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MANAGEMENT BRIEF

VALUE PROPOSITION FOR SAP ENTERPRISE APPLICATIONS

Business Case for IBM eServer zSeries

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EXECUTIVE SUMMARY

Growth. Scale. Consolidation. Integration. Innovation. Business challenges facing SAP users are clear. Operational efficiency must be improved while increasing organizational flexibility. Information and collaboration must be exploited as critical new competitive tools. The potential emerges to achieve transformative gains in business.

The extent to which this potential is realized depends upon many factors. This report deals with one of these: choices of underlying server platforms for SAP applications. Specifically, it examines the business case for deploying SAP solutions on IBM eServer zSeries mainframe servers.

Conclusions are based on survey input from 54 organizations worldwide that have deployed, or are in the process of deploying SAP solutions using mainframes as database servers, application servers, or both. Users cite three main sets of benefits from employing this platform:

1. ***"Classic" mainframe strengths***. Industry-leading availability was identified by 85 percent of users as a critical benefit. Also cited were advanced capabilities for backup and recovery (52 percent), batch performance (46 percent), system and workload management (28 percent) and security (19 percent). Such capabilities directly impact the bottom line.

   In six company examples detailed in this report, higher zSeries availability levels compared to competitive high-end UNIX server configurations result in savings ranging from $11.0 million to $116.7 million in business costs caused by outages. Faster zSeries disaster recovery translates into savings of from $2.0 million to $13.3 million through reduced disruption.

2. ***High-volume workloads***. SAP systems deployed on mainframes are among the world's largest. Among users surveyed, mainframes supported databases of up to 13 terabytes (TB); volumes of up to 10 million transactions per day and 3.5 million transactions per hour; and populations of more than 13,000 named and 5,000 concurrent users.

   Overall, 61 percent cited the ability to support very large databases, transaction volumes, user bases and table sizes, or combinations of these as a critical benefit. The distinctive mainframe strength was the ability not only to handle such workloads, but also to maintain extremely high levels of availability, recoverability and performance while doing so.

3. ***Mainframe synergies***. Most organizations surveyed had employed mainframes before deploying SAP applications, and many retained significant investments in legacy mainframe-based systems. The ability to leverage embedded data center, recovery and operational infrastructures, along with established mainframe and DB2 skills bases, was cited by 70 percent of users.

   Avoidance of the costs and disruptions of large-scale platform change was widely seen as a critical mainframe benefit. Interoperability with existing mainframe-based systems was also cited by 48 percent of users. This was a particularly important issue among banks, insurers and other service companies deploying new SAP core solutions.

These strengths contributed materially to the success of conventional enterprise resource planning (ERP) deployments in many organizations. Moreover, such strengths play a critical role in increasing organizational responsiveness, enabling adoption of real-time competitive strategies, and extending supply chain efficiencies to integrated networks of customers, suppliers and partners. Mainframe attributes will clearly be as important in meeting the new competitive challenges of the 21st century as they have been in the past.

BUSINESS CASE

Status Report

More than SAP 1,000 customer production systems worldwide have been deployed using mainframes as database, or database and application servers.

Many of the world's largest SAP deployments are mainframe-based. Users include at least 27 of the largest 100 SAP corporate customers, 21 of the Fortune Global 500 largest corporations worldwide, and 24 of the Financial Times (FT) Europe 500 companies. There are at least 13 SAP users with 2003 revenues of more than $50 billion, and approximately 50 in the $10 billion to $50 billion range. Mainframe-based SAP systems are also employed by large public sector organizations worldwide.

Smaller users include approximately 40 companies with revenues of less than $1 billion – although many of these are service bureaus and others with disproportionately large workload volumes relative to their size – along with local governments. The remainder includes companies with $1 billion to $10 billion in 2003 revenues, along with smaller public sector organizations.

Early mainframe deployments were predominantly of SAP R/3 ERP systems. Recent placements have included newer mySAP offerings such as Business Information Warehouse (BW), Advanced Planning and Optimization (APO), along with IS-Banking, IS-Retail and other SAP core system solutions for service industries.

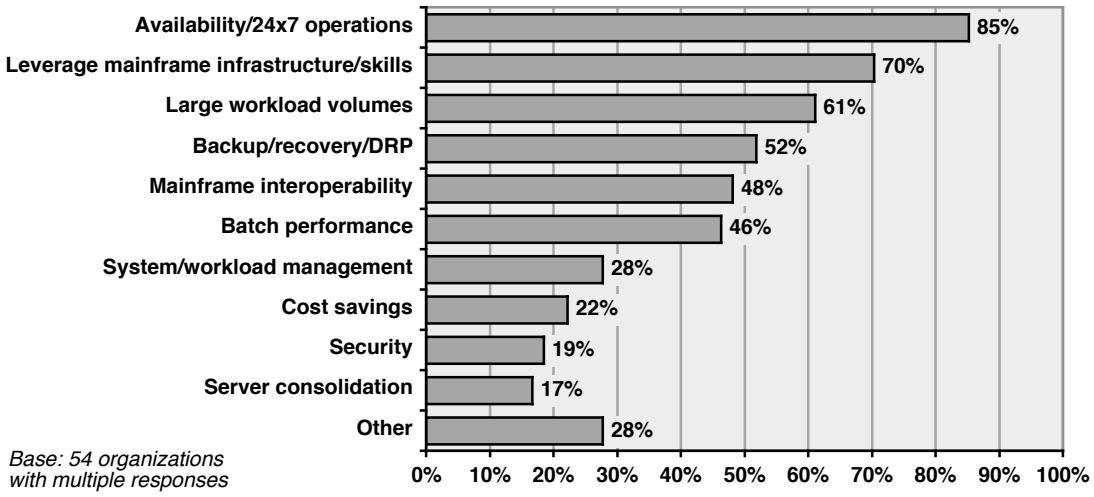
Why Mainframes?

General Picture

The benefits of SAP mainframe deployment have been widely documented, and are confirmed by input – summarized in figure 1 – from organizations surveyed for this report.

Figure 1

Benefits of Mainframes for SAP Deployment: All Users



Two distinct areas of appeal emerge are summarized as follows.

Service Quality and Volume

For organizations that must maintain extremely high levels of availability and recoverability, support exceptionally high-volume workloads, or both, the distinctive strengths of system mainframe architecture and the mainframe DB2 database have obvious appeal. This is particularly the case where very large single system and database instances must be supported.

A key principle applies. The challenges of maintaining extremely high levels of service quality – including variables such as availability, response time, recoverability and security – are substantial under any circumstances. But these challenges are magnified when it is also necessary to support large transaction volumes, user populations or databases. They are further magnified when it is necessary to support all of these.

The costs and difficulties of maintaining 24x7 availability for a system processing, say, 300,000 transactions per hour are not 6 times greater than for a system processing 50,000 per hour. They may be 10 or 20 times greater. Maintaining subsecond response time for a system supporting 3,000 concurrent users is a great deal more difficult than for a system supporting 1,000.

Similarly, backing up and recovering a multiple-terabyte database while avoiding data loss and minimizing outage duration is a task orders of magnitude more difficult than when dealing with 200 gigabytes (GB) or 300 GB of production data. Challenges increase in a manner closer to exponential than arithmetic.

The appeal of mainframe systems proved to be strongest when requirements for extremely high levels of service quality intersected with the need to support exceptionally high-volume workloads. Where this was the case, it was generally recognized that competitive server platforms could not realistically match mainframe capabilities.

Mainframe Synergies

The second major pattern of mainframe appeal involved overlapping sets of benefits in two areas:

1. ***Infrastructures and skills***. Where organizations already employed mainframes for large-scale, business-critical systems, it was a great deal easier to exploit existing infrastructures built around these than to replace them. Existing mainframe and (where this database was already employed) DB2 skills in the management and support of high-volume, high-availability systems could also be adapted to meet new SAP requirements.

   It was not necessary to recreate "from the ground up" entire new infrastructures and skill sets built around platforms that were, in any case, less scalable and reliable than those they replaced. Avoidance of the costs and difficulties of such changes – as well as the penalties that would be experienced in service quality – outweighed the potential total cost of ownership (TCO) benefits of alternative platforms.

