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Intel® Itanium® 2 Processor



## Reducing Total Cost of Ownership (TCO) Through Server Consolidation

### A Quantitative Case Study

March 2007

Fujitsu Limited  
Intel Corporation

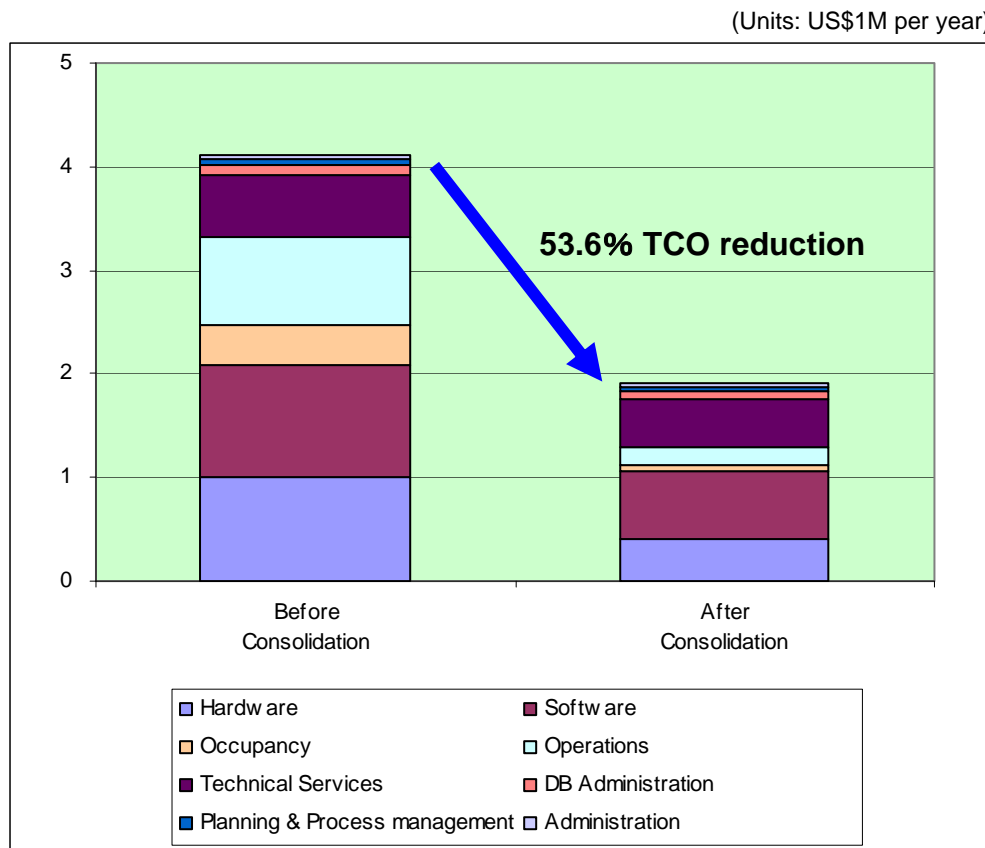
## Executive Summary

The capability and reliability of standards-based servers have increased dramatically in recent years, providing IT organizations with new opportunities for reducing Total Cost of Ownership (TCO). In particular, the scalability, availability and multi-OS support of Itanium-based servers enables cost-effective consolidation of many legacy applications onto fewer and more affordable systems.

This case study quantifies the savings that can be realized through consolidation. It is based on an internal project implemented by Fujitsu Limited to consolidate the company's mission-critical indirect purchasing systems onto Fujitsu PRIMEQUEST servers running the Linux operating system. It uses the widely accepted TCO benchmarking methodology developed by Gartner, and applies that methodology consistently before and after consolidation.

As will be shown in detail, Fujitsu realized a 53.6 percent reduction in TCO by consolidating legacy applications, and achieved substantial savings across all key metrics, including hardware, software, data center occupancy and personnel costs (Figure 1). These results not only validate the TCO benefits of consolidating legacy applications on Itanium-based servers, but also demonstrate a cost model that IT organizations can extend to accommodate their own projects.

In addition to the TCO savings, Fujitsu realized significant gains in workforce efficiency by integrating their purchasing applications during the consolidation project. However, given the enormous diversity among enterprise software environments, it would be challenging to present the costs, risks and benefits of software integration in a way that would be meaningful to other organizations. This paper therefore focuses on the clear and measurable benefits of hardware consolidation.



**Figure 1.** By consolidating its indirect purchasing applications onto Itanium-based PRIMEQUEST servers, Fujitsu realized a 53.6 percent reduction in TCO, with savings across all key IT metrics.

## Introduction: Building a Case for Consolidation

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Many companies are considering server consolidation as a strategy for improving performance and reducing the TCO of their legacy computing solutions. With the dramatic improvements in the performance and reliability of standards-based servers over the past few years, the potential cost advantages of consolidation are better than ever. However, despite a tremendous number of reports and documents promoting consolidation, there have been few concrete examples that quantify the benefits.

This case study addresses that need, by documenting the TCO reduction achieved by Fujitsu in consolidating its mission-critical indirect purchasing systems onto Fujitsu PRIMEQUEST servers (based on the Intel Itanium 2 processor). It describes the legacy and consolidated environments, and provides a detailed description of the Gartner TCO Solution used to measure costs. It also provides quantitative results of the actual savings achieved.

## Fujitsu's Legacy Environment

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Fujitsu Ltd. began working to reduce costs for its central purchasing systems in 2000. Purchasing within Fujitsu is divided into two areas, which are supported by different systems and applications.

