Windows particularly at the database tier.

Today, some customers' R/3 implementations are driving terabyte-sized databases. Unlike the application server, the SAP database server is able to use memory extensions like Address Window Extensions (AWE) to manage the large amounts of data provided the work is transactional. This keeps the data cache hit ratios at a high level and keeps the I/O rate at a reasonably moderate level. But as the volume of the data on the R/3 backend database increases and more SAP functions like batch, data warehousing or planning are executed on the backend database server, the demands for higher amounts of data buffers increase.

---

Bought its first HP Integrity Superdome server in May 2004 and put it into production in July. Taking advantage of the ability to run SAP in a mixed PA-RISC and Intel Itanium microprocessor environment, the company completed the transition of its entire SAP environment to Integrity servers in spring of 2005.

General Mills, North America

---

## SAP Business Warehouse

Another SAP application that will benefit from running on SQL Server 2000 (64-bit) on HP Integrity is SAP Business Warehouse (BW). BW runs many queries against SQL Server that require the aggregation of massive amounts of data, joining dozens of tables, and sorting and grouping the result sets. Typically, the size of the fact tables in BW is larger than the maximum addressable dynamic memory supported on 32-bit systems. This limitation makes it difficult for joins and sorts of multiple tables to be performed completely in memory. And, if multiple users use BW concurrently, it may not be possible to use the entire data cache of SQL Server to accommodate the requirements of one complex query. This severely restricts implementation of medium or large SAP BW solutions on a 32-bit platform.

## SAP Advanced Planner and Optimizer (APO) Applications

SAP Advanced Planner and Optimizer (APO) covers supply chain management. This SAP product differs from all other SAP products because of the existence of a “Live Cache.” The Live Cache operates as an in-memory database whose architecture is based on the SAP Database. This in-memory database is used by the application logic in APO to calculate CPU-intensive processes like production optimization or product planning. The big advantage of the Live Cache is that data is read from the relational database, such as SQL Server, only once and used for later data requests. There is a huge negative impact to APO performance when operating on 32-bit servers. In fact, according to SAP recommendation notes, it is in general only practicable to implement APO on a 64-bit system due to the larger memory addressing offered by 64-bit.

## Implementing mixed SAP Environments (32-bit and 64-bit together)

Many customers naturally wish to implement the most cost efficient architecture possible for themselves, or may only want to upgrade a portion of their SAP environment (the back-end database and central instance for example). They will find that implementing 64-bit based HP Integrity on the back-end and 32-bit IA-32 systems for the front end SAP modules could have a lower acquisition cost and will be a good balance of performance and investment. HP has many success stories around these types of implementations—please visit [www.hp.com](http://www.hp.com) and search for “success stories” to learn more.

## Moving to newer versions of SAP

Upon moving to newer versions of SAP, most customers find that running the same number of transactions requires a much higher performance capability because these transactions are “heavier” or “richer”, meaning more complex code is involved to process the transactions. Consequently, more system computing power is needed just to maintain current system response and meet in-place service-level agreements.

Long-time SAP customers are often faced with the need to migrate from older SAP releases that are no longer being supported or require another upgrade. This may be driven by the need for additional capacity or a need to add features such as 64-bit Unicode. Many customers are facing issues around integrating their legacy SAP infrastructure for efficiency and cost. These customers face a difficult decision to choose the hardware architecture that will best support their future needs and obtain the best return on their IT investment.

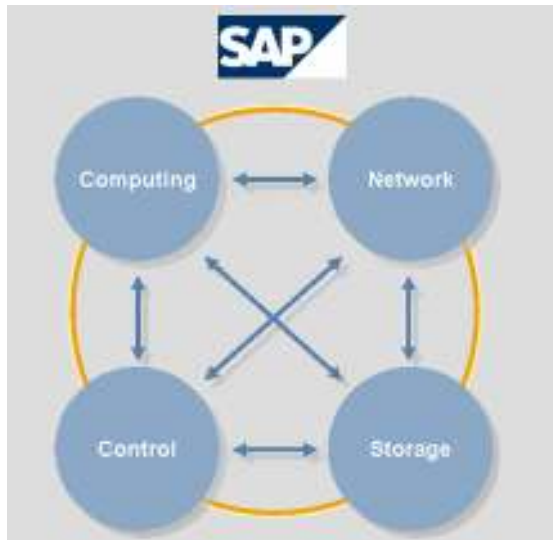
## SAP’s Adaptive Computing—Breaking down rigid architectures

An ever higher proportion of an enterprise’s annual IT expenditure is made up of costs for running and supporting applications. With Adaptive Computing, SAP NetWeaver offers an approach for the dynamic assignment of hardware resources, so that application-related requirements can be met more effectively.