2. ***Mainframe interoperability***. Where existing mainframe-based systems continued to be employed, it was typically necessary to support from dozens to hundreds of interfaces between these and new SAP solutions. Implementation and support complexity was materially reduced if the same platform was employed. Data feeds were also more efficient, particularly when it was necessary to transfer data between systems in real time or near-real time.

These benefits were cited by many organizations that needed to maintain high levels of service quality and support large workloads. In addition, they extended the appeal of mainframe deployment to smaller users with less exacting requirements.

Mainframe synergies were particularly significant in financial services and insurance. For companies in these industries, core systems were already predominantly mainframe-based, and mainframes were the de facto industry standard for the vast majority of transaction-processing workloads.

This is also the case, at least for large organizations, in other service industries and in the public sector. Even where application-level processing and non-core applications have been offloaded to other platforms, mainframes continue to form the basis of organizational IT infrastructures. Mainframes also remain the primary platforms for consolidation of transaction data that will be accessed and exploited by new SAP solutions. Figure 2 shows examples from U.S. experience.

A key principle applies. Most of the implementation cost for deployment of ERP systems in a heterogeneous environment involves linkages to other systems. Costs and difficulties decline significantly if a common server platform is employed, and decline even further if the database is also the same. Data management and movement processes will be simplified and accelerated, and support complexities will be reduced.

New Challenges

The appeal of mainframes for SAP database serving was apparent to users who deployed their first R/3 systems on this platform in the late 1990s. Many organizations found that competitive servers and databases could not realistically handle database sizes and workload volumes, nor could these meet requirements for availability and recoverability.

Recent trends in SAP deployment have, however, magnified the value of these and other distinctive mainframe strengths. This has particularly been the case in three areas:

1. ***Consolidation.*** There has been a broad trend among SAP users toward consolidation of systems. Many companies that initially implemented R/3 systems at the division or business unit level have since moved to larger regional or global ERP instances. New users have also tended to adopt large-scale deployment strategies.

   System consolidation has been driven by a number of factors. Cross-organizational process standardization, and the desire to reduce complexities in business and IT structures have been common motives. Additionally, an increasing number of users have sought create integrated, enterprise-wide views of data for supply chain optimization, integration of customer touch points, business intelligence and other high-impact applications.

   In parallel with system consolidation, there has been a marked trend toward the consolidation of server, storage and network infrastructures. The emerging norm for many multinational corporations, in particular, is to run worldwide SAP systems from two redundant data centers, or from a handful of major regional data centers.

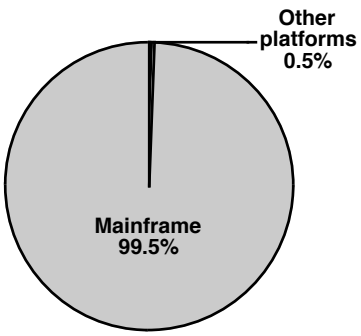
   This trend has affected the full range of SAP offerings. Organizations have tended to build solutions for business intelligence, CRM, e-procurement, e-commerce, intranet collaboration and self-service applications around core ERP systems. Even when new applications are deployed in a distributed manner, they are dependent on operational data supplied by, and interoperate with underlying ERP systems. The core ERP infrastructure remains centralized.

Figure 2

Consolidation of Transaction Data by Platform: Selected Industries

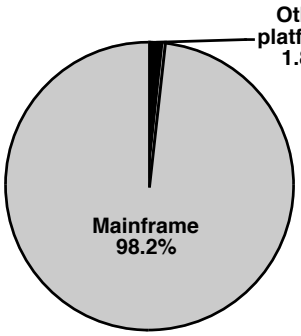
COMPANIES WITH MORE THAN $10 BILLION ASSETS IN 2003

RETAIL BANKS



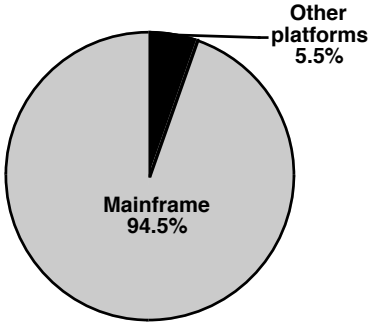
Total transactions: 158.8 billion
Base: 52 companies

INSURANCE COMPANIES



Total transactions: 17.3 billion
Base: 56 companies

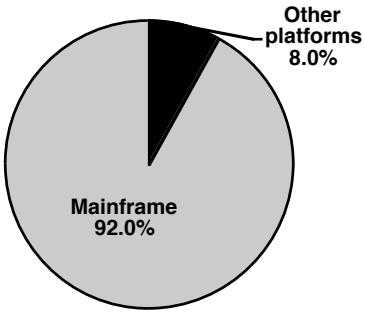
BROKERAGE FIRMS



Total transactions: 12.7 billion
Base: 8 companies

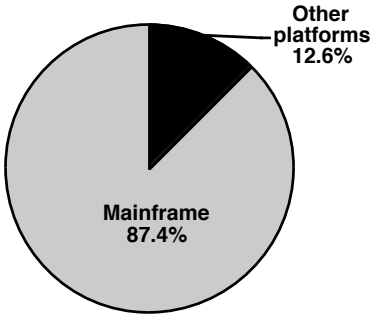
COMPANIES WITH MORE THAN $1 BILLION SALES IN 2003

RETAILERS (Sales data)



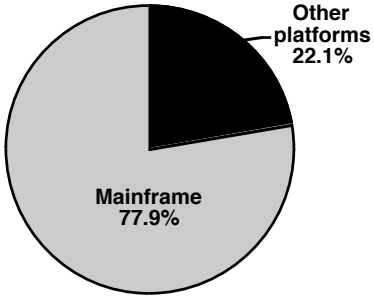
Total transactions: 45.4 billion
Base: 143 companies

UTILITIES (CIS & billing data)



Total transactions: 3.4 billion
Base: 85 companies

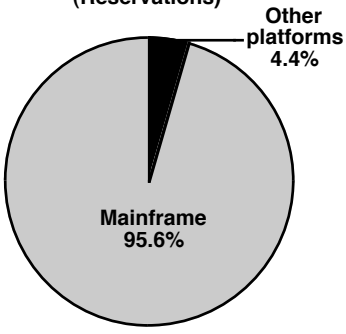
TELECOMMUNICATIONS (CIS & billing data)



Total transactions: 6.5 billion
Base: 24 companies

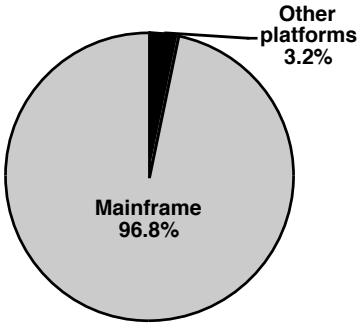
COMPANIES WITH MORE THAN $1 BILLION SALES IN 2003

TRAVEL INDUSTRY (1) (Reservations)



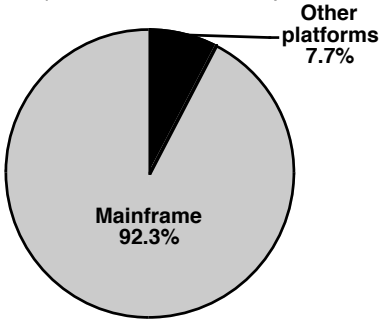
Total transactions: 976 million
Base: 28 companies

RESTAURANT & FAST FOOD CHAINS (Sales data)



Total transactions: 12.4 billion
Base: 14 companies

STATE & LOCAL GOVERNMENT (2) (Financial transactions)



Total transactions: 5.5 billion
Base: 827 organizations

(1) Includes airlines, hotel chains & car rental agencies
(2) Includes states, government of Puerto Rico, counties & municipalities with 100,000+ population, school districts with 100,000+ students

The implications for IT infrastructures are important. Consolidation greatly increases stresses on underlying servers. It becomes necessary to support significantly larger databases and workloads, while at the same time maintaining high levels of response time for remote users.