- **The direct material purchasing** system is used to manage the buying of raw materials and parts that are used in Fujitsu's manufacturing processes.
- **The indirect material purchasing** system is used to manage the buying of office supplies, equipment and other materials that support the company's internal operations.

At the time of this case study, the direct materials purchasing systems had already been consolidated, but the indirect purchasing system was still comprised of multiple systems that had been separately built or acquired by various enterprise divisions. Prior to consolidation, the infrastructure for the indirect purchasing system included the following applications and servers.

- **Administration purchasing system** for purchasing office supplies. This system was supported by three servers, including two Fujitsu GP6000 business servers and one Fujitsu GP7000 UNIX server.
- **Network purchasing system** for managing payments to carriers, etc. This system was supported by eight servers, including two Fujitsu PRIMERGY Intel processor-based servers, two Fujitsu GP5000 Intel processor-based servers, two Fujitsu DS/90 UNIX servers and two Fujitsu GP7000 UNIX servers.
- **Equipment purchasing system** for managing equipment purchases, maintenance and related costs. This system was supported by a single Fujitsu GP5000 Model 280 Intel processor-based server.

The hardware configurations, application architectures, locations and support processes for these three systems were all different. In the effort to restructure and integrate its indirect purchasing system, Fujitsu specified the following goals:

- **Reduce overall costs** by taking advantage of the superior performance and price/performance of the new hardware.
- **Reduce software licensing fees** by running the same workload on fewer but more powerful processors, and by managing licenses more efficiently in the consolidated environment.
- **Reduce data center costs** due to the smaller physical footprint of the new server infrastructure and its reduced power and cooling requirements.

- **Reduce the number of operational personnel** by reducing the number of servers and locations that would have to be managed.
- **Optimize workforce efficiency** by integrating the disparate applications. (Though these gains would also be substantial, the costs, risks and benefits of software integration tend to vary appreciably among different businesses. These factors were therefore not included in this TCO study. The associated application development and support costs were also excluded.<sup>1</sup>)

## Fujitsu's Environment after Consolidation

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Itanium-based Fujitsu PRIMEQUEST servers were chosen for the consolidation, because of their high performance and reliability running Linux (see Appendix B for more information about PRIMEQUEST servers). Red Hat Enterprise Linux AS was chosen as the operating system, since it provides the cost advantages of an open-source OS, along with the support needed for an enterprise-class solution.

The three legacy purchasing systems were integrated and consolidated onto two Fujitsu PRIMEQUEST 480 servers in a clustered configuration (Figure 2). Each system was divided into eight hardware partitions (LPAR), with four CPUs and 16Gbytes of memory allocated to each partition. Four LPAR were used for the production environment, which included the database server, Web/AP server, Document NAVI server, and operations management server (each hosted in a separate LPAR). The remaining four LPAR were used for application development.

Also part of the system, and included in the TCO analysis, were two UNIX servers used for system linkage; two Fujitsu RISC-based servers (running Solaris 9) used for management; and two Intel Architecture-based servers used as output servers.

Both the hardware and software architecture were designed to provide somewhat more capacity than actually needed, so the system would support additional environments for future expansion (development, integration with another system, etc.).

### The PRIMEQUEST Advantage

PRIMEQUEST servers combine the best in open, standards-based technologies with innovations garnered from Fujitsu's extensive experience in mainframe solutions. These servers are based on Intel Itanium 2 processors, which combine a highly parallel architecture with a large-on die cache (up to 24MB), vast memory capacity and strong floating-point performance to deliver essential performance advantages for demanding business and technical applications.

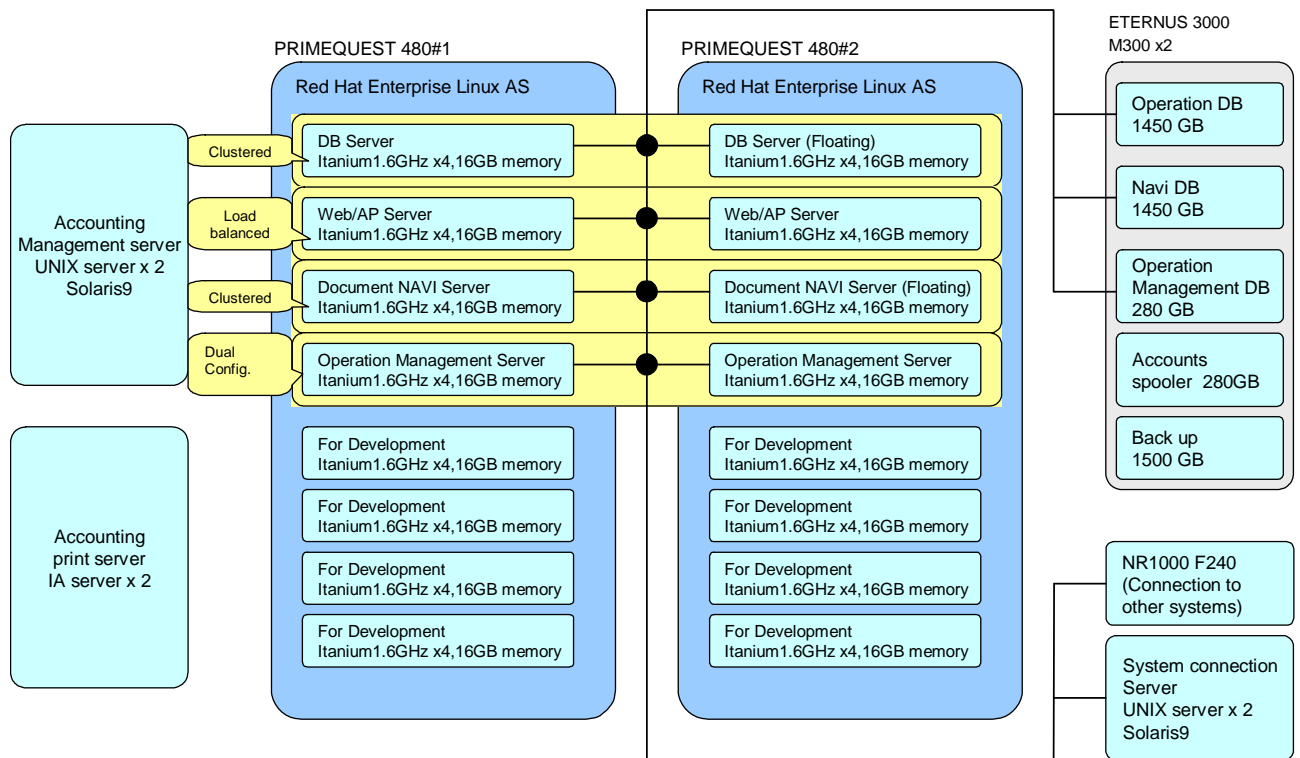
Fujitsu adds an innovative, high-performance chipset and a number of system-level innovations, such as system mirroring for ultra-high availability; partitioning and flexible I/O for matching compute resources to business needs; and built-in management boards (MMB) for further increasing availability while reducing TCO. The result is one of the most flexible, scalable and reliable server systems available today for running mission-critical applications on Linux or Windows.

