

# *TCO for Application Servers: Comparing Linux with Windows and Solaris*

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*IBM sponsored this study and analysis. This document exclusively reflects the analysis and opinions of the Robert Frances Group (RFG) author, who has final control of its content.*



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## *Executive Summary*

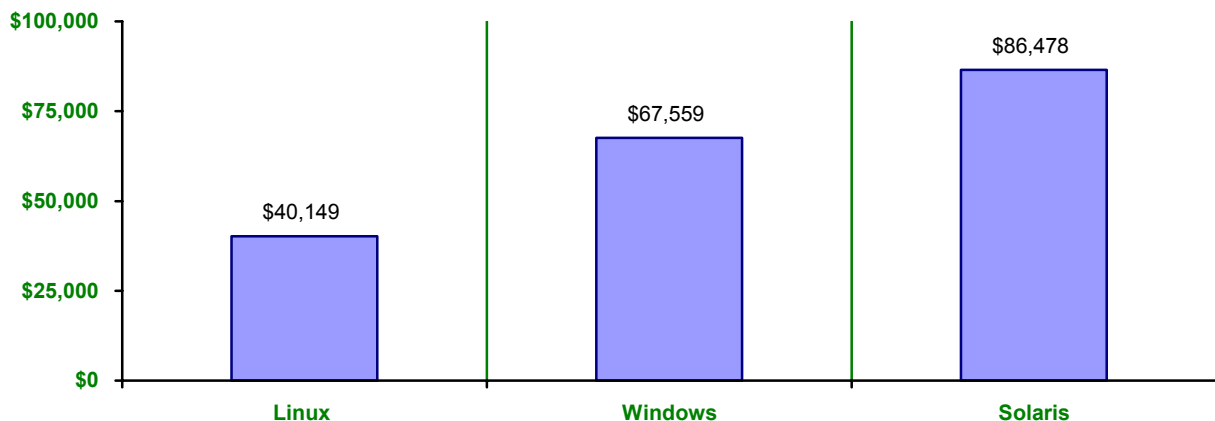
Over the past few years, Linux adoption rates in the enterprise have soared. Users have quoted a wide range of TCO and ROI benefits, and Linux has become a strategic platform for business applications at many companies. It has also come under attack by opponents, who have cast doubt on the cost savings realized by deploying Linux.

In an effort to provide accurate TCO data to enterprise IT executives, RFG performed a quantitative analysis to highlight current operating system experiences in the enterprise. RFG contacted key buyers and IT decision makers across a range of industries, evaluated their level of satisfaction with each operating system, and performed a TCO analysis incorporating their cost data. Because it would be difficult, if not impossible, to evaluate every possible application stack in a single study, RFG examined an application infrastructure layer common to most enterprises – application servers.

The application server is a critical infrastructure component for many companies, and thus represents an ideal target for operating system selection. Because the specific workload profile will have a dramatic impact on the variance in TCO, RFG recommends doing any work analysis this way. IT users should treat with skepticism any studies that do not make such workload distinctions.

RFG has performed several TCO studies in the last 3 years, and thus has a view into how costs have shifted as Linux adoption rates have increased. As Linux has matured, the TCO gap between Linux and Microsoft Windows has narrowed for two reasons. First, commercial product vendors have introduced lower-priced offerings in an attempt to compete with Linux. Second, Linux buyers now treat the platform as they would a commercial product, purchasing the same support offerings, management tools, and other facilities that they would on any other platform. Major vendors now offer a broad array of Linux support options, and most customers make use of these offerings. That said, there is still a significant spread between Linux and the other operating system choices. Over a three year time frame the overall TCO for an application server in each environment is shown below:

### *Overall TCO by Environment*



Linux is 40 percent less expensive than a comparable x86-based Windows solution and 54 percent less than a comparable SPARC-based Solaris solution, based on a 3-year period of ownership for a system supporting 100,000 operations per second on the SPECjbb® benchmark.