“One area that enterprises are devoting more and more attention to is the optimization of IT landscape and system maintenance and administration, and the current discussion is focusing on key terms such as return on investment (ROI) and total cost of ownership (TCO). One of the most important factors for success is a company’s ability to adapt rapidly to changing customer, vendor, and partner requirements. This applies not only for the company’s employees, but also for the software applications it needs for day-to-day business, as well as the underlying IT infrastructure.”<sup>iv</sup>

SAP’s Adaptive Computing is a new approach to design hardware, software and system services following the business-driven need to permanent change and adaptability. It allows the management of SAP applications across multiple systems or resources, whether those are virtual or physical. SAP’s AC provides dedicated resources for computing, storage, network and control, and it allows customers to pool them and share resources when appropriate. The “control” function of SAP’s Adaptive Computing defines application services and virtualizes them.

Figure 1: SAP architecture



What advantages does the SAP Adaptive Computing offer to customers?

SAP's Adaptive Computing:

- Utilizes pooled and shared resources depending on business needs
- Improves overall manageability
- Allows IT to spend more time on innovation to meet changing business demands

SAP expects costs to be reduced by 30 to 40 percent for customers who implement Adaptive Computing.<sup>v</sup>

## Critical selection criteria for enterprise servers

Forrester Research has identified these critical selection criteria for enterprise servers:

1. Address escalating 64-bit performance requirements with an equal focus on the optimization of both technical and commercial workloads;
2. Allow cost-effective and flexible consolidation of multiple OS instances and mixed workloads onto fewer servers;
3. Create a management environment that maximizes system utilization across multiple workloads, while preserving historical reliability and fault resilience;
4. Provide a wide variety of "pay per use" pricing frameworks to create the foundation for an on-demand IT organization.<sup>3</sup>

# The intelligent infrastructure opportunity: HP Integrity server solutions

HP Integrity server solutions provide an excellent platform on which to build an intelligent infrastructure to support an SAP implementation.

---

“Another fundamental point was the cost per transaction we found in the SAP-HP formula. For us, this decision was the best from a return on investment perspective.”

Pedro Elizalde, IT Planning & Technical Support Director  
Cervecería Cuauhtemoc-Moctezuma

---

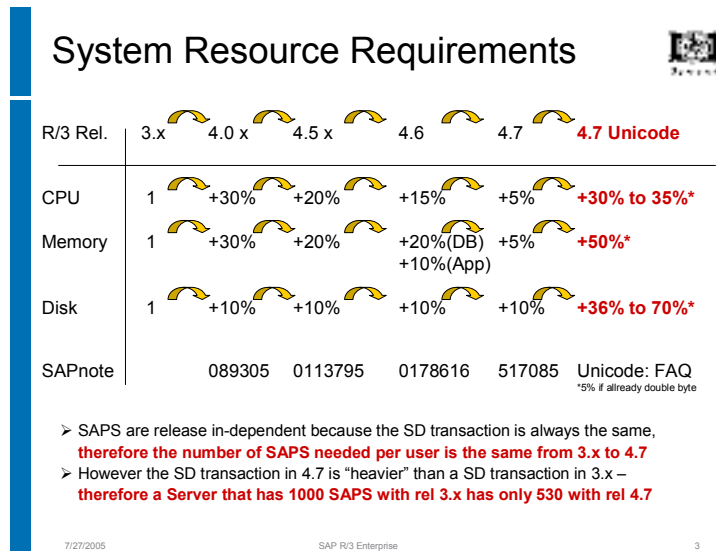
## 1. Addressing escalating 64-bit performance with HP Integrity servers

Until the late 1990's, large SAP implementations with multiple modules had to be scaled out among independent UNIX servers due to CPU and memory driven limitations. This led to a common problem in larger corporations having dozens if not hundreds of separate SAP instances and servers. Complex and certainly less mission critical, these multi-node environments were plagued with low operating efficiencies and high management and operational costs. Worse, when it was deemed time to resolve the high cost/dispersed environment problem, it was nearly impossible to resolve the issue among multiple line-of-business owners.

