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MANAGEMENT BRIEF

VALUE PROPOSITION FOR IBM SYSTEM i

Cost/Benefit Case for SAP All-in-One Solutions Deployments

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TABLE OF CONTENTS

List of Figures

EXECUTIVE SUMMARY

What benefits does an enterprise resource planning (ERP) system bring to a small or midsize business? Experience has shown that companies are able to respond faster and more effectively to customer needs and market conditions. Efficiency is increased, costs are reduced, and growth is facilitated. New forms of competitive differentiation are enabled.

With SAP All-in-One solutions, the world's leading ERP system has become available to small and midsize businesses in a simplified, affordable form. But, once the commitment to an All-in-One solution has been made, other decisions must also be addressed. Not least of these is which platform to run it on.

For many users, the assumption is that All-in-One solutions should be deployed on Windows servers. There is, however, another option – the IBM System i. The value proposition for this platform is based on the following:

- ***Distinctive capabilities***. The System i platform is fundamentally different from Windows servers. It is highly stable, enables significantly higher levels of uptime, and requires only a fraction of the IT staff of Windows server environments. It is also more secure and virus-resistant than the latter.

  The results of a survey of 58 small and midsize businesses (meaning, in this case, organizations with from 10 to 500 users) that had deployed SAP solutions on the System i highlight these capabilities. Overall, 52 (90 percent) commented on the high availability strengths of this platform and 40 (69 percent) cited its low IT staffing levels as critical benefits.

  The strengths of this platform in scalability, backup and recovery, partitioning, security and virus protection, speed and simplicity of deployment, and other areas were also widely reported.

- ***Lower IT costs***. Although Windows server hardware is less expensive than that of System i platforms, overall three-year costs are significantly higher. This is illustrated by six composite profile-based comparisons of manufacturing, retail, wholesale distribution, and construction companies presented in this report.

  In these comparisons, three-year costs for System i deployment scenarios range from 35.5 percent to 52.9 percent less, and average 43.1 percent less than those of Windows server-based equivalents. Costs include hardware acquisition and maintenance, software licenses and support, system and database administration personnel, setup, and facilities.

  Costs were also calculated for Windows server-based scenarios including use of VMware ESX. Three-year costs for these were marginally less than for "pure" Windows server-based scenarios. Although there were some savings in hardware and full time equivalent (FTE) staffing levels, these were largely offset by additional software costs and higher administrator salaries.

  Three-year costs for System i scenarios range from 29.5 percent to 43.5 percent less, and average 36.3 percent less than those of Windows server-based scenarios including use of VMware ESX.

A broader benefit may also be realized. The combination of All-in-One and the System i allows small and midsize businesses to realize state-of-the-art ERP capabilities, while materially reducing the technical complexities and risks to which they exposed. This combination also enables them to deliver a quality of IT service that in the past has been enjoyed only by larger organizations.

The System i may not be attractive to all organizations that plan to deploy All-in-One solutions. But, the value proposition for this platform is sufficiently compelling that the option should be seriously reviewed.

VALUE PROPOSITION

IBM System i and SAP

The System i platform is a long-established feature in the SAP world. More than 1,500 organizations worldwide run their core SAP systems on this platform, and the installed base continues to expand. The vast majority are small and midsize businesses representing a broad range of industries.

For more than a decade, SAP and IBM have cooperated in development and support for the System i platform. Key features of the System i operating system, i5/OS, and of the DB2 database that forms part of it have been closely optimized for SAP environments.

DB2, which also runs on a wide range of other IBM and non-IBM platforms, is SAP's "preferred and recommended" database for its ERP 6.0 generation of solutions, upon which All-in-One is based. The two companies have agreed to coordinate not only development activities, but also future solution upgrade and maintenance cycles.

Cooperation extends to the All-in-One solution set. IBM System i Solution Edition offerings are preconfigured and tuned specifically for All-in-One environments. Project Kobi, which is funded and managed jointly by SAP and IBM, delivers in-depth assistance in configuration, assurance, and support to third parties offering System i-based SAP All-in-One solutions.

While the System i enjoys strong backing from SAP and IBM, its core value proposition for All-in-One users is that it builds upon distinctive capabilities that have been long valued by small and midsize users with small IT staffs and limited resources.

The following sections present additional information on and analysis of the System i value proposition in three areas: (1) core capabilities; (2) high availability; and (3) security and protection against viruses and other forms of malicious code ("malware").

User survey results are presented, and System i technology differentiators are detailed. The report concludes with an in-depth account of cost comparisons and of the methodology used to develop these.

Core Capabilities

General Picture

For more than 20 years, the System i and its predecessors have been among the most popular platforms employed by small and midsize companies to run their core business systems. More than 250,000 are installed worldwide.

The continued appeal of the System i reflects multiple factors. One is that this platform has evolved to integrate new technologies. It is based on the IBM POWER reduced instruction set computing (RISC) processor technology, a recognized industry performance leader. It supports the principal open systems standards, including SQL, Java, the full Internet protocol stack, and Service Oriented Architecture (SOA). There have been no lags in technological currency.

A second factor has been that the characteristics of the System i make it particularly attractive to organizations that cannot afford to maintain large IT staffs. The basic system design, along with a highly integrated operating environment, simplified administrator interfaces, and extensive automation mean that many tasks that would require manual intervention in other server environments are handled automatically by the system.

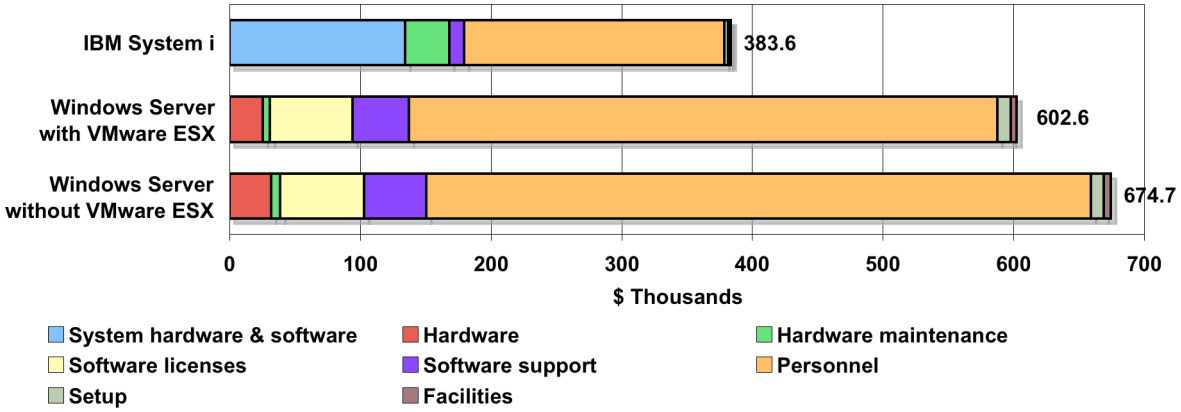
The most visible effect is that staffing levels are a great deal lower than for competitive platforms. The industry norm, for example, is that Windows servers supporting ERP systems require two to three times more full time equivalent (FTE) system and database administrators (DBAs) than System i platforms.

Setup costs, including hardware and software configuration, installation, and test, are also significantly lower for the System i platform. Auto-install capabilities as well as the overall integration of the i5/OS environment were said to allow for comparatively rapid and trouble-free setup of ERP solutions.

As a general principle, System i hardware and software acquisition costs are higher than for Windows servers and software. Over time, however, disparities in this area may be more than offset by lower System i personnel, support, and facilities costs. Initial installation costs may also be lower. This is the case regardless of whether VMware ESX is employed.

In the profile-based comparisons, average three-year costs were distributed as shown in figure 1.

Figure 1
Profile Companies: Average Three-year IT Costs for SAP All-in-One Deployment for IBM System i and Windows Server Scenarios



In these comparisons, "street" prices (i.e., discounted prices actually paid by users) are employed for hardware and software acquisition, hardware maintenance, and software support.

These calculations assume that software stacks remain stable throughout the three-year measurement period. This may not be the case in practice. Windows server users, in particular, often find that additional tools and utilities must be added to provide functionality equivalent to that incorporated into i5/OS.

Profile descriptions, as well as breakdowns of configurations, FTE staffing, and costs for individual companies may be found in the Detailed Data section of this report. The methodology and assumptions used for cost calculations are also presented in this section.