In addition, the focus on Linux has largely shifted from raw cost factors to a range of financial and other benefits, such as administrator skill portability, hardware architecture portability, and vendor diversity. These benefits increase the IT department's ability to quickly and cost-effectively meet future workload demands and business challenges.

Beyond TCO reductions, study participants quoted a range of financial and strategic benefits realized by deploying Linux, including its flexible licensing model, wide range of supported hardware platforms, the choice of support providers, and fast administrator skill set transfer from other Unix platforms. Buyers still appreciate the potential TCO reductions Linux can yield, and this remains an important selection criterion. However, IT decision makers are continually challenged to make their IT infrastructures more flexible and agile. RFG found most participants eager to capitalize on the long-term strategic benefits Linux provides to their organizations.

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### ***Key Take Away and Actions***

- Executives should consider Linux under most circumstances to support high transaction environments that support scale out or scale up applications because of the dramatic savings in platform costs.
  - Executives should not be overly concerned that the cost delta will shrink enough between Linux and alternative systems to make the investment in Linux questionable over the next 2 to 3 years.
  - Executives should feel comfortable to use cost savings as a basis to sell a decision to move to Linux, but can also identify business benefits that will in most cases outweigh the cost savings alone of moving to Linux for specific solutions.
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### ***Methodology***

RFG conducted in-depth interviews with IT executives involved with operating system selection and purchase decisions at over 20 mid-sized to large enterprises (250 employees or more). Study participants included Linux, Windows, and Solaris users. Although many participants were large corporations, industry coverage was broad, and included education, entertainment, financial, government, and retail, among others.

To provide the most direct comparison possible between the platform choices, RFG focused on Java 2 Enterprise Edition (J2EE) application server configurations<sup>1</sup>. RFG evaluated J2EE environments running on x86-based platforms running Linux and [Microsoft Corp.](#)'s Windows, and [Sun Microsystems, Inc.](#)'s SPARC-based platforms running Solaris. Additionally, RFG attempted to collect data regarding Solaris on Opteron, but this product combination in production environments is still relatively new, and RFG did not encounter it during the course of the study.

RFG collected quantitative and qualitative data from study participants in the following areas:

- Purchasing, licensing, and deployment
- Hardware selection and purchase
- Vendor and third-party support
- Employee education and training
- System performance and application workloads
- System management and administration, including security management

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<sup>1</sup> *While Microsoft offers a competing application server technology in .NET, the focus of this study was on the operating system, not the application server. To avoid confusion, RFG only evaluated cases where a J2EE product was deployed.*

RFG has also collected a number of qualitative statements made by the participants during the course of the study. These statements describe additional benefits or drawbacks, for which cost data is either unavailable or not applicable.