Fortunately, today's UNIX/SAP implementations have robust software stacks due to increased maturity and the use of 64-bit memory addressing. The increased processing power associated with HP Integrity servers is accelerating this trend as it is clear now that many high-end mainframe installations are not delivering adequate performance to keep up with growing business requirements. Simultaneously, Windows implementations, while dwelling on a scale-out model, also benefit from Itanium's additional performance and have become a serious mid-range alternative in terms of lower database licensing cost or expertise pervasiveness.

However, higher processing power is not the only factor that needs to be considered when looking at a target consolidation platform. What may be even more important is the nature of the workloads that are being run, leading to an evaluation of the critical performance path.

Figure 2: System resource requirements



HP Integrity servers rely on Intel Itanium® 2 processors, co-developed by HP and Intel. These 64-bit processors were designed to optimize both technical and commercial workloads.

### Scalability

Current 64-bit releases of HP-UX scale well to 64-processors. 64-bit Windows is also delivering more highly scalable installations. Linux now scales to 16 processors and in the near future to 32 processors.

HP has consolidated several management tools for HP-UX environments. The unconstrained memory of a single 64-bit operating system for the management of more SAP users and increases the large-memory applications performance.

In Windows 2003, consolidation of SAP on a single system is possible and effective using hard partitioning.

### Case study #1: General Mills

*Business challenge:* Over the last year, this company realized it was bumping up against capacity constraints in their global infrastructure. As its IT executives looked at solutions, they made the strategic decision to update related subsystems concurrently.

*The solution:* Move SAP and Oracle to HP Integrity servers running HP-UX 11i. Specifically, HP Integrity Superdomes and HP Integrity rx7620s based on Itanium 2 processors. This deployment runs the SAP applications for all North American operations and includes SAP ERP, PLM, SCM, SEM and HR.

---

“HP Integrity servers gave us the power and computer resources that we needed right off the bat. Online transaction performance improved 32 percent and the elapsed time on SAP batch jobs was cut in half.”

Mike Meinz, Director of Information Technology  
General Mills

---

## 2. Allow cost-effective and flexible consolidation with HP Integrity servers

The key driver of server consolidation is virtualization. By allowing IT resources to be shared among users, fewer physical systems are needed to accomplish the same level of work.

As described earlier, SAP predicts their customers can reduce their TCO significantly by implementing SAP’s Adaptive Computing concepts. Since SAP’s Adaptive Computing utilizes pooled and shared resources, obviously it requires a virtualized computing infrastructure.

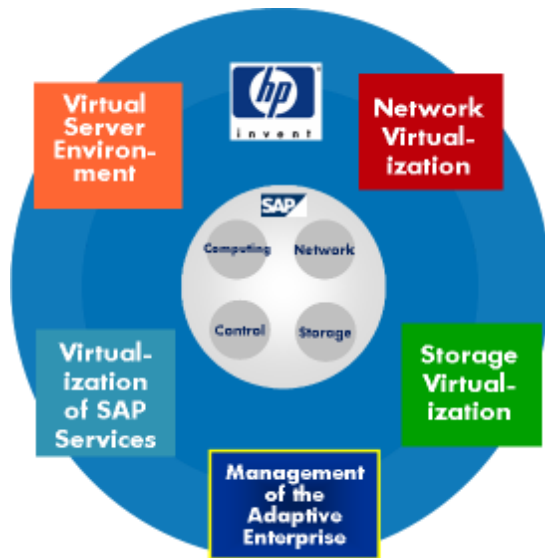
While expected performance is often a key factor for a purchasing decision, benchmarks can only help size a system for single instance peak capacity requirements. As customers consolidate and upgrade their older environments, they look for ways to improve the efficiency out of their implementation. Because systems typically only run at peak capacity for a short period of time every month, methods to utilize the capacity between normal and peak operations are extremely important.