VMware ESX Implications

There has been interest among current as well as prospective SAP users in the use of VMware ESX virtualization tools with All-in-One solutions. The question is raised: would use of these materially improve the cost/benefit case for Windows servers relative to the System i platform?

VMware ESX, which is now supported by SAP, enables organizations to run multiple applications on the same physical Intel-based server using guested instances of Windows or Linux operating systems. The focus in this report is on use with Windows.

Interest in VMware ESX in the SAP world has been driven largely by its potential for improving server capacity utilization through physical consolidation and pooling of resources. VMware ESX is seen as a means of avoiding the use of separate Intel-based servers employed for production as well as development, test, quality assurance (QA), training, and other non-production functions.

For small and midsize companies, however, a number of caveats are in order. They include:

- ***Functionality***. VMware ESX provides an alternative means of hosting Windows server environments using fewer physical servers. In itself, VMware ESX does not provide significant new functionality for SAP All-in-One solutions.

  Organizations still employ Windows systems software, SQL Server databases, and other Microsoft components. The characteristics of the Windows server environment – including the weaknesses of this compared to the System i platform – are largely unaffected.

- ***Complexities and costs***. Use of VMware ESX adds a second operating system to Windows server installations and creates guested, multi-layer software environments with significantly different administrative requirements. Both effects may materially increase the technical complexities with which organizations must deal.

  There are also additional license and support fees, and personnel costs may increase – the current industry norm is that salaries for Windows administrators with VMware skills are approximately 15 percent higher than for those without. As demand for VMware ESX skills is growing rapidly among large users, it may also be difficult for smaller companies to retain experienced staff.

  The central issue for small and midsize companies is thus not whether it would be useful to consolidate servers. It is whether the benefits of doing so would outweigh the negatives. Which brings us to the next caveat.

- ***Server demographics***. VMware ESX has appealed strongly to large organizations with from hundreds to thousands of SAP servers.

  In announcing SAP production support for VMware ESX in December 2007, for example, the two companies cited the experiences of users such as SAP Hosting (with more than 5,000 SAP systems) and T-Systems (with more than 2,000 SAP systems) with VMware. In these and other large installations with numerous SAP systems, the economics of consolidation are attractive.

  The value of this approach for small and midsize businesses is, however, less clear. All-in-One users, in particular, often run only one production instance and one development, test, and QA instance. For such users, consolidation gains would be, at best, incremental.

  In such environments, it is unclear whether production and non-production instances of SAP systems should be hosted on the same physical server. Like any software-based virtualization tool, VMware ESX generates additional system overhead when hosting multiple system instances, and this overhead expands as the number of instances increase.

  Experience with VMware ESX for other, typically light-duty types of application has been that processor overhead is typically 10 percent to 30 percent. With SAP solutions, however, overhead appear to be higher, and there are still uncertainties as to what actual performance would be like.

  These uncertainties are reflected in the results of benchmark tests conducted using SAP Sales and Distribution (SD) metrics, which are a generally accepted means for comparing the performance of servers running SAP ERP workloads.

Figure 2 summarizes results for tests run with and without VMware ESX on the same hardware platforms with Windows Server Enterprise Edition and SQL Server 2005. Tests were certified by SAP between December 2006 and November 2007.

Figure 2
Recent SAP SD Benchmark Results

Server Configuration	VMware Results	Non-VMware Results
Hewlett-Packard ProLiant BL460c, 2 processors / 8 cores / 8 threads, Quad-Core Intel Xeon Processor X5355 2.66 GHz 64 KB L1 cache per core & 4 MB L2 cache per 2 cores, 32 GB RAM	402 SD Users 2,070 SAPS	1,841 SD Users 9,230 SAPS
Fujitsu Siemens Computers PRIMERGY Model TX300 S3/RX300 S3, 2 processors / 8 cores / 8 threads, Quad-Core Intel Xeon Processor X5355 2.66 GHz, 64 KB L1 cache per core & 4 MB L2 cache per 2 cores, 32 GB RAM	420 SD Users 2,150 SAPS	1,865 SD Users 9,330 SAPS
Dell PowerEdge 2950 (with VMware ESX) & 2900 (without VMware ESX), 2 processors / 8 cores / 8 threads, Quad-Core Intel Xeon Processor X5355 2.66 GHz, 64 KB L1 cache per core & 4 MB L2 cache per 2 cores, 32 GB RAM	421 SD Users 2,130 SAPS	1,610 SD Users 8,180 SAPS
IBM System x3755, 2 processors / 4 cores / 4 threads, AMD Opteron Processor 8220SE 2.8 GHz, 128 KB L1 cache & 1 MB L2 cache per core, 16 GB RAM	445 SD Users 2,230 SAPS	1,980 SD Users 9,920 SAPS

Although VMware ESX can in principle support four virtual CPUs and up to 32 physical cores, SD benchmark tests are run with only two virtual CPUs and two active cores. Performance levels are only a fraction of those achieved on the same hardware without VMware ESX.

Performance constraints may not be a major issue if VMware ESX is employed only to co-host comparatively light-duty non-production instances. However, except in very small installations, it may not be feasible to run production and non-production instances on the same physical server without unacceptable performance degradation.

It would thus be necessary to employ at least one additional physical server for development, test, and QA. Moreover, there may be cases where it would not be feasible to run even multiple non-production instances on the same machine. With such constraints, server consolidation may offer little or no benefit to small and midsize businesses.

- ***Risk exposure***. Moving to a new ERP system is a challenging and potentially risky process for any small and midsize business. More than a decade of experience with SAP deployments has shown that greater technical complexity increases implementation difficulties and magnifies risks of functional shortfalls, project delays, and cost overruns.

  Risk exposure would be further expanded by employing a software environment that is new to the SAP world and with which there is, as yet, very little production experience. Moreover, VMware ESX skills for SAP deployment are in short supply, and qualified personnel will tend to be attracted to larger, more lucrative corporate projects.

  "Early adopter" risks may be acceptable to large organizations. Small and midsize businesses are, however, less well-equipped to deal with the problems that may occur when comparatively immature and untried technologies (which is the case for VMware ESX employed for SAP solutions) are put in place by personnel with little or no experience in implementing these.

In comparison, the System i platform offers more sophisticated virtualization capabilities that form an integral part of the i5/OS operating environment, and may be managed as such.

Logical partitioning (LPAR) capability, for example, is built into System i microcode, resulting in low processor overhead. It is also supported by other forms of System i virtualization.

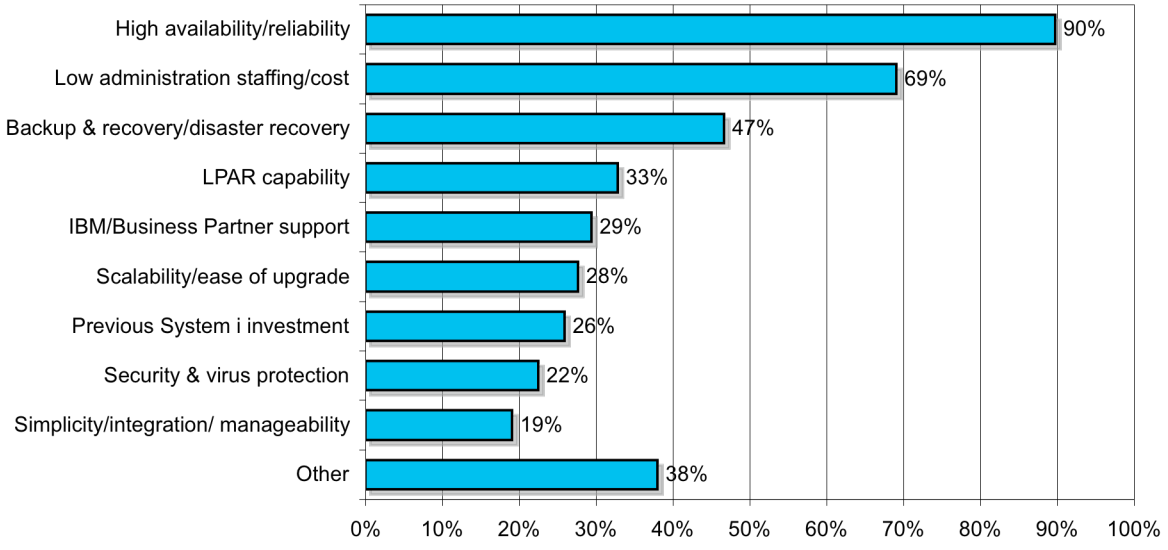
LPARs, as well as related System i capabilities, have been routinely and successfully employed by small and midsize businesses for SAP solutions for more than a decade. Many employ only a single platform.