- *For more information about PRIMEQUEST Servers, see Appendix B.*
- *For more information about Intel Itanium 2 processors, see Appendix C.*

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<sup>1</sup> Fujitsu did report, however, that the efficiency and ease-of-use of the latest development tools simplifies application development, and will provide ongoing benefits as application needs continue to evolve.

**Figure 2. System Architecture after Consolidation**



## The Gartner Benchmarking Solution

Operational terms and definitions vary extensively among enterprise IT organizations, which makes it difficult for an individual enterprise to perform TCO benchmarking in a way that is meaningful to their counterparts in other companies. To address this challenge, Fujitsu took advantage of the Gartner TCO Benchmarking Solution, which defines and models cost structures consistently across diverse organizations, to provide reliable and repeatable results. The Gartner methodology normalizes measurements to enable meaningful comparisons with the real, specific and quantitative cost data of other enterprises.<sup>2</sup>

### About Gartner

*"We deliver the technology-related insight necessary for our clients to make the right decisions, every day."*

Gartner is an independent third-party IT analyst and a pioneer in developing tools and methods for measuring and reducing TCO in enterprise IT environments. Founded in 1979, Gartner is headquartered in Stamford, Connecticut, U.S.A. The company currently serves 10,000 organizations, including chief information officers and other senior IT executives in corporations and government agencies, as well as technology companies and the investment community. The Company has 4,000 associates, including 1,200 research analysts and consultants in 75 countries worldwide. Gartner's strategies and consulting services are highly regarded both nationally and internationally. For more information, visit the Gartner Web site at:

<http://www.gartner.com/it/products/consulting/benchmarking.jsp>

<sup>2</sup> The term "TCO reduction" is common in the IT world, but is rarely explained precisely. This is because no company other than Gartner has successfully defined TCO cost items for the systematic modeling or collecting of IT cost data. The Gartner TCO Benchmarking Solution enables speedy TCO measurement and helps to formulate TCO reduction strategies.

As defined by Gartner, the metrics that comprise TCO for server operation and maintenance are measured on a yearly basis and can be divided into "capital costs" and "non-capital (personnel) costs" (Table 1). Costs related to hardware, software and facilities are included in capital costs, as are lease costs, depreciation and a number of other miscellaneous expenditures. Non-capital (personnel) costs include salaries and benefits, as well as outsourcing costs related to technical support, management and server system operation and maintenance.

Since the primary aim of this study was to verify the TCO benefits of server consolidation, expenses related to disk devices, tape devices, printers and other supplies were excluded from the hardware costs. All hardware and software costs, including support and maintenance expenses, were calculated using five year amortization, and were based on the net (fixed) price.

**Table 1. Capital and Non-Capital Costs in TCO Assessment** (see Appendix D for more detail).

<b>Capital Costs</b>	
Hardware	Processor Disk devices (excluded in this study) Tape devices (excluded in this study) Printers (excluded in this study) Other supplies (excluded in this study)
Software	Operating System DBMS (Database Management System) Middleware
Occupancy	Floor space (including facility costs)
<b>Non-Capital Costs (personnel)</b>	
Technical Support	Operations Technical Services Disaster Recovery High Availability
Physical DB Administrator Planning & Processing management	
Administration	Management Finance & Asset management Account management Accommodation