The first step prior to implementing virtualization is consolidating SAP instances and applications into fewer servers. The next step, resource allocation and partitioning, provides SAP environments with the flexibility to change their processor resource allocations or create isolation between the different environments, while verifying that all SAP modules and instances are running efficiently.

The HP-UX virtualization approach for SAP is comprehensive. When isolation or flexibility are needed, customers have a range of choices—from efficiently isolating SAP modules from each other in the same operating system instance to complete electrical isolation of production, test, and development environments on the same server.

The diagram below shows how HP Virtualized Infrastructure Solutions support and enable SAP’s Adaptive Computing.

Figure 3: HP Virtualized Infrastructure Solutions and SAP Adaptive Computing



### Secure partitions

A recent capability that has been added to better manage application stacking is secure partitions. This capability is available from HP and Sun, but not from IBM. As illustrated in Figure 4, it provides the ability to have multiple SAP instances operating on the same OS instance, but offers greater security between applications than with vPARs. It allows for the management of administrator access rights to regulate at the data and application level. This is an effective solution for stable production environments that need to be separated due to security considerations.

### Physical partitions

Applications and operating environments are electrically isolated and protected from one another by physical separation between 4-processor cells. This capability is independent of the operating system being used and is available on all HP Integrity servers that utilize cell-based architectures—8-way systems and larger. IBM does not have physical partitioning available.

### Advantages

1. **Reduced production impact:** During upgrades, hardware failures and upgrades are confined to the partition in which they occur, making this setup ideal for mixed production and test environments.
2. **Higher performance and throughput:** Evenly splitting a Superdome 32 socket system will greatly diminish scalability overhead and deliver performance roughly equivalent to two rx8620s. Still it is possible to revert to a single partition and scale beyond 16 sockets at some point in the future. Processor resources cannot be reassigned dynamically out of an nPar (see Virtualization and Partitioning Penalties section).
3. **Cell-level granularity:** Large HP Integrity systems that run nPars have granularity at the cell level, enjoying their own dedicated CPU, memory and I/O resources.

---

“Possibly one of the most compelling advantages of the HP Integrity platform is the fact that it enables us to bring the benefits of SAP for Utilities to smaller companies thanks to the advanced physical partitioning capabilities of the HP Integrity servers.”

Werner Kayser, Head of Application Services  
Vattenfall Europe Information Services

---

### Virtual partitions

Virtual partitions (vPars) are partitions with software fault isolation either within a hard partition or a single server (multiple operating system images with software isolation). Virtual partitions on HP Integrity servers can be run with HP-UX 11i v2 and Linux. Created by software, virtual partitions provide application and operating system isolation only.

### Advantages

1. **Virtual partitions:** When using vPars and HP Work Load Manager, processors can be moved into or out of a virtual partition. This allows dynamic CPU migration from one virtual partition to another without rebooting, enabling effective resource allocation.
2. **Multiple OS and partitions:** vPars allow for completely separate operating systems to run on the same system in separate software partitions.
3. **Lowered impact of failures:** The implementation of virtual partitions limits the impact of application failures and operating system panics.



### HP Integrity Virtual Machines

HP has the ability to offer low overhead virtual partitions (vPARs) and electrically isolated hard partitions, allowing sub-CPU granularity. While this is similar to IBM’s micro-partitioning capability, HP’s Integrity VM capability will have lower overhead (between 1 and 35 percent) than IBM’s equivalent product (between 15 percent and 40 percent overhead). Though the application isolation level is different with virtual partitions, it does allow for ease of management with only one O/S instance running, and is useful for consolidations involving multiple low consumption applications. Nevertheless, this scenario tends to apply less to SAP deployments where application stacking is the norm.

### Competitive comparison: Partitioning continuums at HP, IBM and Sun

As can be seen in the Figure 4, IBM AIX and Sun Solaris offer partitioning capabilities similar to HP but not as comprehensive.