System i virtualization capabilities, however, are only part of the business case for this platform. The strengths of the System i in availability (meaning the ability to maintain high levels of system uptime for long periods), backup and recovery, security, virus protection, and other areas have also proved valuable to small and midsize companies.

High Availability

Among the System i SAP users surveyed for this report, high availability was, as figure 3 shows, the most commonly cited benefit of deploying SAP solutions on the System i. It was mentioned by companies of all sizes, in all industries, in all geographies.

Figure 3
Benefits of SAP All-in-One Deployment on IBM System i: User View



Base: 58 organizations

Source: International Technology Group

The System i was variously described as "stable…highly stable…exceptionally stable…solid… dependable… robust…very robust…very reliable…highly reliable…extremely reliable" by survey respondents. Others cited "excellent reliability…very high availability…superior availability…excellent availability…outstanding availability…99.99 percent availability…virtually 100 percent availability" and equivalents.

Why do these strengths matter to small and midsize companies? The question may be simply answered. Literally decades of experience have demonstrated that companies become fundamentally dependent on their ERP systems. Because most or all key business functions are handled by a single integrated system, if the system stops, so does the business.

Respondents repeatedly commented on the importance of avoiding such disruptions. A manufacturing company manager observed, "Without SAP, our production lines would stop, so this is vitally important." Another noted, "We cannot operate without SAP… We absolutely cannot afford downtime."

A third, whose business was primarily build-to-order, reported that it commonly received "rush" orders that had to be completed and delivered to customers within a matter of days to weeks. A serious outage during this window could lose the order. A distributor commented, "We deliver product every day…our trucks must roll out of the gate every morning on time."

For food and beverage companies, outages could cause serious spoilage of goods. One supplier commented, "Some of our products have a shelf life of three days… We can't afford to have the system down." Another observed that downtime could leave products "rotting on the dock."

For many companies, the effects of an outage during peak periods could be particularly damaging. A specialty retailer noted, for example, that more than 40 percent of the company's annual sales volume occurred in the six weeks before Christmas. The impact of an outage during this period could result in serious stockouts. Moreover, the effects could extend for days if supply chain disruptions prevented products reaching stores in sufficient quantity.

Many other such examples could be cited. Companies were, it should be noted, not large. Most had fewer than 1,000 employees. However, even companies with less than a hundred employees commented on the business impact of outages.

There was widespread agreement that availability demands were increasing. This was due to a number of trends. They included:

- ***Competitive pressures***. Companies of all sizes noted that customers increasingly expected that they should be able to place orders; inquire about products, pricing and inventory availability; and interact with them at any time, on a round-the-clock basis.

  In certain industries, such as manufacturing, distribution, and retail, efforts to control inventory costs also contribute to availability pressures. A company with few or no inventory "buffers" is inevitably more vulnerable to outages than one that maintains large surplus stocks. It will be more difficult to meet customer commitments in the event of a disruption.

  The result of outages may be loss of sales, late delivery and imperfect order fees, and other penalties. The largest bottom-line impact, however, could be customer defections. Suppliers who develop a reputation for unreliability tend not to enjoy healthy futures.

- ***Globalization***. Most of the companies surveyed operated internationally, or employed offshore suppliers, foreign distributors, or both. Increasingly, globalization is an issue for small and midsize businesses.

  For example, a 200-employee manufacturer interacted with customers and distributors in more than 60 countries. A 400-employee company operated plants in Germany, France, and the United States, and sourced many of its components from China. A distributor noted, "We sell worldwide, and there's order activity 24 hours a day."

  In these and many other small and midsize companies, certain processes – including order processing, procurement, logistics and, in some cases, customer service – are moving to a 24x7 operating model even if this is not the case for other business operations.

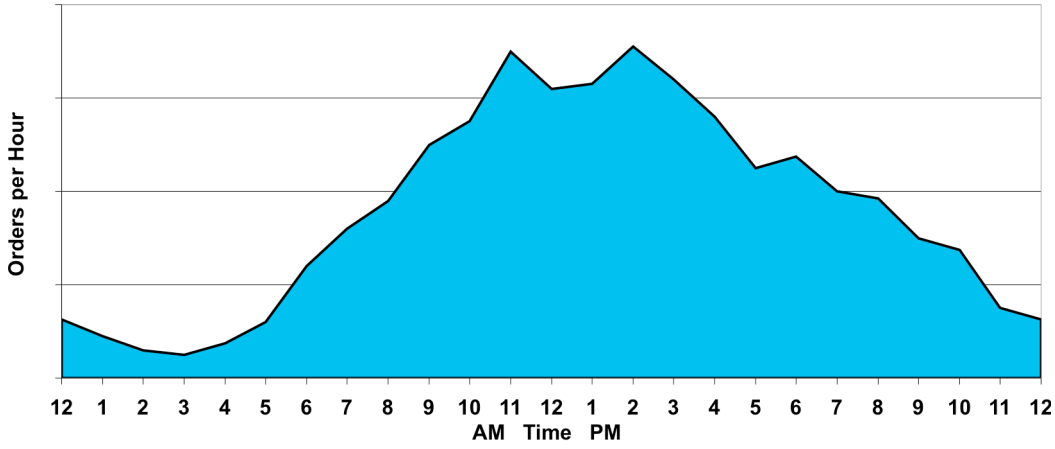
- ***Internet applications***. The trend across most of the industries in which All-in-One is employed is toward greater use of Internet customer and supplier self-service systems.

  Almost by definition, the Internet is a 24x7 medium, and the expectation is increasingly that online systems should be accessible at any time. Internet systems often experience some level of activity at all hours of the day and night, and on weekends and public holidays. Any outage at any time may affect customers.

  The implications of this may be illustrated by the experience of a consumer goods distributor surveyed for this report.

  Many of the company's customers were small retailers whose principals worked in their stores and did not have time to check inventories and place orders until after closing. A growing number of customers were staying open until late in the evening or operating on a 24-hour basis. Figure 4 shows the frequency of online orders placed with the company over a 24-hour period.

Figure 4
Online Order Activity: Distributor Example



  Inability to access the company's online system at any time could result in lost sales for customers as well as for the company itself.

These examples highlight a broader principle. A customer who experiences an outage – either directly (e.g., because an Internet self-service or call center system is down) or indirectly (e.g., because the company's ERP systems are not functioning) will inevitably be dissatisfied.

Customer dissatisfaction translates into customer loss. Even if defections cannot be tied to any specific negative experience, service quality shortfalls contribute to overall levels of satisfaction or dissatisfaction, which in turn affect attrition rates. Lost future business may be substantial.

Security and Malware Protection

In this area, the differences between the System i platform and Windows server environments are more than significant. They are dramatic.

Windows is the operating system most frequently targeted – and penetrated – by hackers worldwide. During 2007, for example, the U.S. National Vulnerability Database, operated by the National Institute of Standards and Technology (NIST), recorded 17 new vulnerabilities for Microsoft Windows Server 2003. Of these, seven were rated as "high vulnerability," the NIST category for the most severe exposures.

In comparison, the NIST database has recorded no vulnerabilities for i5/OS or its predecessor, OS/400, since collection of statistics began in 1992. Although there are variations in definition of vulnerabilities, other security sources confirm wide disparities between Windows and i5/OS.

Similarly, there are more than 100,000 known Windows viruses, and the number of these, along with other forms of malware such as worms, Trojans, bots, and spyware, is increasing rapidly. Industry experience has been that an unprotected Windows server exposed to a network will typically be infected within a matter of minutes.

In comparison, there are no known native i5/OS viruses. This is, to some extent, because i5/OS is less well known. Distinctive System i characteristics also, however, result in a level of vulnerability that is significantly lower than that for Windows server environments.

There are dual benefits:

1. ***Reduced exposure***. System i users are less exposed to the disruptions that may be caused by security violations or malware damage and to the business and legal consequences that may occur if sensitive customer, partner, or employee data is compromised.