Since outages have a more widespread impact than in a decentralized environment, maintenance of de facto 100 percent availability becomes increasingly critical. This is particularly the case where systems support operations across multiple time zones. The effects of even short outages are magnified.

A company whose business-critical systems are concentrated at only a few points is also more vulnerable to a disastrous outage. High-speed data replication and failover mechanisms are mandated. These must enable resumption of high-volume processing and reinstatement of large volumes of data with maximum speed and minimal disruption.

2. ***Real-time competition***. A company's ability to operate in real time is becoming an increasingly critical competitive issue among SAP users. In practice, "real time" may be defined as the ability to assemble, organize, distribute and exploit data rapidly, on a continuous basis.

   Real-time models represent the next phase of ERP evolution. For companies, which have already achieved major gains in operational efficiency through ERP deployment, the focus moves from transactional activities to higher value-added processes such as decision-making, internal collaboration, and interaction with customers and suppliers.

   A new set of competitive variables comes into play: the speed at which organizations operate; the effectiveness with which they use information to respond to changes in customer requirements, and in market and competitive conditions; and the quality and timeliness of information delivered to users and applications throughout the enterprise.

   Real-time techniques have been widely applied to supply chain optimization. Streamlined order-to-delivery and procurement cycles reduce manufacturing, logistics and inventory costs. Real-time inventory visibility enables more effective order promising. Continuous generation of forecasts translates into better planning, capacity optimization and cost control.

   The potential is, however, significantly broader. Financial services, telecommunications and travel companies have, for example, begun to post customer transaction data in real time – across all channels – for more responsive customer service, and for event-driven marketing actions. Hundreds of such applications are emerging in a wide range of industries and public sector organizations.

   There are, again, important implications for IT infrastructures. A real-time business is even more vulnerable to outages than one operating in a conventional manner. The need for de facto 100 percent availability becomes even more pervasive and critical. The business impact of failing to deliver information on time may be even more serious than a delay in getting a critical part to a production line, or a shipment to a customer.

   Another effect – less visible, but equally, if not more significant – is that traditional batch cycles start to disappear. In an organization characterized by high-speed information flows, batch windows for database updates, inter-system data transfers, data warehouse extract, transformation and load (ETL) cycles, and similar functions pose unacceptable delays.

High levels of batch performance are mandated, and it becomes necessary to process online and batch workloads concurrently rather than sequentially. This, in turn, requires increasingly sophisticated workload management capabilities. These must be capable of operating in a highly reliable manner in highly concentrated, high-volume environments.

3. ***Migration***. Conventional R/3 environments were characterized by comparatively simple, transaction-oriented workload structures. However, the mySAP environment is significantly broader and more diverse.

   Transactional, as well as query, collaborative interaction, and Internet- and intranet-based processes must be managed. Moreover, these processes will become increasingly interdependent as organizations move toward higher levels of process integration. Sophisticated, highly granular system and workload management mechanisms will be required.

   The challenges of maintaining availability, recoverability and other variables of service quality will also increase as technology content and process structures become more complex.

   These challenges will be magnified by the fact that mySAP technologies will, for some time, be less stable and mature. Equally, as systems are opened up to the Internet and pervasive, organization-wide intranets, risks of user error, virus damage and security violations will be significantly greater than was the case in conventional R/3 environments.

   The ability of mainframe systems to minimize planned – as well as unplanned outages – will prove valuable to organizations as they undertake protracted technology transitions. Challenges of maintaining 24x7 availability will not be trivial as users migrate core systems to new technology bases.

   Pressures for (to use SAP's term) "time to value" will encourage users to build upon existing mainframe infrastructures and skill bases, and to minimize the costs and difficulties of integrating with mainframe-based legacy systems. Less time and effort spent on the underlying server infrastructures will inevitably accelerate the delivery of business advantage.

There are obvious correlations between these requirements and core mainframe strengths.

One implication emerges clearly. While the capabilities of alternative server platforms and databases have improved significantly since the late 1990s, the requirements for successful SAP deployment and operation have also become a great deal more exacting. The distinctive strengths of the mainframe environment are equally, if not more, relevant to meeting these new challenges.

Many of the problems experienced during early R/3 deployments occurred because choices of underlying server platforms were treated as a matter of technological detail. The focus was on delivery of new application functionality and reengineering of business processes. Little attention was paid to the strengths and weaknesses of underlying platforms, or to planning the infrastructures it would be necessary to build around them.

Mainframe systems may not be appropriate for SAP deployment in many organizations. But where volume and service quality requirements are already demanding – and will become even more so in the future – there is a strong business case for evaluating this option.

Business Value of Continuity

Impact of Disruptions

The bottom-line impact of disruption on business performance has been extensively documented.

There is, for example, a great deal of evidence that in tightly integrated supply chain environments, even relatively short disruptions can generate ripple effects that spread rapidly across the entire organization, and extend to customers and suppliers. The impact on supply chain performance may continue to be felt long after service has been restored.

Outages experienced by many Web commerce companies have highlighted the cost implications of failure to maintain availability. The impact is measured in terms not only of lost sales, but also of lost customers. Users who cannot access a Web site, or experience delays in obtaining information or executing transactions, may defect to competitors. Some will not return.

Disruptions affecting customer service, internal communications and other functions have bottom-line implications. Real-time competitiveness means, more broadly, that any delay in availability or use of information is potentially damaging. In large organizations, the impact of hundreds or thousands of such delays occurring over long periods is clearly substantial.

The ability to maintain continuous, efficient service is becoming a competitive mandate for any company. Avoidance of outages becomes a business, rather than an IT issue.

The implications of continuity are, however, often addressed inadequately – or are not addressed at all – in many analyses of ERP costs and benefits. All too often, other values in return on investment (ROI) or TCO calculations are quantified in precise detail, while generic assumptions about "lost sales" or "lost productivity" are employed for the bottom-line impact of service continuity. New approaches are needed.

Cost Comparisons

Cost implications of the different levels of continuity delivered by mainframe and competitive platforms were determined using a more in-depth methodology for six large SAP user organizations. Two variables were quantified.

1. ***Availability*** calculations are based on the duration of outages affecting business operations.

   Comparisons are based on two sets of configurations: (1) mainframe systems employing zSeries 990 processors, DB2 Version 8 databases and Parallel Sysplex clusters equipped for data sharing; and (2) Hewlett-Packard (HP) Integrity servers equipped with Itanium 2-based mx2 processors, the HP-UX operating system, Oracle 10g databases, HP Serviceguard clusters and Oracle Real Application Clusters (RAC). Database and central instance servers are clustered.

   Higher levels of mainframe availability result in five-year business costs between 59.8 percent and 69.3 percent less than for equivalent Integrity configurations. Results are summarized in figure 3.

Figure 3

Availability Cost Comparisons

COMPANY	A	B	C
Industry	Energy (Oil & gas)	Consumer Electronics	Consumer Packaged Goods
Revenues	$25 billion	$12 billion	$10 billion
SAP Modules	IS-Oil FI, AM, CO, MM, PM, PP, PS, SD, BW, SEM	FI, CO, MM, PP, WM, SD, APO, BW, CRM Internet Sales	FI, HR, MM, PC, PP, SD, BW, CRM, EBP
Number of Users	8,000+	4,000	5,000
Integrity Platform			
Availability Level	99.725%	99.825%	99.85%
Cost of Downtime	$114.9 million	$152.3 million	$175.0 million
Mainframe Platform			
Availability Level	99.9%	99.95%	99.95%
Cost of Downtime	$43.1 million	$46.7 million	$58.3 million

COMPANY	D	E	F
Industry	Chemicals	Industrial Manufacturing	Retail
Revenues	$6 billion	$4 billion	$2 billion
SAP Modules	FI, CO, MM, PM, PP, PS, SD, APO, BW, CRM, EBP, KM Internet Sales	FI, CO, AM, MM, PM, PP, PS, APO, BW, PLM	IS-Retail FI, CO, MM, WM, SD, BW
Number of Users	8,000	8,500	1,000+
Integrity Platform			
Availability Level	99.85%	99.75%	99.75%
Cost of Downtime	$44.1 million	$56.7 million	$18.4 million
Mainframe Platform			
Availability Level	99.95%	99.925%	99.925%
Cost of Downtime	$15.1 million	$18.2 million	$7.4 million

2. ***Recoverability*** calculations are based on the time taken to resume service and reinstate data following a severe unplanned outage.