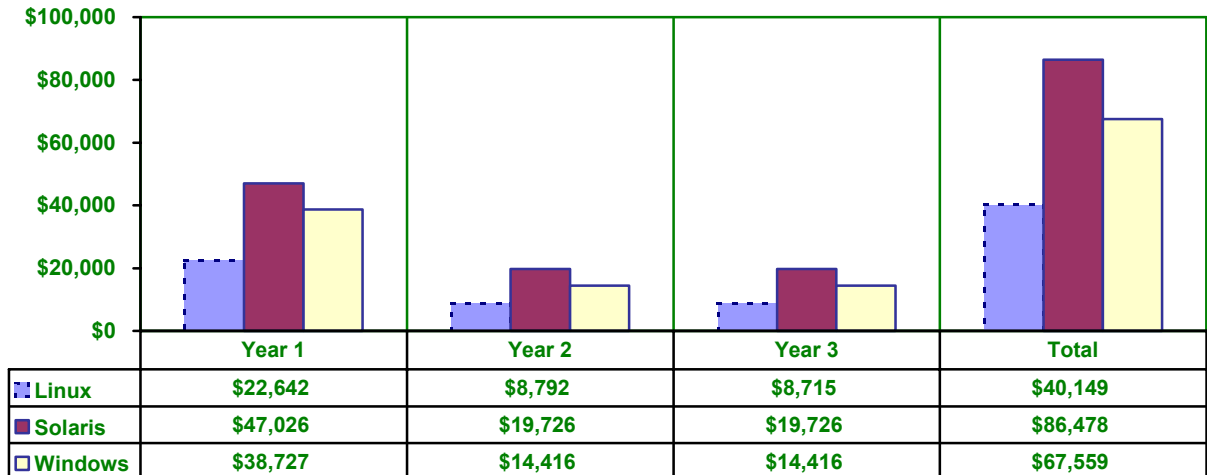
### ***Quantitative Results***

The following analysis summarizes the individual cost components and the rationale used to develop them. All analysis is done on a three-year period with hardware acquisition costs included in the first year. Prices were scaled to one Unit of Workload, defined as 100,000 operations per second on the [SPEC®](#) Java business application benchmark, SPECjbb®.

The components we use to calculate TCO include:

- Hardware Acquisition Costs
- Software License & Maintenance Costs
- OS Support & Systems Administration Costs
- Application Server Support & System Administration Costs

#### ***Total Cost of Ownership Summary Totals (per Unit of Workload)***



The total cost of Linux solutions is thus significantly less than either Solaris or Windows. The difference is primarily driven by a mix of lower operating costs and capital investment requirements due to greater processing efficiency for the same unit of work.

### ***Hardware Acquisition Costs***

Hardware acquisition costs were calculated as follows:

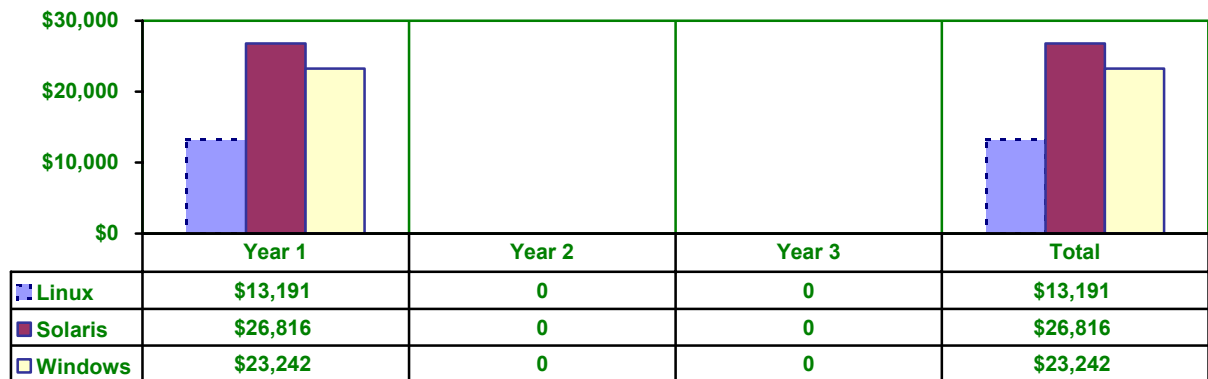
1. The closest matching system was selected from the SPECjbb® database, yielding a known test configuration and its expected performance.
2. x86-based configurations (or its closest equivalent) were priced for purchase from [Dell Inc.](#), [Hewlett-Packard Development Company, L.P.](#), and [IBM Corp.](#), and the average retail price from these vendors' Web sites were used as the system cost. SPARC-based systems were priced directly from Sun's Web site. Retail pricing was used to eliminate

deltas in negotiated discount levels, which were primarily based on participant size and negotiating skill, not operating system selection.

3. System costs were scaled to one Unit of Workload.

Hardware costs thus represent the actual system purchase itself, and are not amortized or deferred. Further, system configurations exclude external resources, such as SAN deployments, firewalls and other security devices, and network switches. Finally, environmental costs (such as power) were excluded. Servers that can handle a given workload are usually available in a variety of sizes and configurations, and this decision is based on available resources and business requirements, not operating system selection.

### ***Hardware Acquisition Costs (per Unit of Workload)***



RFG was surprised to find such a large gap between the Linux and Windows hardware acquisition costs. An analysis of the data revealed that study participants drove their Linux systems to higher utilization levels than those who used Windows, and ran more applications on each server; they therefore did not deploy as much excess computing capacity. This allowed participants to use less expensive systems to support the same workload. IT executives should include their own utilization levels when performing this calculation for their organizations.