   This is becoming an increasingly important issue. Security authorities worldwide report that both system intrusions and malware attacks are becoming more prevalent and sophisticated over time, and that small and midsize companies are increasingly targeted.

   Companies surveyed noted that growing Internet use was increasing their exposure. One company noted, for example, that it dealt online with hundreds of customers worldwide. The company had recently experienced two serious hacking attempts, and virus exposure was "continuous." The company's System i was unaffected.

2. ***Time and cost savings***. A great deal of time is spent by Windows system administrators applying software patches to protect against newly discovered security and malware vulnerabilities. During 2007, for example, Microsoft issued 33 such patches (they are released in monthly batches) for Windows Server 2003, the operating system used in comparisons in this report.

   The industry "rule of thumb" is that it takes at least two hours to apply a patch to a single server. A company that deployed All-on-One on Windows servers would typically employ at least two to four of these. If the number of Microsoft patches were the same as in 2007, administrators could expect to spend at least 132 to 264 person-hours a year on this task. The amount of time required could be significantly higher.

   (It should be noted that use of VMware ESX does not materially affect this picture. Multiple virtual Windows servers running on a single physical platform still represent multiple targets. Moreover, VMware itself may attract malware.)

   Among the companies surveyed, there was general agreement that System i patching requires only a fraction of the time of Windows server environments. One respondent noted, "We spend maybe 50 (person-hours) a month patching our Windows (servers)… With the (System i), we do one or two a year, and that's strictly as a precaution." For another, application of System i patches required "a few hours a year."

The dual benefit equations also apply to other areas of System i capability. High levels of integration and automation, for example, lower personnel costs as well as facilitate uptime by reducing the potential for administrator and operator errors causing outages, data loss, or both. Backup and recovery processes become more reliable for the same reason. Other such examples could be cited.

USER VIEW

Survey Results

What is the appeal of the System i for SAP deployment? The survey of small and midsize businesses conducted for this report offers answers.

The following benefits were cited:

- ***High availability***. The ability of the System i to operate for long periods without outages was cited by 52 of out of 58 companies (90 percent) as a central benefit of deploying SAP solutions on this platform.

  One company reported that it had used the System i and its predecessors for more than 10 years and had never experienced an unplanned outage. Another observed simply that some long-time members of the company's IT team "remembered a two-hour (unplanned) outage in the 1990s," but that there had been none since then. Others made similar comments.

  There was general agreement that System i availability levels were significantly higher than for Windows servers. Nine companies that employed Windows servers for file/print serving, hosting Web sites and intranets, e-mail, and other applications commented on higher System i uptime.

  Two companies that had migrated from Windows server-based ERP systems to SAP on System i confirmed this picture. One commented that with the System i "downtime has been enormously reduced." The other observed, "Downtime has been virtually eliminated."

- ***Low administration staffing/cost***. The second most commonly reported benefit of employing the System i was the low administrative staffing required for this platform. This was reflected in the comparatively small number of personnel required to handle system administration, database administration, and related tasks. Personnel costs were correspondingly lower.

  Overall, 40 of 58 of companies surveyed (69 percent) cited low System i administrative staffing levels. As figure 5 illustrates, System i advantages in this area were particularly valued by companies with fewer than 100 users. Of the 11 companies in this size bracket, nine (82 percent) found this characteristic of the System i platform to be a central benefit.

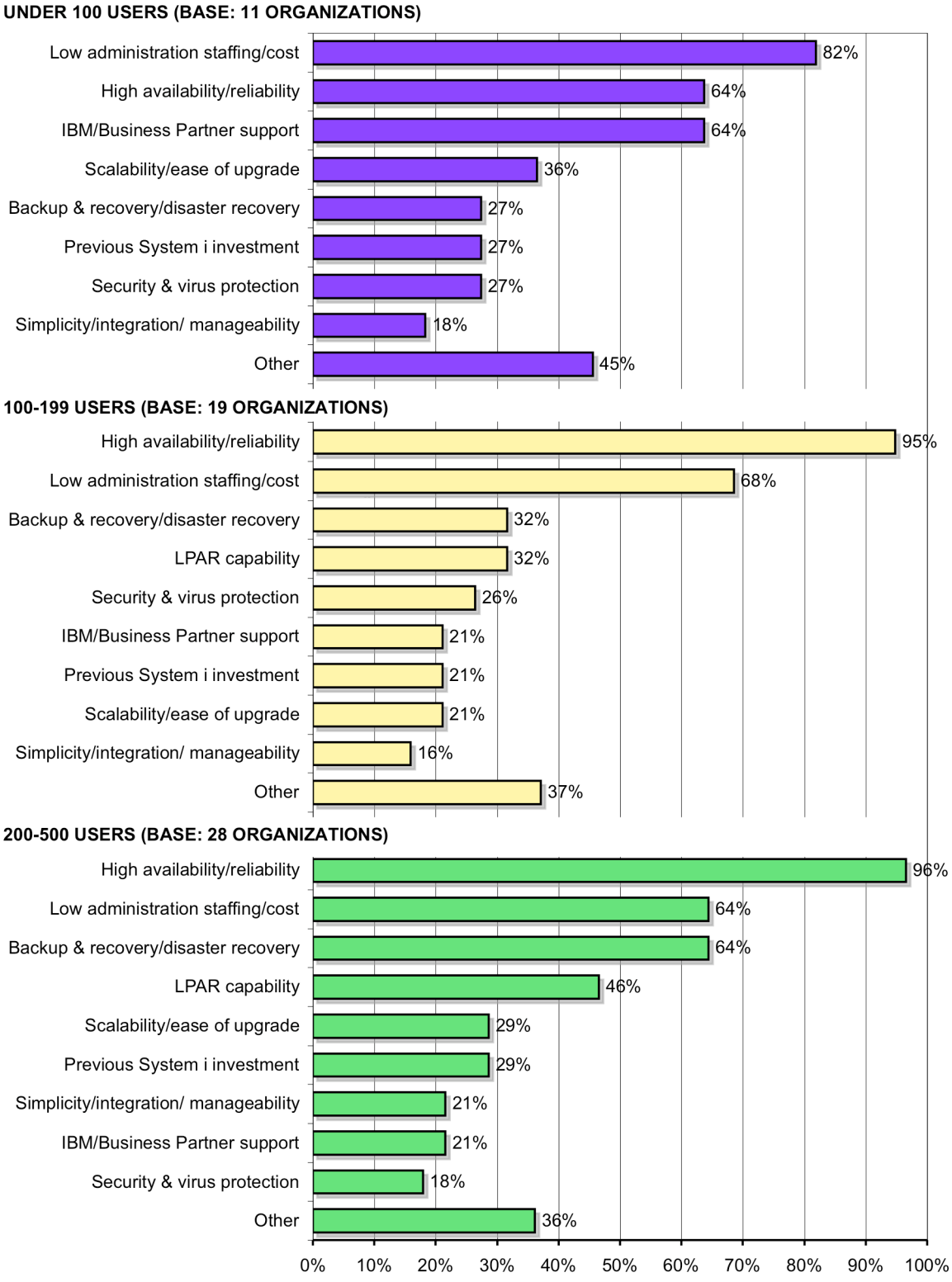
  IT teams were typically small (one to four people) and, it was repeatedly noted, overworked. The ability to minimize routine administrative tasks not only resulted in smaller numbers of personnel, but also enabled staff to (to quote one respondent) "get on with more important jobs."

  System i administrative staffing levels were contrasted favorably with Windows server equivalents. A common observation, for example, was that more administrators were required to support comparatively simple Windows server functions such as file and Web serving than to support System i platforms running complex, organization-wide SAP solutions.

  One company that had deployed a SAP ERP system on the System i reported that it was able to handle all IT tasks with a team of three people. The company had considered moving to Windows servers, but had rejected the option after calculating that would have required additional hires for SQL Server and Windows administration.

Figure 5

Benefits of SAP All-in-One Deployment on IBM System i: Responses by Installation Size



Source: International Technology Group

Another company commented that it would have been required to increase its SAP administration staff from one to two FTEs. A third calculated that the increase would be from two to three or four. Others reported similar ratios. Most estimates put the number of Windows administrators in the range of two to three times higher than for System i platforms.