   The same base configurations as for availability are employed for these comparisons. However, in three cases – companies B, C and E – mainframes are also equipped with Geographically Dispersed Parallel Sysplex (GDPS) cluster facilities, enabling high-speed failover between data centers up to 100 kilometers apart. Integrity servers are equipped with equivalent HP Extended Cluster facilities supporting Oracle RAC.

   For base configurations, shorter mainframe recovery times result in one-time business costs between 48.8 percent and 68.2 percent less than for Integrity equivalents. For mainframes equipped with GDPS, one-time business costs are between 66.3 percent and 75.1 percent less than for Integrity configurations equipped with Extended Clusters. Results are summarized in figure 4.

Figure 4

Profile Companies: Recovery Values

COMPANY	A	B	C
Industry	Energy (Oil & gas)	Consumer Electronics	Consumer Packaged Goods
Integrity Platform			
Configuration	Integrity Oracle RAC Serviceguard	Integrity Oracle RAC Serviceguard Extended Cluster	Integrity Oracle RAC Serviceguard Extended Cluster
Recovery Time	5 hours	4 hours	3.5 hours
Cost of Downtime	$9.4 million	$17.7 million	$14.3 million
Mainframe Platform			
Configuration	zSeries, DB2 Parallel Sysplex	zSeries, DB2 GDPS	zSeries, DB2 GDPS
Recovery Time	2 hours	1 hour	1 hour
Cost of Downtime	$3.8 million	$4.4 million	$4.1 million

COMPANY	D	E	F
Industry	Chemicals	Industrial Manufacturing	Retail
Integrity Platform			
Configuration	Integrity Oracle RAC Serviceguard	Integrity Oracle RAC Serviceguard Extended Cluster	Integrity Oracle RAC Serviceguard
Recovery Time	3 hours	2 hours	8 hours
Cost of Downtime	$4.1 million	$8.9 million	$8.5 million
Mainframe Platform			
Configuration	zSeries, DB2 Parallel Sysplex	zSeries, DB2 GDPS	zSeries, DB2 Parallel Sysplex
Recovery Time	1.5 hours	45 minutes	2.5 hours
Cost of Downtime	$2.1 million	$3.0 million	$2.7 million

Abbreviations for SAP applications are listed in figure 5.

Figure 5

SAP Application Abbreviations

APO	Advanced Planning and Optimization	PC	Purchasing
BW	Business Information Warehouse	PLM	Product Lifecycle Management
CO	Controlling	PM	Plant Maintenance
CRM	Customer Relationship Management	PP	Production Planning and Control
EBP	Enterprise Buyer Professional	PS	Project System
FI	Financial Accounting	QM	Quality Management
HR	Human Resources	SD	Sales and Distribution
KM	Knowledge Management	SEM	Strategic Enterprise Management
MM	Materials Management	WM	Warehouse Management

In these comparisons, mainframe and Integrity platforms are equipped with latest-generation clustering and failover solutions from their respective vendors. Availability levels would be lower and recovery times longer for both sets of platforms if these were not employed.

Availability costs are measured in gross profit – meaning profit net of cost of goods sold (COGS) but before deduction of selling, general and administrative (SG&A) and other expenses – for five years, assuming consistent levels of availability over this period. Industry- and company-specific values for the effects of supply chain disruption, customer attrition and other effects are employed.

Recoverability costs are calculated in a similar manner, although higher values are assigned for disruption effects for each hour of outage. In each case, it is assumed that severe outages occur during the company's peak month of business activity.

Profiles are composites based on the experiences of 18 companies employing mainframe as well as UNIX servers. A "best practices" approach was employed – e.g., the experience of one user with SAP ERP systems was combined with the experience of another in SAP BW deployment, and a third in consolidation of data centers supporting SAP systems.

Complete profiles are described in the Detailed Data section of this report.

MAINFRAME BENEFITS

Survey Results

The 54 organizations surveyed cited a range of overlapping benefits of deploying SAP applications on mainframe systems.

The survey base consisted primarily of European, U.S. and Canadian users, and included organizations employing the full range of SAP applications in a variety of industries. All of these had deployed, or were in the process of deploying SAP database serving on mainframes, and five had adopted mainframe Linux IFLs for application serving. Additional details of demographics and applications may be found in the Detailed Data section.

Users had typically evaluated competitive high-end UNIX servers and Oracle databases before deciding to employ mainframes as database servers, and most comparative comments apply to these. In most cases, Microsoft Windows servers were not regarded as serious alternatives for mainframe-class workloads.

Continuity Strengths

Availability

The ability of mainframe systems to maintain high levels of availability emerged as the most common benefit of SAP mainframe deployment reported by users. Mainframe availability for database, central instance serving, or both was cited by 46 organizations (85 percent). The pattern of responses was largely consistent across industries and organization sizes.

Overall, 24 organizations reported that it was necessary to support ERP operations on a 24x7x365 basis, and others indicated that it was necessary to do so except for a few major public holidays in the course of the year. Requirements for “de facto” 100 percent availability were also cited for SCM and CRM systems, customer- and partner-facing Internet systems, as well as for strategic intranets, self-service finance and HR systems, and some business intelligence applications.

There was general agreement that pressures for 24x7x365 availability were increasing. Even where businesses were not active on a 24x7 basis, growth in batch workloads and shrinking windows for batch application processing and data backups was the norm. There was a pervasive trend toward round-the-clock data center operations even in small organizations.

Mainframe availability strengths were seen as partly a function of greater hardware and software reliability, which reduced risks of unplanned outages. Additionally, other capabilities were cited as enabling users to avoid planned outages for application and database updates, configuration upgrades, scheduled maintenance and other functions. These included the ability to conduct online database reorganizations with DB2, and to upgrade systems without disrupting service.

Parallel Sysplex clusters were seen as contributing to avoidance of planned and unplanned outages. Several organizations familiar with alternative UNIX-based clustering solutions commented that Parallel Sysplex capabilities were both more mature and more functional than these. Organizations employing standalone S/390 or zSeries systems also, however, indicated that in their experience availability levels were higher than could be achieved with alternative platforms.

Recoverability

There was, similarly, general agreement that mainframe backup and recovery capabilities, including disaster recovery planning (DRP) strengths, were superior to those of alternative platforms. These were cited by 26 organizations (52 percent) as a critical benefit of employing mainframes as database and central instance servers.

Organizations had often significantly reduced their vulnerability to severe outages. For example, one company had reduced its R/3 recovery point objective from 8 hours to 0.25 hour, while the time taken to reinstate data was reduced from more than 24 hours to less than 6 hours. Another reported that its disaster recovery time target had been reduced from 8 hours to less than 2 hours. During a disaster recovery trial, however, the process was completed in less than 1 hour.

The best recovery performance was reported by organizations employing GDPS technology. This group cited recovery times of from less than two hours to four hours.