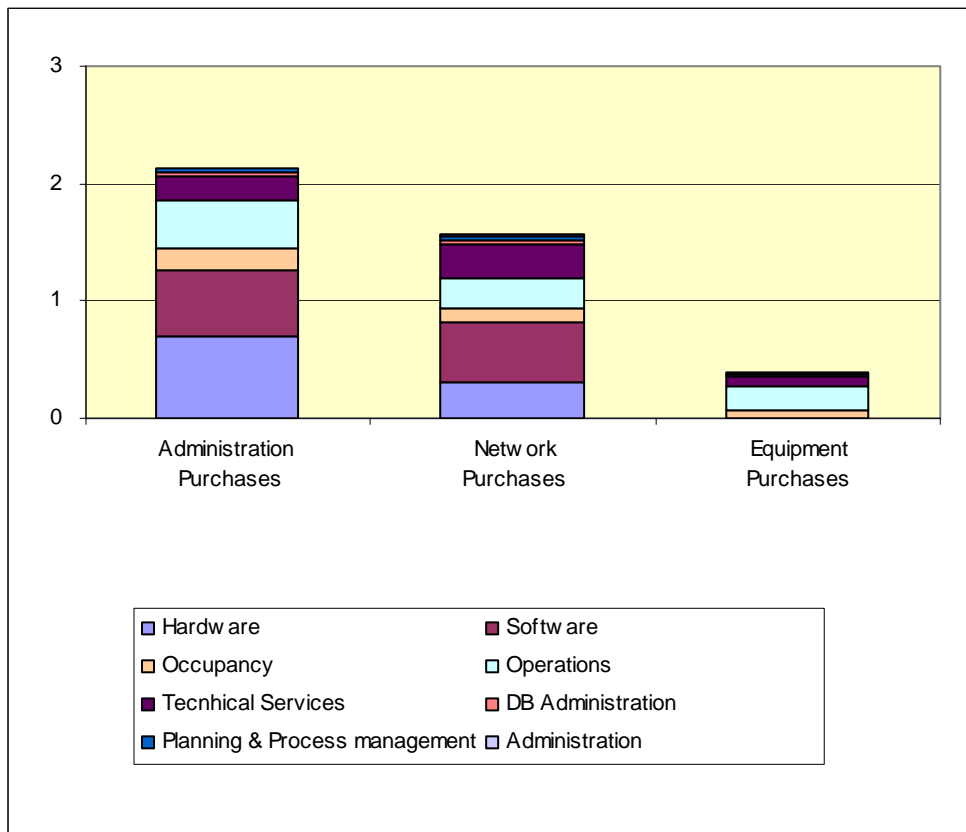
## Measured TCO and TCO Savings

TCO for the Fujitsu indirect procurement system was measured twice using the Gartner TCO Benchmarking Solution: once before consolidation and again after consolidation.

- **TCO Before Consolidation:** TCO was measured for each of the three indirect purchasing systems (Administration, Network and Equipment), and the results were combined to determine TCO for the full solution (Figure 3). The total cost of ownership per year prior to consolidation was approximately \$4.1 million.
- **TCO and Savings after Consolidation<sup>3</sup>:** The same TCO benchmark was applied to the consolidated system. The results demonstrated that cost savings were achieved across all metrics (Table 2 and Figure 4). Altogether, the annual TCO of the consolidated system came to \$1.9 million, or 46.4 percent of the TCO of the unconsolidated legacy systems.

<sup>3</sup> As noted in the previous section, Fujitsu used two Fujitsu PRIMEQUEST 480 servers (equipped with 32 single-core Intel Itanium 2 processors) to consolidate the legacy applications and provide capacity for future uses. However, the capacity required for the consolidation project could currently be supplied by two of the latest PRIMEQUEST 540 servers (equipped with 8 Dual-Core Intel Itanium 2 processors). To provide TCO results that would be most meaningful to IT organizations performing a similar consolidation, the TCO measurements in this report are based on the cost and capacity of the latest PRIMEQUEST 540 servers.

(Units: US\$1M per year)



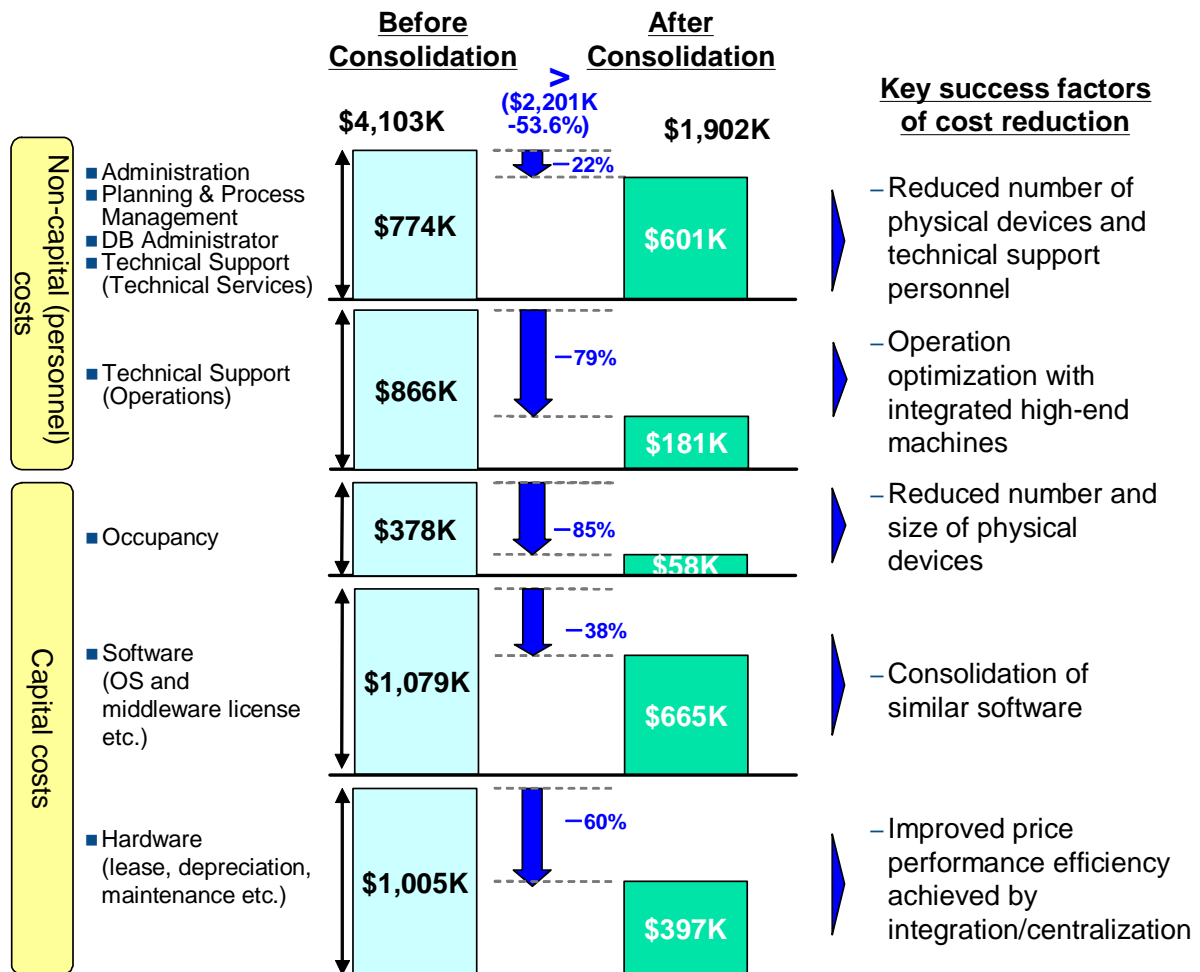
**Figure 3. TCO Before Consolidation.** The combined TCO for the legacy indirect purchasing systems was approximately \$4.1 million. (See Table A1 in Appendix A for a breakout of individual costs.)