Differences in DBA staffing were also commented on. There was general agreement that DBA tasks for System i DB2 databases were simpler and less time-consuming than for SQL Server or Oracle environments.

Most System i users did not employ a dedicated DBA – database administration was handled by the same individuals who handled system administration, application development, and other tasks. Even small companies, however, reported that they would have required a dedicated DBA if SQL Server or Oracle were employed.

One company noted, "Hiring another person to serve as a DBA was not possible." Another noted simply, "We can't afford a DBA."

In addition, 11 companies (19 percent) cited System i "simplicity," "integration," "ease of management," and equivalents as benefits of deploying SAP solutions on this platform.

- ***Backup and recovery capability.*** System i capabilities in this area were cited by 27 companies (47 percent). Backup and recovery capabilities were particularly valued by larger organizations. Among companies with 200 or more users, 18 of 28 (64 percent) reported that the backup and recovery strengths of this platform were a benefit.

  Among companies of all sizes, however, the ability to perform backup operations rapidly was seen as a useful means of improving availability. The ability to restore systems and recover data quickly in the event of a serious outage was seen as critically important.

  Users mentioned a number of System i features as enabling highly effective backup and recovery. These features included Save While Active, Remote Journaling, Independent Auxiliary Storage Pools (IASPs), and third-party clustering solutions.

  There was general agreement that System i backup and recovery strengths were superior to those of Windows server environments.

  One company reported that, in their experience, System i failover was a great deal more reliable than that of Windows-based systems. Another noted that IASPs provided capabilities that were not only more reliable, but also were less expensive than Windows-based clusters.

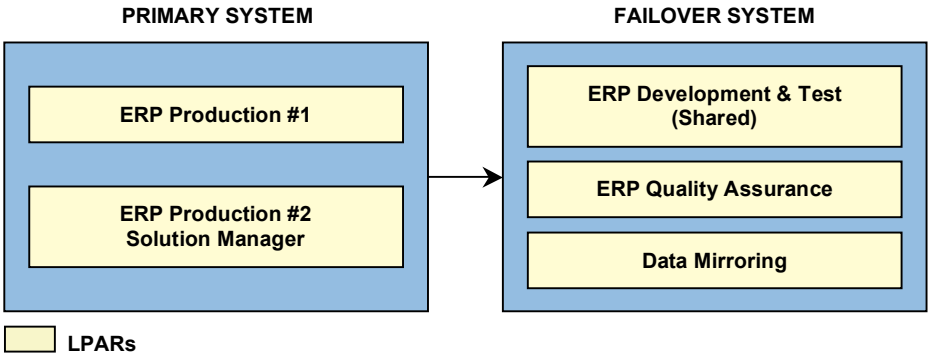
- ***LPAR capability***. The ability to deploy multiple SAP instances on a single System i physical platform using LPARs was cited by 19 companies, or one third of the total.

  The most common approach was to use LPARs to co-host production as well as development, test, and QA instances of SAP solutions on the same platform. Companies also employed LPARs to host i5/OS-based Domino e-mail and groupware, along with Linux applications.

  Some larger organizations employed LPARs to co-host multiple SAP production instances. One company, for example, had deployed separate ERP instances supporting two different divisions, along with SAP Solution Manager in LPARs on its primary production platform.

  A second System i platform employed LPARs to act as a failover system and to host development, test, and QA instances. Figure 6 illustrates this configuration.

Figure 6
IBM System i SAP Configuration Using LPARs: Example



Comparable approaches had been adopted by other companies for SAP ERP, Business Intelligence (BI), Customer Relationship Management (CRM), Advanced Planning and Optimization (APO), and other systems.

For all of these applications, use of LPARs was said to reduce system administration workloads. Backup and recovery processes were also facilitated, because it was not necessary to replicate these across multiple platforms.

- ***IBM and Business Partner support***. The quality of support available from IBM and from IBM Business Partners supporting SAP on the System i was referenced by 17 companies (29 percent).

  This was a particularly significant issue among smaller businesses. Among companies with fewer than 100 users, this support was cited by 7 of 11 (64 percent).

  Among larger users, quality of support was notably cited by companies that maintained systems in multiple geographies. Systems integrators specializing in the System i, it was said, were better able to handle global support requirements.

- ***Scalability/ease of upgrade***. The comparative ease with which System i capacity could be upgraded to handle workload growth was commented on by 16 companies (28 percent) as a benefit of employing this platform. These included companies that were expanding, or expected to expand through organic business growth, mergers or acquisitions, or both.

  Companies also cited the need to deal with exceptional workload peaks. Retailers, for example, referred to Christmas and other peak sales periods. Others had to deal unpredictable demand patterns. A build-to-order manufacturer noted, for example, that its workloads could double or triple with little advance notice.

  There was general agreement that System i scalability was superior to that of Windows servers. For example, one respondent noted that, if the latter were employed, growth could be handled only by installing new, more powerful servers. In contrast, even small System i models could be upgraded to handle "orders of magnitude" of workload growth.

- ***Previous System i investments***. The ability to leverage previous investments in System i infrastructures and skill bases was valued by 15 companies (26 percent) as a benefit of deploying SAP solutions on this platform.

The appeal of the System i to this group was in part that they were able to avoid radical changes in skill sets. Although SAP deployment involved major changes in some areas of IT competence, basic system, storage, and DB2 database administration skills were reported to be generally transferable to System i-based SAP environments.

Companies, moreover, could continue to employ System i-based infrastructures for data center operations, backup and recovery, and other functions. This was the case even if older AS/400 or iSeries processors were replaced as primary production systems. Companies often retained these as development or backup systems, or both.

It was noted that moving to SAP solutions was, under any scenario, a difficult and potentially risky process. However, challenges could be reduced by leveraging existing skill sets and minimizing the degree of change in underlying system infrastructures. This was particularly attractive to companies with limited resources.

Four companies continued to employ some legacy RPG- or COBOL-based applications alongside SAP solutions. The ability to host these on the same platform was reported to facilitate interoperability and to enable better utilization of staff time and skills than if multiple platforms were employed.

- ***Security and virus protection***. System i strengths in these areas were cited by 13 companies (22 percent). The responses of this group were discussed earlier in this report.
- ***Simplicity, integration and manageability***. These characteristics of the System i platform and i5/OS environment were cited by 11 companies (19 percent). Responses overlapped with those citing low System i administrative staffing levels.

  The comparative ease with which DB2 databases could be configured and tuned was particularly commented on. A respondent at one company that had previously deployed a Windows-based SAP system noted that it was easier to install DB2 than SQL Server.

In addition, System i Windows server integration capabilities were referenced as a benefit by four companies. These employed IBM technologies such as the Integrated xSeries Servers (IXSs) and Integrated xSeries Adapters (IXAs), as well as newer IBM offerings enabling iSCSI attachment of BladeCenter servers to System i hosts. These were employed for Windows file, print, Web, e-mail, and domain serving, and as firewalls. Companies also commented on the ability to deploy Linux applications in System i LPARs.

In several cases, multiple capabilities were employed to facilitate server consolidation initiatives. One company, for example, had employed a mix of IXS, iSCSI, and LPAR technologies to consolidate 13 separate Windows servers.

Other benefits were reported to include performance advantages for specific SAP applications and workloads; lower hardware and software license costs compared to Windows servers; and specific System i workload management capabilities.

Survey Demographics

The survey population included 34 manufacturing, 15 wholesale distribution, and 9 retail companies, located in Europe (31), North America (20), Latin America (2), and the Asia/Pacific region (5).

TECHNOLOGY DIFFERENTIATORS

System Architecture

From a system architecture perspective, the System i platform incorporates multiple elements. These include a distinctive basic system design; a highly integrated operating environment incorporating database management and other components; and advanced partitioning and virtualization, system and workload management, and autonomic features.

This architecture has evolved in a manner that is significantly different from that of Windows and UNIX servers. There are major differences in the following areas:

- ***System design***. The core System i design, which is derived from the earlier IBM System/38 and AS/400, is built around an object-based kernel in which all system resources are defined and managed as objects.

  The kernel also incorporates single-level storage capability – meaning that the system treats all storage resources, including main memory and disks – as a single logical entity. These may be exploited transparently by applications, regardless of physical type and location. In addition, key components of the i5/OS operating environment are implemented in microcode.