Scalability and Performance

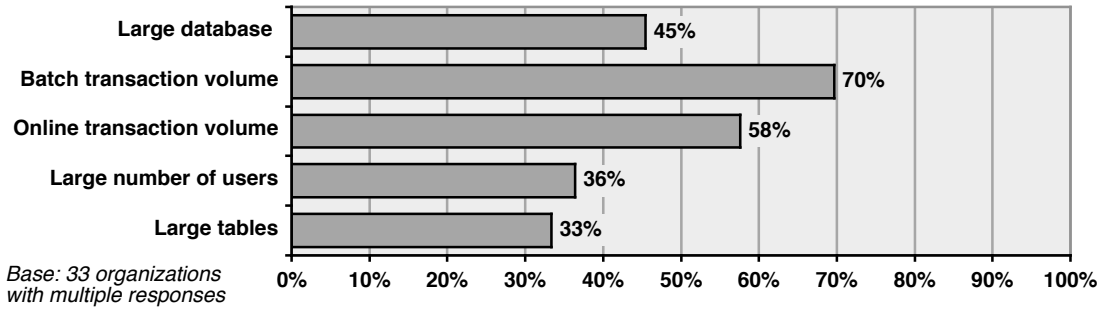
High-volume Workloads

The ability of mainframe systems to handle high-volume workloads was cited primarily by larger organizations, but was also seen as a critical benefit by some smaller companies, including service bureaus. Responses tended to overlap with those for availability and recoverability – i.e. mainframe appeal tended to be strongest when it was necessary both to support large workloads and to deliver high levels of service quality.

Mainframe strengths were described as applying to five principal types of high-volume workload. The pattern of responses was as shown in figure 6.

Figure 6

Types of High-volume Mainframe Workload



Responses tended, again, to overlap – e.g., organizations cited the ability of mainframes to support large databases and numbers of users, or high online and batch transaction volumes, or various other combinations of these.

Among organizations citing mainframe volume strengths were 8 supporting 10,000 or more named users, while an additional 10 reported from 5,000 to 9,999. One organization planned to support more than 20,000. Numbers of concurrent users ranged from 2,000 to more than 5,000. One organization reported a workload of more than 10 million transactions per day, 3 reported between 5.0 million and 9.9 million, and 12 reported between 2.0 million and 4.9 million.

The ability of mainframes to handle large tables was cited by financial services, manufacturing, retail, transportation and utility companies.

Figure 7 shows examples of high-volume mainframe-based systems among the companies surveyed.

Figure 7

Mainframe-based High-volume SAP Systems: User Examples

INDUSTRY	WORKLOAD	INDUSTRY	WORKLOAD
Banking*	40 million+ customer accounts	Manufacturing	8,500+ users (3,000+ concurrent) 2 million transactions/day
Banking	24 million customer accounts 3.5 million transactions/hour peak 10 million transactions/day	Manufacturing	8,000+ users 1 million+ transactions/day
Communications	HR system for 100,000+ employees 10,000+ users (4,500 concurrent) 13 TB database	Manufacturing	5,000+ users (2,000+ concurrent) 5 TB+ database
Energy	8,000+ users (2,000+ concurrent) 5 TB database	Retail	700,000+ transactions/hour 4 TB database (100 million rows)
Government	10,000+ users (3,000+ concurrent)	Transportation	6,000+ users (2,500+ concurrent) 4 million transactions/day
Government	5,000+ concurrent users	Utility	12,000+ users (3,000+ concurrent) 10 TB+ database
Manufacturing	10,000+ users (3,500 concurrent)	Utility*	3 million+ transactions/day
Manufacturing	10,000+ users (3,000+ concurrent)		

*Service bureau

In at least 17 organizations, recent or ongoing system consolidation initiatives contributed to growth in workload volumes. These included companies that had consolidated ERP system images supporting manufacturing, logistics and equivalent operations, or had put in place shared services structures for finance, HR, procurement and other functions. In some cases, both had occurred.

Batch Performance

There was general agreement that mainframe batch performance was significantly better than for UNIX servers and 25 organizations (46 percent) cited this as a critical benefit of deploying SAP applications on this platform.

One organization reported that, for equivalent configurations, mainframe batch performance was 30 percent to 40 percent higher than that of competitive high-end UNIX servers. A second reported improvements in the 40 percent to 80 percent range, depending on workloads.

In one case, a batch window declined from more than 5 hours to approximately 0.5 hours per day. In another, nightly batch windows were reduced from approximately 7 hours to 2.5 hours for order processing, from more than 6 hours to 1.25 hours for billing, and from 7 hours to less than 4 hours for management reporting.

Mainframe batch strengths were cited by several organizations as enabling them to handle exceptionally large tables. One retailer, for example, reported that its R/3 database contained approximately 30 tables with more than 100 million rows. The company's centralized replenishment file contains more than 50,000 items, and the price lookup file more than 300,000 items. More than 10 million batch transactions were processed nightly.

Large general ledger (GL) files were also cited by a number of organizations. For example, one financial services company had put in place a single global GL replacing more than 50 local systems. Table size increased dramatically. Pressures to accelerate the company's closing cycle meant batch consolidation processing was concentrated into a significantly shorter period.

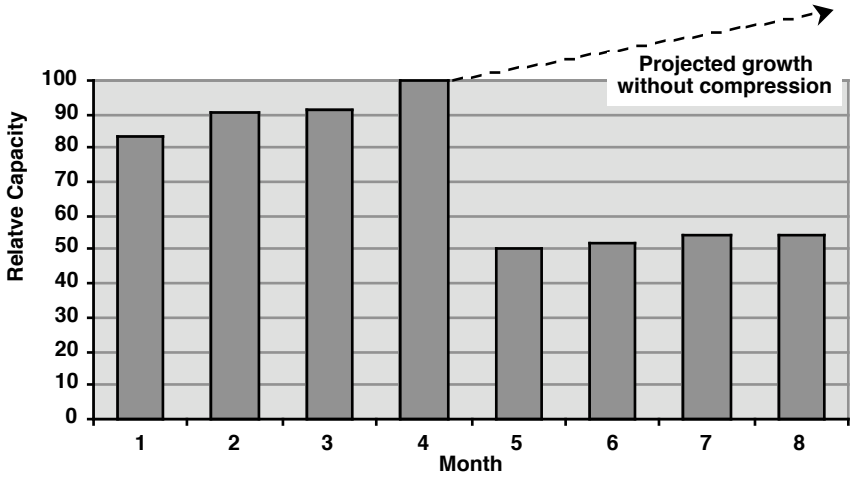
Data Compression

CPU-based data compression was cited by six organizations as a significant mainframe strength. System-wide compression levels of between 50 percent and 80 percent were reported for tables. Overall data compression levels were in the 30 percent to 60 percent range, depending on database size and characteristics. The norm was greater than 50 percent.

Data compression was reported not only to improve I/O and database performance, particularly for large tables and batch processing in general, but also to reduce capacity requirements. In several cases, significant reductions to growth in processor and storage capacity occurred. Figure 8 illustrates the experience of one organization over an eight-month period.

Figure 8

Effects of CPU-based Data Compression on R/3 Database Size: User Example



In contrast to disk controller-based data compression, a standard function on most high-end disk storage subsystems, CPU-based compression is a unique mainframe characteristic. The ability to compress data across the system as a whole yielded substantially better results than if only controller-based facilities were employed. Because high system overhead, software-based compression was not seen as a viable alternative.

Mainframe Synergies

Infrastructures and Skills

In all of the organizations surveyed, mainframes already hosted major organizational systems before it was decided to deploy new SAP solutions. Mainframe database, data center operations, and backup and recovery mechanisms were already in place, and teams of mainframe database administration, system and data management, and operational support personnel were available.

The ability to leverage these was seen as a critical benefit by, and contributed materially to mainframe deployment decisions in at least 38 organizations (70 percent). Existing mainframe infrastructures were cited by organizations of all sizes, although smaller users were more sensitive to skills issues.

Moreover, many organizations would have continued to employ mainframes for other applications and workloads even if they had hosted R/3 database servers on UNIX servers. It would thus have been necessary to duplicate tools, staff and operating procedures.

Respondents in a number of smaller organizations noted that they were primarily (to quote one) "mainframe and Windows shops." In these cases, mainframes hosted core business systems and data, while Windows servers were employed in various distributed and low-end roles.

If mainframes were used for SAP database serving, and Windows platforms for application and Web serving, it was not necessary to acquire skills for and support a third major operating environment – i.e. UNIX. This was regarded as a significant benefit in organizations with relatively small IT staffs. Users with little or no experience with Oracle were also able to avoid investment in this environment.