**Table 2: Summary of TCO Savings** (See Table A2 in Appendix A for a more detailed breakdown of costs and savings.)

(Units: US\$ per year)

	Old TCO	New TCO	Savings	Percent Reduction
Hardware	1,005,130	396,826	608,304	60.5%
Software	1,079,487	665,339	414,148	38.4%
Occupancy	378,435	58,174	320,261	84.6%
Technical Support Personnel	1,448,348	631,336	817,012	56.4%
Other Personnel	192,000	150,261	41,739	21.7%
<b>Total</b>	<b>4,103,400</b>	<b>1,901,936</b>	<b>2,201,464</b>	<b>53.6%</b>

**Figure 4 TCO Before and After Consolidation.**



The key factors that brought about the cost reductions are as follows:

**Occupancy Costs**

This includes data center rental costs, as well as electric power and air conditioning expenses. Prior to consolidation, Fujitsu’s indirect purchasing servers were physically distributed across three locations. They are now integrated in a single location. Moreover, the physical number of installed servers was reduced from 12 to 8. As a result, Fujitsu achieved a cost reduction of about \$320 thousand in data center occupancy costs (85% reduction).

**Technical Support Personnel Costs**

This includes the cost of personnel needed to operate the server infrastructure. As a result of consolidation, these costs were reduced by \$817 thousand (56.4%), due to the reduced number of physical locations and a reduction in the required operational skill sets.

### **Other Personnel Costs (DB Administration, Planning & Process Management)**

This includes expenses for indirect work related to system maintenance. Following consolidation, 10 in-house and outsourced workers were required, which corresponds to a reduction of three FTE (full time equivalent). IT organizations should be aware that, if they are consolidating just a few servers, it may be more difficult to successfully reduce personnel costs.

### **Hardware Costs**

This includes the cost of servers, as well as certain peripherals and maintenance costs. Before integration Fujitsu spent \$1.005 million on hardware maintenance. After server consolidation, this was reduced to just \$397 thousand (calculated using five year amortization, based on the net (fixed) price). Fujitsu is also benefiting from improved price/performance of the servers and the reduced complexity of a consolidated environment.

### **Software Costs**

This includes the cost of the operating system, the database management system (DBMS) and the middleware. Maintenance and depreciation costs for the business application are not included in the Gartner TCO model. Through consolidation, Fujitsu reduced their software costs from \$1.079 million to \$665 thousand (a 38% reduction). This included significant cost reductions in licensing and support for the DBMS and middleware.

## **Conclusion**

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To simplify its computing environment and reduce total costs, Fujitsu undertook a project to consolidate its indirect purchasing systems onto fewer servers in a single location. Itanium-based PRIMEQUEST servers were used as the primary platform for consolidation, because of their high performance and reliability running the Linux operating system. The Gartner TCO Solution was applied before and after the consolidation, to provide a quantitative measurement of cost savings that would be both reliable and meaningful to other businesses contemplating similar consolidation projects.

The results were compelling. Through consolidation onto Itanium-based servers running the Linux operating system, Fujitsu reduced its total cost of ownership by \$2.2 million, for a 53.6 percent overall reduction in TCO. Cost savings were realized across all cost categories, including hardware, software, occupancy and personnel. Clearly, the use of industry-standard server technologies is not only a viable alternative for server consolidation, but an excellent way for IT managers to drive down TCO for legacy applications.