Figure 4: Partitioning continuum

	Windows	Linux	HP-UX	Solaris	AIX
Resource partitioning: multiple SAP instances within an OS instance	dynamic WSRM	dynamic HP PRM	dynamic HP PRM	dynamic Resource Mgr.	dynamic AIX WLM
Goal-based resource partitioning (resp. time)	dynamic WSRM	dynamic HP WLM	dynamic HP WLM	No offering	manual AIX eWLM
Secure partitions: multiple SAP instances within an OS instance	No offering	dynamic Secure Partition	dynamic Secure Partition	Dynamic Solaris Containers	No offering
Virtual machines: multiple SAP instances on multi sub CPU OS instances	VMware No support by SAP	Integrity VM	Integrity VM	No offering	Micro-partitions
Virtual partitions: multiple SAP instances on multiple OS instances	Integrity VM	Integrity VM	Integrity VM	No offering	No offering
Hard partitions: multiple SAP instances on different OS instances	static	static	static	dynamic but SAP reboots	No offering

### 3. Manageability to maximize system utilization with HP Integrity server solutions

#### HP Process Resource Management with SAP

HP Process Resource Management (PRM) is meant to give the administrator an opportunity to set dedicated resources within a single operating system image using either a virtual or hard partition, with granularity down to the sub-CPU level (see next graphic). Resource granularity is defined by either the percent share of the CPU through HP PRM or whole number of CPUs through pSets (processor sets) with HP Workload Manager. These resource objectives can be assigned to “groups.” HP PRM is used in HP-UX/SAP deployments to verify that high priority workloads have the necessary level of resources, and especially works well in deployments with large operational workloads during the day and heavy batch operations in the evening or at end-of-period roll-ups.

#### HP Workload Manager with SAP

HP Workload Manager (WLM) is the automation engine that monitors application performance and business policies and determines when resources should be reallocated (automated, goal-based resource management) based on CPU usage or through pre-defined scripts (ex: minimum number of active users connected). HP WLM supports policy-based resource management, and the combination of policy based and goal-based management. HP WLM can dynamically change CPU allocations between applications within an OS and between virtual partitions (vPars), as well as activate/deactivate Temporary Instant Capacity (TiCAP) and pay-per-use (PPU) CPUs (without rebooting) to change the amount of physical resources available. WLM can move active CPU licenses between node partitions (nPars) on servers with available TiCAP CPUs. It does this without increasing the total number of active CPUs in the server, so the customer is not billed. HP WLM is useful when running SAP at peak periods as CPUs are allocated to meet those higher needs.

## Manageability, high availability and the Adaptive Enterprise

In an effort to facilitate better management and high availability of SAP environments, HP has developed a series of tools and capabilities that have enhanced SAP environments running on HP platforms.

## Ignite-UX

This administration toolset helps customers perform a number of provisioning and disaster recovery tasks. With Ignite UX, HP-UX 11i images can be installed in servers across the network. Also, with the ability to create operating system golden images stored separately, custom configurations and remote disaster recovery capabilities are enabled.

What many customers have found most useful is the ability of Ignite-UX to deploy both files and objects, dramatically increasing the ability to provision systems across a network.

Ignite-UX has a capability unique in the industry. It is able to record and use system golden images for production, DR and replication of HP servers. For example, a new system brought into an enterprise can have a golden image, operating system patches, and applications loaded onto the systems quickly and with guaranteed quality. This ability eliminates the need to have costly installation processes for new servers.

---

“We have a wide range of clients which we use Ignite for. They include both PA-RISC and Itanium-based servers; K, L, and N class servers; and RP7400, RP8400 and RX4640 class servers. In total, we use Ignite on 100+ servers running HP-UX 11.11 and HP-UX 11.23 for PA- or IA-based servers.”

Chevron, North America

---

## High availability and HP Serviceguard extensions for SAP

The HP Serviceguard Extension for SAP (SGeSAP) provides failover cluster capabilities to SAP application environments. SGeSAP provides a single, uniform interface to cluster SAP R/3, mySAP, SAP Web Application Server (SAPWAS), SAP Netweaver and SAP stand-alone J2EE based SAP application. Key features of SGeSAP include:

- SGeSAP protects the SAP Central Instance and database within a SG cluster. It is not just a script example, but an easily integrated and standardized solution that uses simple Serviceguard commands
- Continuously monitors the health of each SAP node and automatically responds to failures or threshold violations
- Full tested and certified by both SAP and HP (single point of support)
- Even faster implementation with HP services and HP Cluster Consistency Assessment
- Available on both Serviceguard for HP-UX and for Linux

---

“With the HP Virtualized Infrastructure Solution for mySAP™ Business Suite, we have achieved flexibility in our IT load handling and business agility. It has also cut Total Cost of Ownership: infrastructure and marginal costs have gone down, which will result in savings of 30 to 40 percent of operating costs.”