  These features enable high levels of configuration flexibility and materially improve the efficiency with which processor and storage resources are used, with corresponding benefits in performance and capacity utilization.

- ***System integration***. The i5/OS environment includes not only core operating system functions, but also the DB2 database management system; WebSphere Application Server; and tools for system, storage, backup and recovery, communications, security, operations, and other management tasks. These are closely integrated and share common administrator interfaces.

  Equivalent functionality in Windows server environments typically requires that users acquire, install, configure, and administer multiple software products, often sourced from different vendors. This increases deployment complexity, and tends to create integration and administration challenges that are greater than those faced by System i users.

- ***Automation***. The high levels of automation built into the i5/OS environment are reinforced by advanced autonomic capabilities.

  Autonomic computing – meaning the application of artificial intelligence technologies to IT administration and optimization tasks – has been a major IBM development focus since the 1990s, and the company is the clear industry leader in this area. The System i platform benefits from the one of the most extensive implementations of autonomic technologies within the IBM product line.

  There are four categories of System i autonomic functions: self-configuring; self-optimizing; self-protecting; and self-optimizing. These functions, summarized in figure 7, extend across i5/OS and DB2 and are embedded into major hardware components and subsystems.

Figure 7
IBM System i Autonomic Functions

SYSTEM	
Self-configuring	**Self-protecting**
Connect automated services CPU capacity upgrade on demand Enterprise Identity Mapping EZSetup Wizards Hot plug disk & I/O Linux & Windows Virtual I/O RAID subsystem Switchable auxiliary storage pools Windows NetServer file/print support Windows dynamic storage addition Wireless system management access	Automatic virus removal Chipkill Memory Digital certificates Digital object tagging Enterprise Identity Mapping Integrated Kerberos support Integrated SSL support IP takeover RAID subsystem Self-protecting kernel Tagged storage
Self-optimizing	**Self-healing**
Adaptive e-transaction services Automatic performance management Automatic workload balancing Dynamic disk load balancing Dynamic LPAR for i5/OS & Linux Expert Cache Global resource manager Heterogeneous workload manager Quality of service optimization Single-level storage	ABLE problem management engine Auto-fix defective PTFs Automatic performance adjuster Chipkill Memory, dynamic bit steering Concurrent maintenance Domino auto restart, clustering Dynamic IP takeover, clustering Electronic Service Agent (“call home”) First-failure data capture & alerts Service director
DATABASE	
Self-configuring	**Self-protecting**
Automatic collection of object relationships Automatic data striping & disk balancing Automatic distributed access configuration Automatic object placement Automatic self-balancing indexes Automatic TCP/IP startup Graphical database monitor	Automatic enforcement of user query limits Automatic enforcement of user storage limits Digital object signing Object auditing OS-controlled resource management
Self-optimizing	**Self-healing**
Automatic Index Advisor Automatic memory pool tuning Automatic query plan adjustment Automatic rebind & reoptimization Automatic statistics Caching of open data paths & statements Cost-based Optimizer	Automatic access path protection Automatic backup/restore of database objects Automatic database object extents Automatic database restart Automatic system-managed journaling First-failure data capture & alerts

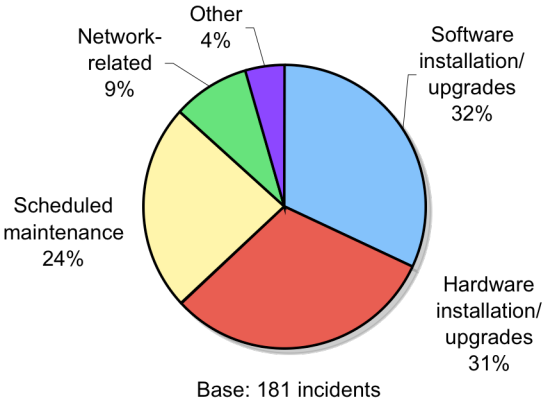
High Availability

Maintenance of high levels of system availability over long periods can be a challenging process. Organizations must deal with risks of unplanned outages caused by hardware and software failures, administrator and operator errors, workload spikes that overload systems, hacker attacks, virus damage, and other factors. Vulnerability to these may vary widely between platforms.

Unplanned outages can be highly disruptive, particularly if they occur during periods of peak business activity. The majority of downtime, however, will be due to planned outages for such functions as hardware, operating system, database, and applications software upgrades; database reorganization; and scheduled hardware and software maintenance.

Like unplanned outages, planned downtime tends to be platform-dependent. In a Windows server environment, for example, frequent planned outages will typically be required for hardware and software upgrades, including patching, preventative maintenance, and other functions. Figure 8 illustrates these.

Figure 8
Representative Causes of Planned Outages: Windows Servers



Base: 181 incidents

Source: International Technology Group

Avoidance of both types of outage is a central design parameter of System i architecture. Distinctive capabilities are implemented at multiple levels.

At the most basic level, these include industry-leading embedded reliability, availability, and serviceability (RAS) features, which are in many cases derived from mainframe systems. High levels of redundancy, along with monitoring, diagnostic, and fault isolation and resolution facilities are built into all major components and subsystems.

Operating system-level capabilities include Remote Journaling (file and system changes may be automatically copied to a second server); Save While Active (backups may be performed without taking systems offline); Independent Auxiliary Storage Pools (data may be mirrored to remote site systems); and Clustering Management Services, which are embedded into i5/OS and leveraged by third-party solutions.

LPARs further contribute to reduction of planned outages. Software modifications may be made, and new versions installed and assured, without disrupting operations. Backups may also be performed, and batch workloads executed concurrently with mainstream processes.

Concurrent maintenance ("hot plugging"), dynamic microcode upgrades, LPARs, and other capabilities also reduce requirements for planned outages.

Generally similar capabilities may be implemented for Windows servers. There are, however, a number of key differences. One is that System i hardware-, microcode-, and software-based facilities are closely integrated and optimized. This not only increases overall reliability, but also greatly simplifies problem identification and resolution processes.

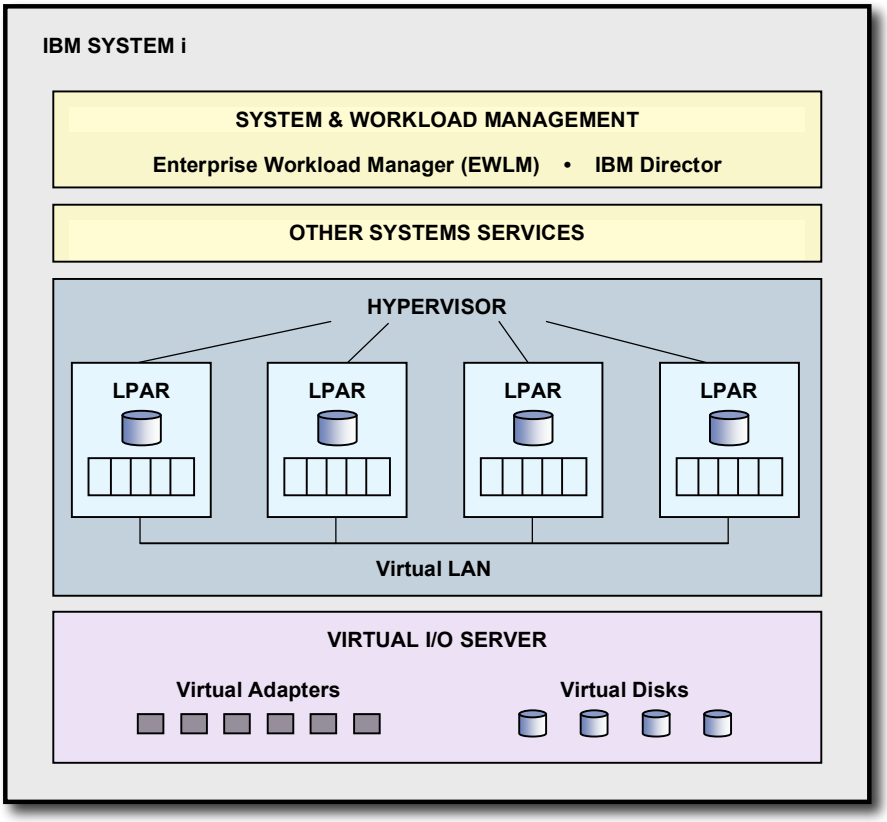
Windows server availability challenges are magnified by the fact that organizations must deal with hardware and systems software components from multiple vendors (particularly if VMware ESX is employed). There are more potential points of failure. Moreover, availability mechanisms are less well integrated, and problem identification and resolution are more complicated and time-consuming.