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## Appendix A: Detailed TCO Data

**Table A1. TCO Measurements Before Consolidation.**

(Units: US\$ per year)

		Administration Purchases	Network Purchases	Equipment Purchases	Total before consolidation	
Capital costs	Hardware	695,583	308,948	600	1,005,130	
	Software	572,487	506,678	322	1,079,487	
	Occupancy	189,217	113,530	75,687	378,435	
Personnel costs	Technical Support	Operations	404,870	265,461	195,757	866,087
		Technical Services	206,609	281,739	93,913	582,261
	DB Administration		34,435	46,957	13,565	94,957
	Planning & Process management		20,661	28,174	9,391	58,226
	Administration		13,774	18,783	6,261	38,817
Total		2,137,635	1,570,270	395,496	4,103,400	

**Table A2. TCO Measurements and Cost Savings After Consolidation**

(Units: US\$ per year)

		Before Consolidation	After Consolidation	Reduction effect		
Capital costs	Hardware	1,005,130	396,826	-608,304	-60.5%	
	Software	1,079,487	665,339	-414,148	-38.4%	
	Occupancy	378,435	58,174	-320,261	-84.6%	
Personnel costs	Technical Support	Operations	866,087	180,553	-685,534	-79.2%
		Technical Services	582,261	450,783	-131,478	-22.6%
	DB Administration		94,957	75,130	-19,826	-20.9%
	Planning & Process management		58,226	45,078	-13,148	-22.6%
	Administration		38,817	30,052	-8,765	-22.6%
Total		4,103,400	1,901,936	-2,201,464	-53.6%	

## Appendix B: The PRIMEQUEST Advantage

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PRIMEQUEST servers combine the very best in open, standards-based technologies with innovations garnered from Fujitsu's extensive experience in mainframe solutions. The result is one of the most flexible, scalable and reliable hardware architectures available today for running mission-critical applications on Linux or Windows. These systems provide impressive performance, along with exceptional flexibility for aligning computing resources with business needs. This makes them an ideal hardware platform for database, ERP, and other mission-critical enterprise applications.

### Hardware Technology Innovations

- **High-Performance Fujitsu Chipset**—Based on cutting-edge, 90nm process technology and an ultra high speed interface, this custom-designed chipset provides a balanced system architecture that enables top performance across a wide range of workloads.
- **Dual-Core Intel® Itanium® 2 processors**—The latest Intel Itanium 2 processors approximately double calculation speeds and throughput versus the previous generation, and provide a large increase in memory address space. They provide a fast, reliable and scalable foundation for processing large data sets and complex, multi-threaded applications.

### System Innovations

- **System Mirroring**—Major components, including memory, chipsets and crossbars, can be mirrored to ensure uninterrupted operation. This enables PRIMEQUEST servers to surpass mainframe levels of reliability, by automatically isolating failed components without interrupting processing.
- **Flexible I/O**—This unique technology enables resource separation between System Boards (containing CPU & Memory) and I/O Units (containing Disks & PCI cards). Resource utilization is improved and restarts are quicker following system failure, since floating system boards can be used on system reboot.
- **Partitioning**—PRIMEQUEST servers can be divided into multiple partitions, with each partition running different applications and operating systems. In particular, PRIMEQUEST580 can be sub-divided into 16 partitions using the extended partitioning (XPAR)<sup>4</sup> function. The combination of partitioning and flexible I/O provides unprecedented flexibility in allocating hardware resources (CPU, memory and I/O).
- **Management Boards(MMB)**—Included in every PRIMEQUEST server, MMB units provide advanced hardware monitoring, configuration management, error messaging, partition management, network management and power control. No dedicated server or management software is required. Paired for non-stop operation, this consolidated management function reduces server management resources and costs, while further increasing reliability.

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<sup>4</sup> XPAR : eXtended Partitioning divides each system board into two partitions, with a maximum of two CPU per partition.

## Appendix C: More about the Intel Itanium 2 Processor Family

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Intel Itanium 2 processors are designed to deliver the highest levels of performance and availability for mission-critical, data-intensive applications, while delivering new levels of choice and flexibility that enable easier integration and lower total costs.

### **High Performance**

By allowing the compiler to optimize code for parallel throughput, the EPIC technology of Intel Itanium 2 processors improves performance while eliminating the need for complex, on-die scheduling circuitry. This has enabled Itanium-based servers to deliver preeminent performance and scalability for core business applications, such as large databases, Enterprise Resource Planning (ERP), Supply Chain Management (SCM), Business Intelligence (BI), and data mining. Servers based on the latest Dual-Core Intel Itanium 2 processors have doubled performance compared to the previous generation, and Intel has a strong roadmap of future processors that will continue to drive performance to new levels.

### **Advanced RAS**

With their Advanced Machine Check Architecture, all Intel Itanium 2 processors provide a standards-based framework for monitoring and correcting errors at the hardware, firmware and OS levels. Dual-Core Intel Itanium 2 processors add Intel® Cache Safe Technology and processor lock-step support to take high availability to the next level. Fujitsu and other system vendors are building on this foundation to provide highly fault-tolerant systems that support 99.99999 and higher availability.

### **Choice and Flexibility**

Intel Itanium 2 processors are based on an open, industry-standard architecture. They are supported by dozens of server vendors, over 11,000 applications, and more than 10 operating systems, including Windows, Linux and UNIX. This gives customers a broad choice of vendors, hardware and software so they can build and extend their systems more easily. The broad community of vendors also leads to faster innovation and lower costs. System vendors are freed from the high cost of processor development, and can focus on delivering the unique system and software capabilities that provide the greatest value to their customers.

### **Low Power Consumption**

Dual-Core Intel Itanium 2 processors not only double performance compared with the previous generation, but also reduce power consumption by about 20 percent. This delivers a 250 percent increase in performance per watt, which delivers substantial value for Internet infrastructure, network edge, security and other front-end data center applications. It reduces electricity and cooling costs, and enables high-density form factors that reduce data center footprints. This can have a significant impact on operating costs and can help IT organizations extend the life of existing facilities.