Mainframe Interoperability

Although many of the organizations surveyed could, in principle, have phased out legacy mainframe-based systems altogether, most chose not to do so. Even where this would have been technically feasible, it would have been a protracted and expensive process. The resources necessary for complete legacy replacement could, it was widely believed, be better employed to meet other priorities.

In most organizations, there was thus a significant requirement to implement and support interoperability between new SAP solutions and mainframe-based systems. One manufacturing company, for example, reported a need to support more than 50 ongoing interfaces with legacy systems. An insurance company reported more than 70 interfaces for FI and CO only. A government organization reported more than 120 interfaces. A financial services company reported more than 300.

Examples of such interfaces included core banking systems; claims processing and policy management systems in insurance; customer information and billing systems in utility and telecommunications companies; core sales and merchandising systems in retailing; government revenue and financial systems; various custom transaction-processing systems in other industries; mainframe-based EDI systems; and legacy accounting and payroll applications.

A general industry principle applies: the greater the diversity of platforms that must be dealt with, the larger will be the investments required for gateways, conversion and custom programming. Integration of data generated by different financial applications, as well as integration of financial and operational data become more challenging processes. Additionally, it becomes more difficult to consolidate, backup and recover data across applications in a reliable and timely manner.

Organizations with major investments in mainframe applications and data were thus able to contain costs and difficulties of creating – and maintaining – interoperability between these and new SAP solutions. This was particularly the case where only a subset of the SAP portfolio (e.g. financial or HR applications) was deployed, and where DB2 was already employed for major systems.

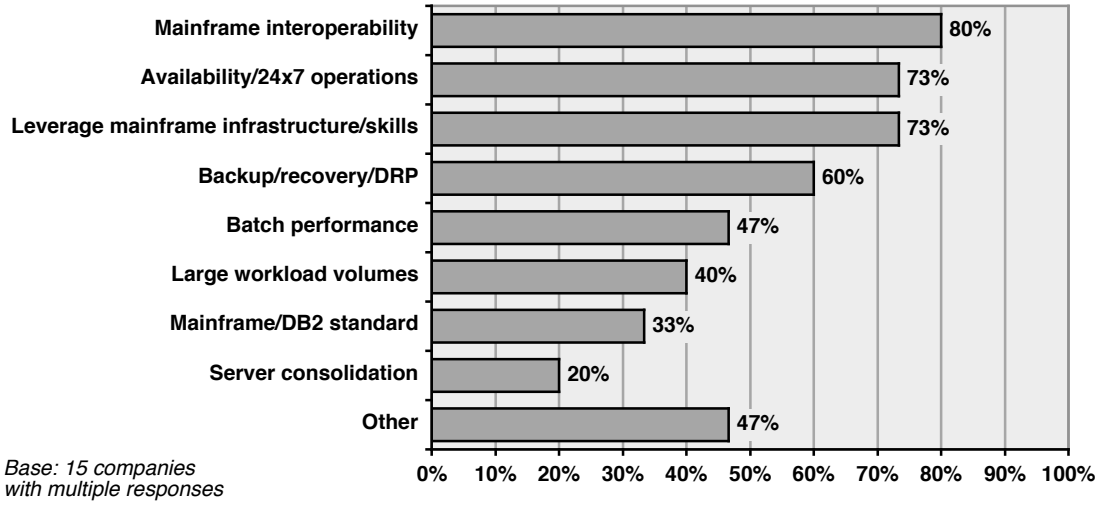
In several organizations, synergies between the mainframe version of DB2 and legacy data structures such as VSAM and IMS were also significant. One respondent noted, for example, that DB2 was the obvious bridge between the conventional mainframe environment and the relational data structures inherent to the SAP ERP design.

While interoperability with other mainframe systems was rarely the only, or even primary reason for deploying SAP solutions on mainframes, it contributed to decisions in favor of this platform in at least 26 organizations (48 percent).

Mainframe interoperability was, as figure 9 shows, a particularly significant issue in financial services and insurance. Out of 15 companies in these industries, 12 (80 percent) cited this a critical benefit of deploying SAP solutions on mainframes. Responses were largely consistent regardless of organization size. This was a higher ratio than for companies in other industries.

Figure 9

Benefits of Mainframes for SAP Deployment: Financial Services and Insurance Companies

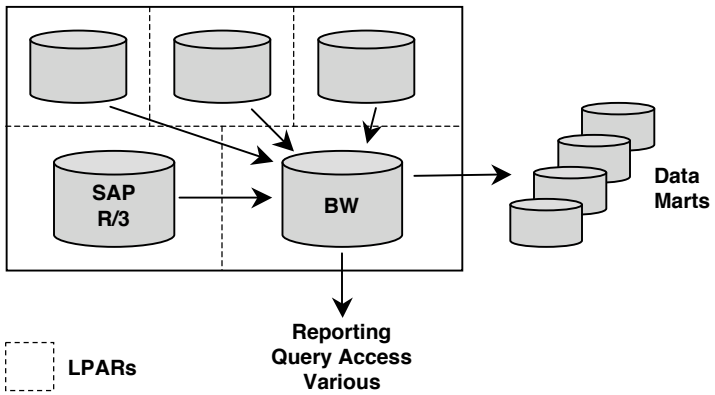


Mainframe interoperability influenced decisions to deploy not only ERP, but also BW databases on mainframes. According to users, this approach was simpler when the majority of data feeds into BW-based data warehouses were from mainframe-based R/3 systems, legacy systems, or both. Legacy data feeds were particularly common among financial services and insurance companies.

One financial services company had, for example, implemented the database architecture illustrated in figure 10.

Figure 10

Mainframe-based R/3 and BW Database Architecture: User Example



In this case, data was moved from production R/3 and legacy systems to BW databases, and ETL processes were performed within the mainframe environment. Mainframe batch performance and workload management strengths could be exploited, and automatically allocated to BW updates on an "as available" basis. Use of high-bandwidth internal communications facilities within the mainframe processor complex minimized transfer latencies.

A key benefit of this approach was that it was possible to update data warehouses in near real time for a range of informational applications.

Other Benefits

System and Workload Management

Mainframe strengths in system and workload management were cited by 15 organizations (28 percent) as a critical benefit. Mainframe capabilities in such areas as partitioning, job scheduling, allocating capacity, and monitoring and managing operations were regarded as superior – typically by wide margins – to those of competitive platforms.

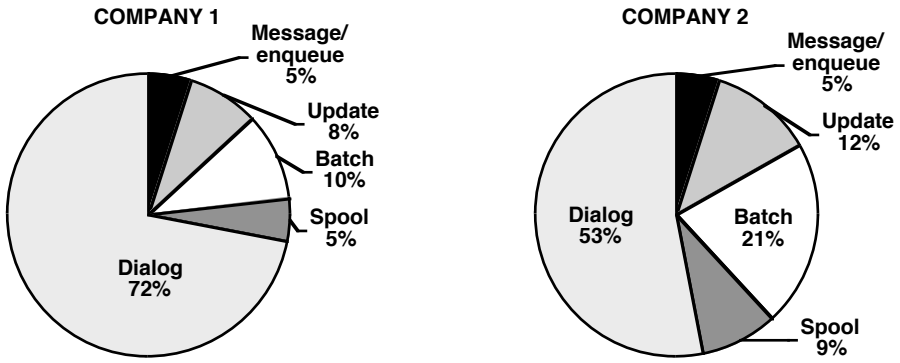
One major benefit was the ability to spread and manage workloads dynamically across logical partitions (LPARs) not only on the same mainframe system, but also across multiple systems within a Parallel Sysplex cluster.

LPARs were variously used to host multiple instances of the R/3 systems (one company had, for example, deployed database instances supporting business operations in North America, Latin America, Europe, Asia, Australia and other regions across two clustered systems); multiple SAP systems (e.g., R/3, BW, APO); and multiple instances of the same system for development, test, quality assurance, integration and other non-production applications.

Mainframe strengths in mixed workload management were also significant. Even relatively simple single-instance SAP environments were characterized by varying mixes of dialog, batch, update, spooling, and message and enqueue workloads. Figure 11 shows examples.