A second major difference is that the technical complexities of Windows server environments are significantly greater than those of System i platforms. High availability and recovery facilities must be overlaid on more complex underlying configurations. The overall solution will tend to be less stable and require greater expenditure, higher staffing levels, or both.

Partitioning and Virtualization

System i capabilities in partitioning and virtualization are implemented at multiple levels, and are closely integrated with other components of the System i platform. These capabilities are illustrated in figure 9.

Figure 9
IBM System i Partitioning and Virtualization Capabilities



LPARs enable users to host multiple operating system instances and applications on a single physical platform and to better manage and balance diverse workloads across the system. Resources may be allocated and re-allocated dynamically between partitions, enabling organizations to achieve high levels of capacity utilization.

The System i architecture can support up to 254 LPARs using the microcode-based Hypervisor. Up to 20 and 40 LPARs respectively are supported on the System i models 525 and 550 employed for cost comparisons in this report.

LPARs are commonly used to host development, test, and production instances on the same system; to perform software updates and other tasks without taking systems offline; and to consolidate multiple production instances. Companies surveyed had adopted all of these approaches.

In addition to multiple copies of i5/OS, AIX 5L Version 5 (the current IBM version of UNIX) and Linux operating systems may also run in LPARs.

System efficiency is augmented by three additional virtualization capabilities. ***Virtual I/O*** and ***Virtual Disk*** enable multiple LPARs to share adapters and physical disk drives respectively – i.e., fewer physical adapters and less disk capacity are required.

Virtual LAN supports high-speed linkages between LPARs and enables creation of virtual Ethernet switches and adapters, which may result in additional hardware economies and reduced configuration complexity. A further benefit is that Virtual LANs are more secure than external LAN connections.

System i partitioning and virtualization capabilities are closely integrated with sophisticated i5/OS system and workload management facilities. These are designed into the core System i architecture and embedded into i5/OS. Key facilities such as the Enterprise Workload Manager (EWLM) and IBM Director provide uniform management support for all system-level and LPAR resources.

The implications of this integration are important. With any platform, it is not sufficient simply to create partitions. The efficiency with which a partitioned system operates also depends on how effectively workloads are distributed between, and resources managed across these. System i capabilities in these areas are among the most advanced in today's IT world.

Security and Malware Resistance

Like other System i capabilities, security and malware protection functions are designed into the core system architecture, and are embedded into i5/OS rather than implemented as software overlays. These functions are tightly integrated with the system's compiler, directory server, and object-based file system. Programs that do not meet highly demanding validity criteria cannot execute.

A further benefit is that high levels of system integration and administrator productivity make it easier to implement and maintain security policies than in a more complex IT environment. This is particularly valuable for companies with few or no security professionals and limited security resources.

These capabilities do not mean that System i users do not face security or malware threats. However, the probability that these will materialize is significantly less than for other platforms. Staff time and funds that must be expended to guard against them is correspondingly less.

DETAILED DATA

Comparison Profiles

Cost calculations presented in this report are based on six company profiles, which were constructed using data on application suites, workloads, server hardware and software configurations, and IT staffing supplied by 25 companies in the same industries and approximate size ranges. Companies had deployed SAP ERP solutions with between 20 and 300 users on Windows server or System i platforms.

Profiles, which are summarized in figure 10, are composites drawing upon inputs from multiple companies. A best practices approach was employed. For example, the experiences of one wholesale distributor with SAP ERP and Supplier Relationship Management (SRM) solutions were combined with those of a second with SAP CRM. The other profiles were constructed in a similar manner.

Figure 10
Profiles Summary

CONSTRUCTION	CONSUMER PRODUCTS	RETAIL
Business Profile		
Homebuilder $70 million sales 200 full-time employees Delivers 250+ homes per year	Sporting goods manufacturer $40 million sales 1 production plant 5 sales offices 400 employees	Specialty retailer $500+ million sales 180 stores 3 distribution centers 2,500 employees
All-in-One Solution		
Based on SAP for Engineering, Construction & Operations	Based on SAP for Consumer Products	Based on SAP for Retail
Number of Users		
60	120	150
FABRICATION & ASSEMBLY	**WHOLESALE DISTRIBUTION**	**FOOD & BEVERAGE**
Business Profile		
Manufacturer of stamped metal components & assemblies $65 million sales 3 production plants 600 employees	Electrical goods distributor $350 million sales 2 distribution centers 40 sales offices 750 employees	Prepared foods manufacturer $150 million sales 3 manufacturing plants & distribution centers, 800 employees
All-in-One Solution		
Based on SAP for Automotive plus BI	Based on SAP for Wholesale Distribution plus SRM & CRM	Based on SAP for Consumer Products
Number of Users		
170 ERP, 40 BI	200 ERP & SRM, 25 CRM	300

For each profile, scenarios were then developed for use of Windows servers with VMware ESX, Windows servers without VMware ESX, and System i platforms. These are summarized in figure 11.

Scenarios included the following:

- ***Servers***. For all Windows server scenarios, server configurations included Windows Server 2003 Enterprise Edition and SQL Server 2005 Enterprise Edition, along with third-party virus protection tools providing functionality equivalent to the i5/OS environment.

Figure 11
Scenarios Summary

CONSTRUCTION	CONSUMER PRODUCTS	RETAIL
IBM System i		
525 1 x 1.9 GHz 14 GB RAM i5/OS, BRMS – 2 LPARs 0.3 FTE	550 2 x 1.9 GHz 20 GB RAM i5/OS, BRMS – 2 LPARs 0.5 FTE	550 4 x 1.9 GHz 40 GB RAM i5/OS, BRMS – 2 LPARs 0.65 FTE
Windows Servers with VMware ESX		
2/8 x Xeon 1.6 GHz 8 GB RAM Windows Server, SQL Server, VMware ESX 0.65 FTE	4/8 x Xeon 2.6 GHz 8 GB RAM Windows Server, SQL Server, VMware ESX 1.1 FTEs	4/8 x Xeon 2.6 GHz 8 GB RAM Windows Server, SQL Server 4/8 x Xeon 2.6 GHz 8 GB RAM Windows Server, SQL Server, VMware ESX 1.5 FTEs
Windows Servers without VMware ESX		
2 x 2/8 x Xeon 1.6 GHz 8 GB RAM each Windows Server, SQL Server 0.9 FTE	2 x 2/8 x Xeon 2.33 GHz 8 GB RAM each Windows Server, SQL Server 1.45 FTEs	2 x 4/8 x Xeon 2.6 GHz 8 GB RAM each Windows Server, SQL Server 2/8 x Xeon 2.33 GHz 8 GB RAM Windows Server, SQL Server 1.8 FTEs
FABRICATION & ASSEMBLY	**WHOLESALE DISTRIBUTION**	**FOOD & BEVERAGE**
IBM System i		
550 4 x 1.9 GHz 48 GB RAM i5/OS, BRMS – 3 LPARs 0.75 FTE	550 4 x 1.9 GHz 48 GB RAM i5/OS, BRMS – 2 LPARs 0.7 FTE	550 4 x 1.9 GHz 40 GB RAM i5/OS, BRMS – 2 LPARs 0.8 FTE
Windows Servers with VMware ESX		
4/8 x Xeon 2.6 GHz 12 GB RAM Windows Server, SQL Server 4/8 x Xeon 2.6 GHz 12 GB RAM Windows Server, SQL Server, VMware ESX 1.8 FTEs	4/8 x Xeon 2.6 GHz 8 GB RAM Windows Server, SQL Server, VMware ESX 4/8 x Xeon 2.6 GHz 12 GB RAM Windows Server, SQL Server, VMware ESX 1.6 FTEs	4/8 x Xeon 3.2 GHz 8 GB RAM Windows Server, SQL Server 4/8 x Xeon 3.2 GHz 8 GB RAM Windows Server, SQL Server, VMware ESX 1.75 FTEs
Windows Servers without VMware ESX		
4/8 x Xeon 2.6 GHz 12 GB RAM Windows Server, SQL Server 4/8 x Xeon 2.6 GHz 8 GB RAM Windows Server, SQL Server 2/8 x Xeon 2.5 GHz 8 GB RAM Windows Server, SQL Server 2.1 FTEs	2 x 4/8 x Xeon 2.6 GHz 8 GB RAM each Windows Server, SQL Server 2 x 2/8 x Xeon 2.33 GHz 8 GB RAM each Windows Server, SQL Server 2.25 FTEs	4/8 x Xeon 3.2 GHz 8 GB RAM Windows Server, SQL Server 4/8 x Xeon 2.6 GHz 8 GB RAM Windows Server, SQL Server 2/8 x Xeon 2.33 GHz 8 GB RAM Windows Server, SQL Server 2.1 FTEs

In this summary, numbers of processors and cores are shown for Windows servers – e.g., "2/8 x Xeon 1.6 GHz" refers to a server with two quad-core Intel Xeon processors, while "4/8 x Xeon 2.6 GHz" refers to a server with four Intel Xeon 2.6 GHz dual-core processors, again for a total of eight cores. Numbers of cores only are shown for System i configurations.