## Appendix D: More about the Gartner TCO Model

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In the Gartner TCO model, server operation and production environment costs are measured and analyzed over a fixed period (usually one year), to determine the total IT cost. This cost consists of two main components: capital costs and non-capital (personnel) costs. Capital costs include hardware, software and location costs. Non-capital costs include personnel costs for server operation (see cost breakouts below). By providing unambiguous definitions of each cost item, and a clear method for compiling data, Gartner's TCO model enables precise and high quality benchmark analysis.

### Capital Costs

#### Hardware

This includes the costs associated with maintenance and operation of the system processors, disk devices, print devices, tape devices (e.g., ATLS and tape drives) and other peripherals associated with the centralized systems—as well as other miscellaneous devices needed to support the processing equipment. It also includes the cost of miscellaneous supplies (e.g., paper and tapes). It does not include circuit or similar costs needed to connect to the network, but does include the costs to connect multiple data centers or processors/devices to each other. It also includes:

**High-Availability Hardware:** These are hardware-related costs linked to planning, testing and implementing high-availability procedures — the processes and resources used to maintain the enterprise's ability to continue operation of vital business functions without interruptions or outages. Examples include duplicate and redundant hardware.

**Disaster Recovery:** These hardware-related costs are linked to planning, testing and implementing disaster-recovery procedures — the processes and resources used to safeguard the enterprise's ability to continue operation of vital business functions following physical damage or other catastrophes impacting business facilities.

**Client Devices:** These are the desktop, mobile and PDA devices used by the Operations staff.

#### Software

**Operating System:** The operating system is the main control program that runs a computer and sets the standard for running application programs. It is the first program loaded when the computer is turned on, and it resides in memory at all times. An operating system is responsible for functions such as memory allocation, managing programs and errors as well as directing input and output.

**Database and Data Management:** This encompasses all server database licenses, including database utilities, data mining, business intelligence tools and report writers that run on production servers. It does not include the cost of application software that uses these databases, nor does it include the cost of IT management software as defined below.

**Messaging:** This includes the server component of e-mail, groupware and collaboration software.

**IT Management Software:** This refers to server-based software that is used exclusively by the IS department, including purchased software such as network, systems, storage and asset management, service desk management, training and high-availability software.

**Disaster Recovery:** This includes software-related costs linked to planning, testing and implementing disaster recovery procedures — the processes and resources used to safeguard the enterprise's ability to continue operation of vital business functions following physical damage or other catastrophes impacting business facilities.

## Occupancy

This refers to the costs imposed on the facilities occupied by the hardware and workers. It includes equipment installation space, office space, power supply equipment, maintenance, property tax, office articles of consumption, telephone, PC, the stability power supply, the no-power failure device, and similar costs. Areas include:

**Raised Floor:** This is the floor area that is elevated to facilitate wiring and ventilation. Costs are often determined by multiplying the size of the raised floor space (i.e., square footage or square meters) by 12 times the monthly rate for that space.

**Office Space:** This is the office areas that are not raised floor space and are used by the FTEs included in the TCO analysis. Costs are often determined by multiplying the average size of the office space per employee (i.e., square footage or square meters) by 12 times the monthly rate for that space.

**Disaster Recovery Hot-Site:** This refers to the cost of the disaster recovery contract and related non-labor costs. It includes the following items:

- Disaster recovery contract costs
- Disaster recovery document and procedure management software
- Tape and disk storage costs related to disaster recovery
- Off-site data storage costs

## Non-Capital Costs (Personnel Costs)

### Technical Support

#### Operations

**Operations Support:** These personnel have responsibility for the overall operation of installed computer systems, specifically:

- System start/stops
- Monitoring system jobs
- Responding to console messages
- Diagnosing and correcting production failures

Typical positions: Shift supervisors, shift operators, operations automation, change management.

**Tape Support:** These personnel control, store and provide tapes that are needed by the users of the processing environment. They also:

- Request, mount and remove tapes
- Order, clean and dispose of tapes
- Catalog volumes in a tape management system

Typical positions: Tape librarians, tape operators.

**Output Support:** These personnel maintain the operating environments of output devices by:

- Replacing consumables such as paper, toner, fiche and developing solution
- Removing output from the devices
- Separating the output media by appropriate client or client group
- Directing the output to the clients

These personnel **do not** deliver output to operations center clients or provide mailing or finishing services.

**Production Control:** These personnel maintain the integrity of the production environment by:

- Turning over applications from test into production after the systems have been developed and tested.
- Ensuring that systems to be placed in the production environment meet certain standards.
- Providing job procedural documentation such as scheduling requirements and rerun procedures.

- Establishing and adjusting the batch job schedule.
- Providing ongoing job monitoring.
- Reviewing the service level of production jobs to improve quality and/or efficiency.

Typical positions: Production turnover, production scheduling, production monitoring

### **Technical Services**

This represents the personnel cost/FTEs associated with the technical installation and maintenance of equipment, software or other technologies specifically required for performance. It includes only those personnel costs/FTEs that are within the scope of the specific TCO analysis.

**System Support:** These personnel maintain the operating system and transaction processing (e.g., online) environments, by:

- Evaluating, installing, maintaining (e.g., fixes and upgrades) and removing system software, security packages, systems utilities and database transaction packages.
- Establishing technical standards.
- Diagnosing and resolving system problems.
- Tuning system performance.

This cost category **does not** include personnel who develop applications or support them after implementation.

Typical positions: System administrators, system programmers.

**System Security:** These personnel develop standards and procedures for ensuring overall system integrity, by:

- Controlling system access (for example, by user-id and password).
- Establishing standards for file access software (security software).
- Auditing system security and correcting violations.