Prof. Claus Rautenstrauch, Faculty for Informatics  
Director of the Magdeburg HCC

---

#### 4. HP provides a wide variety of "pay per use" pricing frameworks

HP offers a wide variety of "pay per use" pricing frameworks in which the hardware is metered in computing cycles, including Instant Capacity on Demand (ICAP) and the industry's first Pay Per Use for Microsoft Windows, similar to the leasing program HP started with its HP-UX servers.

These pay-per-use pricing frameworks allow for pre-provisioning of customer's server resources, so that the customer only pays for additional capacity when it is needed; at month-end or compiling quarterly financial statements, for example.

### Cost considerations of a transition to a new IT platform

When considering a transition to a new IT platform, here are some key facts to keep in mind:

- The acquisition cost of hardware and operating system is typically quite small (less than 8 percent) compared to the cost of the implementation consulting and SAP software licenses (see table below).
- The difference between having to replace an existing infrastructure in five years versus eight or 10 can have a dramatic impact on total cost of ownership (TCO).
- The ability to pre-provision and virtualize your server resources is key to achieving better server utilization and reducing your total cost of ownership.

---

Table 1: Typical SAP project budget for a medium-sized implementation

Item	Purchase Costs	Annual Support Costs	Annual Support (at end of life)
SAP Application Software	\$10.5 million (19.7%)	\$2.0 million	\$2.25 million (17% to 19%)
Hardware, operating environment, and installation	\$4.1 million (7.6%)	\$0.5 million	>\$1.5 million (upgrade + support)
Implementation Consulting	\$38.7 million (72.6%)		
Total	\$53.3 million (100%)	\$2.5 million	>\$3.75 Million

Note: Implementation costs were taken from an actual HP sizing document for a US East Coast university.

---

## Conclusion

HP Integrity server solutions offer flexible capacity, secured availability, and simplified manageability; providing an excellent platform on which to build an intelligent infrastructure to support an SAP implementation. SAP's new Adaptive Computing architecture effectively utilizes pooled and shared resources, improves overall manageability, and allows IT to spend more time on innovation to meet changing business demands. Together HP and SAP have a proven track record of helping customers to meet their business needs and their IT challenges; helping customers to lower their Total Cost of Ownership and increase their Return on Investment.

## Additional resources

For more information on the HP and SAP Alliance, visit: [www.hp.com/go/sap](http://www.hp.com/go/sap)

To learn more about SAP and infrastructure management, you might consider these books on implementing SAP, written by HP SAP experts:

- *SAP System Operations*  
by Michael Missbach, Ralf Sosnitzka, Josef Stelzel, and Matthias Wilhelm (SAP Press)
- *Adaptive Hardware Infrastructures for SAP*  
by Missbach, Hoffmann, Buhlinger, and Matzerath (SAP Press)
- *SAP Hardware Solutions: Servers, Storage, and Networks for mySAP.com*  
by Michael Missbach and Uwe Hoffmann (Prentice Hall PTR: HP Professional Series)
- *mySAP Tool Bag for Performance Tuning and Stress Testing*  
by George W. Anderson (Hewlett-Packard Professional Books, 2004)
- *SAP Planning: Best Practices in Implementation*  
by George W. Anderson (SAMS Publishing, 2003)

---

<sup>i</sup> HP Webcast: "Meeting the Business Needs of the Enterprise," Don Jenkins, HP BCS, January 2006

<sup>ii</sup> "End-User Reasons for Choosing HP Integrity servers," Ideas International, 2005

<sup>iii</sup> HP Webcast: "HP Integrity—Selection Criteria of the Mission-Critical Enterprise," Brad Day, Forrester Research, March 2005

<sup>iv</sup> "Adaptive Computing—Breaking Down Rigid Architectures," Roland Wartenberg and Georg Dittmar (SAP INFO, November 28, 2005)

<sup>v</sup> HP Webinar: "Maximize your SAP investment with HP Virtualized Infrastructure Solutions," Ron Eller, HP, November 2005