In System i scenarios, LPARs are employed to host production as well as development, test, and QA instances on a single physical platform. Configurations also include IBM Backup Recovery and Media Services (BRMS) backup and recovery software.

For Windows server scenarios with VMware ESX, the latter is employed in scenarios for the construction and consumer products companies to co-host production as well as development, test, and QA instances on the same physical server.

For the wholesale distribution company, VMware ESX is employed to co-host production ERP, SRM, and CRM instances on one physical server, and to co-host development, test, and QA instances of these systems on a second server.

For Windows server scenarios with VMware ESX for the other three companies, it was decided not to co-host production and non-production instances of ERP systems on the same physical server because of the performance issues. For scenarios for the retail and food and beverage companies, VMware ESX is employed to host multiple development, test, and QA instances on one physical server.

For the fabrication and assembly company, VMware ESX is employed to host production and development, test, and QA instances of a SAP BI solution, along with an ERP development, test, and QA instance. Production systems run on separate physical servers that are not equipped with VMware ESX. All VMware ESX configurations employ two virtual processors.

Windows server configurations employing VMware ESX also include VMware Consolidated Backup or, where servers are not equipped with VMware ESX, a comparable third-party backup and recovery package.

Except for the retail company, Windows server and System i configurations were equipped with 146 gigabyte (GB) and 141 GB disk drives respectively, operating at 15,000 revolutions per minute (15K rpm) each. Because of the relatively large data volumes involved, 300 GB and 282 GB 15K rpm drives respectively are employed for retail company configurations.

Except for use of VMware ESX, all configurations are based on user-reported data. In some cases, users supplied configuration data for older IBM iSeries and Windows server models. Where this was the case, configurations were updated to current-technology models using vendor comparative performance guidelines and sizing estimates, and other inputs as appropriate.

For reasons discussed previously, it was not possible to obtain an adequate base of user inputs for VMware ESX sizing purposes. Configurations are thus based on International Technology Group (ITG) estimates using SAP SD benchmark results and other sources.

- ***Staffing***. FTE staffing levels for Windows system administrators, SQL Server database administrators, and System i scenarios were determined based on user-reported data. Lack of user experience meant, however, that it was again not possible to employ user inputs for VMware ESX FTE staffing. Values for this are thus based on ITG estimates drawing upon experiences with VMware ESX supporting other types of system.

All configurations and staffing levels are for SAP Business Partner solutions based on the All-in-One industry suites shown in figure 10.

IT Cost Calculations

IT costs were calculated as follows:

- ***Server costs***. Windows server costs include acquisition and three-year 24x7 maintenance coverage for hardware; licenses and three-year Microsoft Software Assurance coverage for Windows Server 2003 and SQL Server 2005 software; and licenses and three-year support costs for third-party antivirus and backup tools.

  For Windows server scenarios with VMware ESX, server costs also include licenses and three-year VMware Gold coverage for VMware ESX and Consolidated Backup.

  System i costs include acquisition of hardware and i5/OS and BRMS licenses, along with three-year 24x7 hardware and software maintenance coverage for these. Costs for all items for all scenarios were calculated using discounted street prices. All server configurations are rack-mounted.

- ***Personnel costs***. These are for FTE values. Calculations were based on annual salaries of $83,909 for i5/OS system administrators; $80,959 per year for Windows system administrators in Windows server scenarios with VMware ESX; $70,399 for Windows system administrators in Windows server scenarios without VMware ESX; and $90,714 for SQL Server DBAs for both sets of Windows server scenarios.

  The average annual salary for Windows system administrators in Windows server scenarios with VMware ESX is calculated using a base salary of $70,399 for Windows Server 2003 Enterprise Edition skills, plus 15 percent to allow for the additional cost of VMware ESX skills.

  Annual salaries for all personnel in all scenarios were increased by 28.2 percent to allow for bonuses, benefits and other non-cash compensation, training, and other items.

- ***Setup costs*** were calculated assuming assumptions of $150 and $185 per person-hour for external specialist assistance for Windows server-based and System i deployment scenarios respectively.

- ***Facilities costs***. These costs were calculated using vendor specifications for electricity consumption and footprints for server configurations included in scenarios.

  Costs include data center occupancy – calculations were based on standard rack mount units and service clearances for these, plus allowance for inactive areas – and electricity consumption by servers. Electricity costs were calculated based on specific utilization levels and hours of operation for each profile, using a conservative assumption for average price per kilowatt/hour.

  Facilities costs also include power and cooling equipment acquisition, maintenance, occupancy, and electricity consumption. Cost calculations were based on specifications and discounted list prices for equipment from leading vendors, and were prorated – e.g., if a server configuration required 15 percent of the output of a cooling unit, the cost was calculated as 15 percent of the cost of the unit.

Calculations do not include costs for applications software, external storage, peripherals, networks, personnel other than for system and database administration, and other resources not identified above.

Cost Breakdown

A detailed breakdown of three-year costs for all profiles and scenarios is presented in figure 12. All cost calculations are based on U.S. data.

Figure 12
Detailed Costs Breakdown

Company	Construction	Consumer Products	Specialty Retail	Fabrication & Assembly	Wholesale Distribution	Food & Beverage
IBM SYSTEM i SCENARIOS						
System hardware & software	44.7	94.3	176.5	168.1	165.3	158.4
Hardware maintenance	6.7	30.6	41.4	41.4	41.4	41.4
Software support	8.9	11.9	11.9	11.9	11.9	11.9
Personnel	96.8	161.4	209.8	242.0	225.9	258.2
Setup	2.6	2.6	2.6	3.3	3.7	2.6
Facilities	0.8	1.3	2.0	2.2	2.5	2.6
TOTAL ($000)	**160.5**	**302.1**	**444.2**	**468.9**	**450.7**	**475.1**
WINDOWS SERVER WITH VMWARE ESX SCENARIOS						
Hardware	10.8	15.9	32.4	32.0	31.8	31.4
Hardware maintenance	2.4	2.9	5.7	5.5	9.0	5.7
Software licenses	31.9	46.9	56.2	72.4	78.8	92.1
Software support	22.4	32.5	38.0	49.3	54.5	62.4
Personnel	208.0	351.9	482.1	583.0	515.1	563.7
Setup	7.5	7.5	10.5	11.1	13.2	10.5
Facilities	1.1	1.6	5.3	6.0	7.2	7.4
TOTAL ($000)	**284.1**	**459.2**	**630.2**	**759.3**	**709.6**	**773.2**
WINDOWS SERVER WITHOUT VMWARE ESX SCENARIOS						
Hardware	13.1	14.6	39.3	39.7	45.4	37.7
Hardware maintenance	4.7	4.7	8.1	7.8	10.4	8.1
Software licenses	34.3	48.8	61.1	71.7	80.3	89.3
Software support	24.9	35.8	45.0	53.0	58.6	66.2
Personnel	255.4	412.1	518.6	615.5	644.4	607.7
Setup	6.6	6.6	10.2	10.8	12.6	10.2
Facilities	1.5	1.5	6.0	6.6	8.6	8.0
TOTAL ($000)	**340.5**	**524.1**	**688.3**	**805.1**	**860.3**	**827.2**

IBM System i hardware and i5/OS operating system software are priced as a package.

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