Typical position: Security analyst

### **Disaster Recovery**

These personnel are responsible for planning, testing and implementing contingency procedures. They are dedicated to safeguarding the enterprise's ability to continue operation of vital business functions following physical damage or other catastrophes impacting business facilities. Responsibilities include:

- Maintaining disaster recovery documentation.
- Negotiating contingency site arrangements and serving as liaison with the vendor.
- Managing off-site data retention.

### **High-Availability**

These personnel are dedicated to maintaining the enterprise's ability to continue operation of vital business functions without interruptions or outages.

### **Physical DBA**

These personnel maintain the physical placement and integrity of databases used in the environment. Activities would include periodic re-organizations and layout of the database within the disk storage system.

### **Planning and Process Management**

These personnel perform activities related to the planning for and management of current and future technology needs and the establishment of policies and processes relating to technology. This includes, but is not limited to, systems research, product management, technology evaluation and purchase decision making, establishment of processes surrounding security and virus protection, and business continuity/recovery.

## Performance

These personnel develop standards and measures for the technical performance of operating systems and major subsystems by:

- Identifying overall system performance trends and problems that may be used as input to other technical areas.
- Targeting specific applications for performance improvements and working with developers and system programmers to implement associated changes.
- Recommending workload balance procedures.
- Helping to establish client service-level objectives.
- Measuring and reporting on performance relative to system service-level objectives.
- Reporting on performance relative to service-level agreements.

Typical position: Performance analyst

## Capacity Planning

These personnel establish the performance and capacity thresholds for computer system changes, monitor system utilization and forecast capacity needs. Responsibilities include:

- Evaluating and recommending new hardware.
- Planning upgrade schedules.

Typical position: Capacity analyst

## Storage Management

These personnel work to establish, report on and optimize the utilization of the storage environment. Responsibilities include:

- Determining and using the tools necessary to perform the function.
- Managing physical and logical configurations of disk devices.
- Determining criteria for tape silo data sets.
- Working with physical placement of data sets.
- Establishing standards for data set retention, reorganization and migration.

Typical position: Storage analyst

## Administration

### Management

**Operations:** These personnel have management responsibility for two or more of the operations functions described above. If managers have responsibility for only one of those operations functions, the costs should be included within that specific function.

**Technical Services:** These personnel have management responsibility for two or more of the technical services functions described above. If managers have responsibility for only one of those functions, the costs should be included within that specific function.

**Occupancy:** These in-house and contract personnel are responsible for the overall administration of the facilities under the scope of the TCO analysis. Typical positions include operations manager and facilities manager.

### Finance and Administration

**IS Administration:** These personnel provide direct administrative and clerical support to all operation center organizations. Typical positions include secretary, receptionist and administrative assistant.

**Budget and Chargeback:** These personnel establish the operation center's budget, monitor actual expenses versus the budget, arrange financing for purchases and provide financial reporting to other enterprise areas. They also handle the operation of the chargeback system. Typical positions include financial analyst and chargeback administrator.

**IS Training:** These personnel are the primary source for the delivery of training within the IS organization. They may also prepare training materials, evaluate employee skills and assist in the creation of custom training programs for the organization.

### **Asset Management**

**Tracking:** These personnel provide administrative support for tracking systems and system components. They account for labor and contract costs for managing depreciation records and lease contracts, perform asset inventories (physical or automatic management), asset identification and tracking, asset database management, and change recording and reconciliation. Additional functions include the creation and maintenance of an up-to-date record of installs, moves, adds, changes, removals and final disposal of all assets (e.g., hardware, software and circuits). The records they maintain contain information for locating, assessing, auditing, troubleshooting, counting, and assigning assets, or performing other technical and business functions, without the need to repeatedly visit the asset location or reassemble data records. These personnel also determine an asset's useful life, including planning for the installation, upgrade, and removal/disposal of the asset and executing the plan.

**Procurement:** These personnel solicit bids, negotiate purchasing agreements, establish purchase orders, validate vendors' bills, coordinate with accounts payable for payment and handle contract administration. Typical position: purchasing.

### **Account Management**

These personnel manage activities related to customer and vendor relationships that are essential for mutual success.

**Business Unit Relationship Management:** These personnel are responsible for the ongoing assessment of the relationship between IS and the lines of business, including monitoring of service levels and ensuring that the evolving support and technology needs of the business are proactively identified and addressed. Typical tasks include business unit alignment, gathering application and infrastructure requirements, business case development, and ongoing project management.

**Outsource Contract Management:** These personnel perform functions similar to supplier/vendor management, but directed specifically toward managing the performance of outsource service providers. This cost category is explicitly separated from supplier/vendor management due to the scale and complexity involved in large outsourcing deals.

**Supplier/Vendor Management:** These personnel are responsible for the ongoing management of all supplier/vendor relationships, ensuring that service providers are meeting all contractual obligations. This includes vendor selection, negotiation and definition of terms and conditions, service levels, points of contact, rules of engagement, problem resolution, escalation procedures and discount structures.

### **Accommodation**

These costs encompass support for the physical space inhabited by systems, system components and IS staff.

**Environmental Control:** These personnel monitor and maintain environmental support systems. These include heating, air conditioning, water and power. A typical position is maintenance engineer.

**Hardware Installation:** These personnel determine the physical placement of computer hardware within the data center, the connections among devices, the power requirements and the environmental needs. They coordinate with the local utility to provide power feeds and supplement these resources with private power plants and batteries as needed. They typically manage the tasks associated with facility requirements, but it is the technical services — systems support staff that actually manages the tasks associated with the physical installation.