Figure 11

Breakdown of SAP Workloads by Process: User Examples



The challenges of managing diverse workloads were magnified in more complex SAP environments. In all cases, the ability to allocate capacity in a highly granular, dynamic manner enabled economies in overall capacity utilization significantly greater than could be realized with competitive platforms. Overall mainframe utilization levels were typically in the 80 percent to 90 percent range.

Effective system and workload management capabilities also contributed to higher levels of availability, recoverability and performance, and reduced operations costs. Several organizations reported, for example, they were able to run "lights out" (i.e. unattended) operations for two shifts per day. This would not have been a realistic option had UNIX servers been employed.

Cost Savings

Twelve users (22 percent) reported cost savings. This group included organizations that had developed TCO comparisons of mainframes and competitive platforms for their requirements, as well as those that had factored migration, infrastructure set-up, skills acquisition and other costs into their calculations.

These figures probably understate the significance of cost issues as a mainframe benefit. Some organizations had not conducted detailed cost comparisons because it was believed that alternative platforms could not adequately handle high-volume workloads, or could not maintain adequate levels of service quality, or because mainframe deployment had been decided upon for other reasons.

A number of factors were cited as reducing mainframe hardware and software costs. These included higher levels of capacity utilization due to architectural efficiencies, system and workload management granularity and data compression; and lower staffing levels for system management, database administration, operations and other support functions compared to UNIX platforms.

Where mainframe infrastructures and skill bases were already in place, however, the most important factor was the recognition that "costs of change" would be comparatively low. Incremental costs of upgrading mainframe capacity, data center and data management infrastructures, and skills were less than for the more radical changes required for UNIX and Oracle deployment.

Server Consolidation

Nine users (17 percent) cited enablement of server consolidation as a critical benefit of SAP deployment on mainframe systems. These included six companies that had consolidated central instance and application servers using IFLs, Linux guests under the z/VM operating system, or both.

Mainframe benefits reported by this group included the following:

- ***Availability***. All users cited the greater reliability of mainframe hardware and systems software compared to other platforms. Although Parallel Sysplex clustering is not supported for mainframe Linux, several companies had implemented, or planned to implement clustering solutions enabling failover between Linux images on S/390 or zSeries systems.
- ***Performance***. Users reported batch performance levels ranging from two to four times better than for their experience with UNIX environments. Update performance was also reported to be better. One user reported a 30 percent increase in dialog performance compared to its existing UNIX-based database server platform.

  HiperSockets – an IBM software technology that enables high-speed intra-system communications between Linux IFLs and database servers via IP protocols – was expected to boost performance for application-to-database server interactions. The effects would be particularly significant for very high-volume, time-sensitive workloads.
- ***Capacity utilization***. The ability to spread workloads efficiently over virtualized servers significantly increased overall utilization of processor capacity. One user noted, for example, that while only 25 percent of the processor capacity of standalone production application servers was utilized, this increased to more than 80 percent under mainframe Linux.

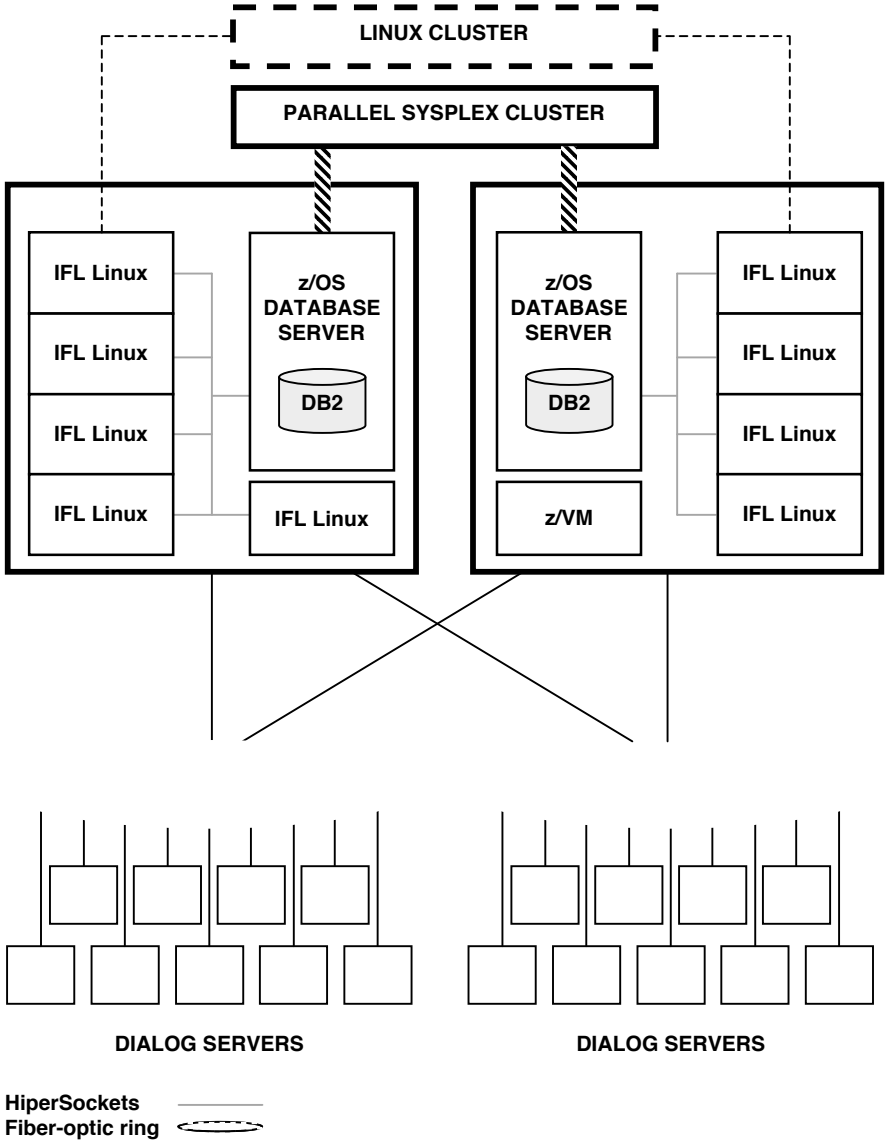
  Others reported similar experiences. Even larger improvements were reported for test, development and other non-production servers.
- ***Configuration flexibility***. Adding an IFL to an existing zSeries machine, or (for non-production applications) creating a new z/VM Linux image were reported to be simpler, faster and less disruptive processes than deploying additional UNIX or Windows machines. This was seen as a critical benefit in two companies experiencing major workload growth.
- ***Cost savings***. Improved capacity utilization, according to users, translated into lower server hardware, software and operating costs, including costs of data center occupancy, as well as reduced system administration and support overhead. Elimination of network connections between application and database servers offered additional savings.

Users saw broader advantages in being able to combine database and application serving on the same platform. One company planned, for example, to employ a mix of IFLs running messaging/enqueue, update, batch and potentially other types of workload on a duplexed zSeries configuration, shown in figure 12, which also acted as a core R/3 database server.

This approach enabled the company – which was in the process of consolidating 27 separate R/3 instances – to create a compact central complex supporting multiple-terabyte R/3 databases. Location of IFLs on the same zSeries platforms would allow extremely fast batch and update performance to be maintained even as database sizes and workload volumes expanded far beyond historical levels.

Figure 12

Mainframe Database and Application Server Configuration: User Example



Other Responses

Other benefits cited by organizations that had decided to deploy SAP applications on mainframes included better security than competitive platforms (10 responses); the fact that mainframes, DB2 or both were de facto standards in specific industries (5 – all of which were financial services or insurance companies); better mainframe response time (4); general "stability" or "maturity" of the mainframe environment (3); and availability of superior tools for mainframes and DB2 (3).

DETAILED DATA

Company Profiles

Company A

Among the six profiles presented for availability and recoverability comparisons, Company A is a division of a major petroleum company with interests in exploration and production, refining, downstream marketing and distribution, natural gas and petrochemicals.

The division's revenues are more than $25 billion and it has approximately 30,000 employees. It operates 4 major refineries and 19 other production facilities. Supply chain, logistics, marketing and financial operations are supported by a large-scale R/3 system. Shared services centers handle all regional finance and procurement operations.

While the initial focus of the company's ERP strategy was on increasing operational efficiencies, the division now places a major emphasis on more effective use of information for decision-making applications at all levels of the organization. SAP BW, SEM and other business intelligence solutions have been deployed, along with a division-wide intranet and self-service and knowledge management tools accessible to a wide range of employees.

SAP systems operate on a 24x7x365 basis and support more than 8,000 users. The R/3 system processes more than 25,000 batch jobs daily. E-commerce extranets are accessed by most of the company's suppliers, dealers, distributors and other partners.

Servers, storage and other IT resources supporting SAP systems have been concentrated in two data centers. These are connected by high-bandwidth networks, enabling real-time data replication and remote failover in case either facility experiences a severe outage.

Company B

This profile is of a regional manufacturing, sales and distribution organization of a major consumer electronic manufacturer. Sales in 2003 were approximately $12 billion. The organization operates 7 manufacturing plants and 30 sales and distribution centers, and has approximately 15,000 employees.

In order to standardize processes, realize efficiency savings, and improve information quality and accessibility, the organization has replaced divisional ERP systems with a common large-scale R/3 system. This is one of the world's largest single R/3 instances.

The organization faces increasingly fierce competition in a volatile market. Besides targeting conventional ERP efficiency gains, the organization has put in place a major APO system providing available to promise (ATP) and transportation planning and scheduling services, along with BW, CRM and other new SAP systems. There are more than 1,000 BW users.

SAP Internet Sales forms part of a large-scale e-commerce network linking all of its customers. The network, and the back-end ERP systems that interface to it, operate on a 24x7 basis. More than 1.2 million orders and 2 million invoices are processed annually.

Following a major consolidation initiative, servers and storage supporting SAP systems are located at two regional data centers. These are equipped for remote failover in case either is disabled.

Company C

This profile is of a global consumer packaged goods manufacturer with approximately $10 billion in revenues and 35,000 employees. R/3 systems support operations at 120 manufacturing plants, 200 distribution centers and more than 400 administrative and sales facilities.

During the 1990s, the company realized major gains in supply chain efficiency through R/3 ERP systems deployed in a decentralized manner across 18 regional and national business units. Continued competitive pressures, increasingly mature markets, along with consolidation among major retail customers have, however, led the company to revise its ERP strategy.

Four regional R/3 systems have been put in place, along with shared services structures for finance, procurement and other functions. A real-time business model is being adopted. The ability to assemble information from all stages of the supply chain, and to interpret and exploit it in real time is critical to the company's ability to respond to fast changing, increasingly exacting customer requirements.

A range of new SAP solutions, including APO, BW, CRM, and EBP, are central to the real-time strategy. More effective exploitation of information is seen as a means not only of improving operational efficiency, but also of accelerating product development, marketing and promotional cycles, and of increasing innovation throughout the company.

The company's 27 data centers have been consolidated to 2. These are located approximately 20 kilometers from each other and are duplexed for disaster recovery purposes.

Company D

This profile is of a global manufacturer of commodity and specialty chemicals with revenues of approximately $6 billion. The company has approximately 40,000 employees and operates more than 60 plants worldwide. It serves more than two million customers in chemicals, electronics, food processing, healthcare, industrial manufacturing, metals and other industries in 50 countries.

The company operates in largely mature, price-sensitive markets that experience little technological change. Because of high transportation costs, the company is obliged to maintain numerous local production facilities. The potential for cost reduction through manufacturing consolidation is thus comparatively limited.

Therefore, the company business strategy has focused on achieving incremental improvements in operating profit over time. In addition to targeting continued gains in operational efficiency, management anticipates that use of real-time decision-making tools and improved use of customer and supplier extranets will deliver further economies. SAP APO, BW, CRM, EBP and Internet Sales systems have been deployed.

SAP knowledge management solutions are being rolled out to large segments of the workforce. The goal is to encourage cross-functional collaboration and foster innovation in product development, process strategies, customer interaction and other areas.

Existing SAP systems support more than 8,000 users worldwide, and process more than one million online transactions per day during peak periods. It is expected there will be at least 12,000 users of SAP knowledge management tools. Servers and storage supporting all SAP systems have been consolidated to two data centers located near the company's global headquarters. These are duplexed for disaster recovery.

Company E

This profile is of a global manufacturer of industrial machinery, components and materials with approximately $4 billion in revenues and 30,000 employees. The company operates 40 manufacturing facilities, maintains 60 sales and distribution locations, and supplies more than one million customers directly and through distributors.

The company offers more than 20,000 separate variants of its products. For this reason, and because of high levels of interdependency between its different production bases, the company's order management, manufacturing, logistics and procurement operations are exceptionally complex. The challenges of maintaining supply chain efficiency and responsiveness to customers are greater than for most other businesses.

As part of a broader corporate strategy to reduce operating costs and increase competitive performance, the company has consolidated its core R/3 systems to five instances, and has begun to standardize ERP processes across its more than 50 business units worldwide.

APO, BW, PLM and other latest-generation SAP systems have been put in place. Servers and storage supporting strategic systems have been consolidated into two co-located data centers, which are duplexed for disaster recovery purposes. Smaller centers are maintained in the company's major geographies to support local systems.

Company F

This profile is of a specialty retailer with revenues of approximately $2 billion and more than 20,000 employees. The company operates more than 900 stores, and sells through catalogs and the Internet. Two distribution centers support all channels.

The company employs one of the world's highest-volume SAP IS-Retail systems. Peak workloads exceed 750,000 online transactions per hour, and more than 10 million batch transactions per night. The IS-Retail database exceeds 4 TB.

SAP R/3 systems are also employed for the company's logistics operations and financial applications. RFID capability is being implemented. In addition, the company has deployed a large-scale SAP BW-based data warehouse, which is equipped with real-time data feeds from the core IS-Retail system and which, in turn, supplies data marts located in marketing departments and in larger stores.

Like the other profile companies, this company's ERP strategy has a dual focus on realizing ongoing gains in operational efficiency, and using information more effectively. The company's business is fashion-sensitive. The ability to conduct trend analysis, update forecasts and initiate replenishment actions in real time is emerging as a critical new source of competitive advantage.

Servers and storage supporting SAP systems are concentrated in a single data center. A third-party services firm provides disaster recovery coverage in the event of a severe outage. The company's database size and high transaction volumes pose exceptional availability recovery challenges. It is particularly important to avoid outages during the peak pre-Christmas sales season.

Survey Base

The survey base was composed of companies involved in manufacturing (17), financial services (10), insurance (5), utility, (5), transportation (4), energy (3) and other (5) industries, along with 5 public sector organizations.

Manufacturing companies included chemicals, consumer products, electronics, industrial machinery, mill products and steel manufacturers. Financial services companies included retail as well as commercial banks.

Of the 49 companies, 6 reported revenues of more than $50 billion for their most recent fiscal year, while 10 reported between $10 and $50 billion, 28 reported between $1 billion and $10 billion, and 5 reported less than $1 billion.

Distribution of applications among the organizations surveyed was as shown in figure 13.

Figure 13

SAP Applications Employed by Surveyed Organizations

Application	Number	Application	Number
Financial Accounting (FI)	49	Treasury (TR)	7
Controlling (CO)	39	Advanced Planning & Optimization (APO)	7
Human Resources (HR)	36	Core banking	5
Materials Management (MM)	32	Special Purpose Ledger (SL)	5
Sales & Distribution (SD)	27	Quality Management (QM)	4
Business Information Warehouse (BW)	19	Customer Relationship Management (CRM)	3
Production Planning & Control (PP)	16	IS-Oil	3
Plant Maintenance (PM)	10	Strategic Enterprise Management (SEM)	3
Project System (PS)	10	Warehouse Management (WM)	3
Asset Management (AM)	9	Other	25

The overall base included 30 European and 22 North American organizations, along with one each in Australia and South Africa.

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