### ***Key Take Away and Actions***

For companies with capital constraints facing system refresh decisions, Linux can have significant bottom line impact by supporting both small and large workloads on a range of hardware platforms, including inexpensive x86-based systems.

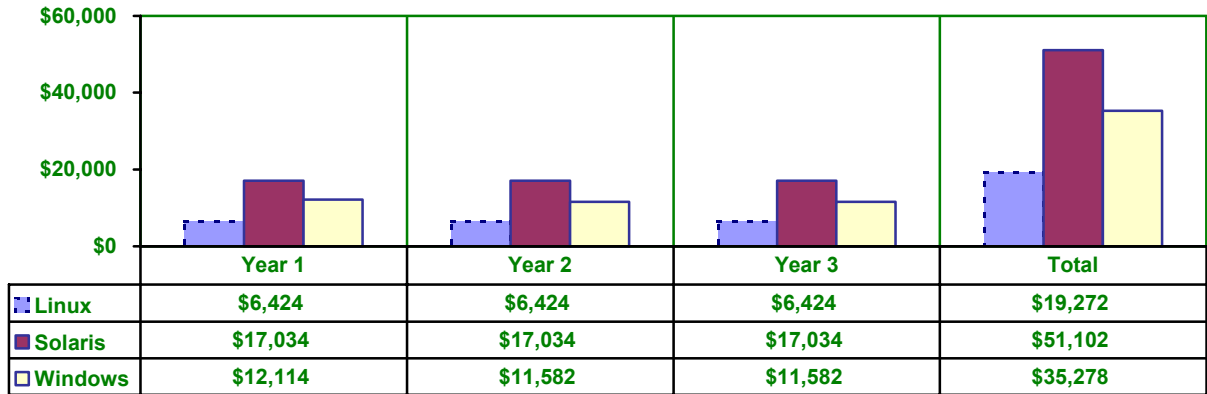
### ***Software License and Maintenance Costs***

Software license and maintenance costs were calculated by determining the number of systems each participant would need to have deployed to provide one Unit of Workload. This server count (for per-server licensing) or the number of processors it represented (for per-processor licensing) was then multiplied by the purchase price of the operating system, JVM, and any management software deployed principally to manage these elements.

The vast majority of the participants chose per-processor licensing for their JVM environments. This produces a delta for environments that used fewer systems to support a given workload, as fewer processors were required, and as noted in the hardware section, Linux users fall into this

category. RFG believes that most companies will look at different software licensing models in the future, as multi-core processors start to dominate server configurations. Linux received a further benefit because two environments contained an Open Source J2EE server, which removed one element of cost.

**Software License and Maintenance Costs (per Unit of Workload)**



**Key Take Away and Actions**

Linux can reduce on-going licensing and maintenance costs, especially where per-processor licensing models are used. This can also provide flexibility for IT executives examining system consolidation and vertical scaling, reducing the budgetary impact of that choice.

**OS Support Costs**

OS Support costs were calculated as follows:

1. The number of administrators responsible for the systems involved was determined, factoring in the percentage of time those administrators spent solely on the systems in question (for example, 20 administrators spending, on average, 10% of their time on the systems in question was counted as 2 administrators).
2. This count was then multiplied by the ratio of systems deployed to the number of the participant's systems required to support one Unit of Workload.
3. To adjust for regional salary variations, participant salary numbers (including 30% overhead) were divided by regional salary averages to produce a pay scale ratio for each participant. This ratio was multiplied by national salary averages to produce a normalized salary figure for each company. To this number, RFG added any additional costs, such as training.
4. Finally, personnel costs were obtained by multiplying the values from steps 2 and 3 to produce a final cost for each category.

First year costs include administrator time and other one-time costs for system deployment, a task not typically repeated in future years. This study did not examine upgrade costs, because most of the upgrade cost in a JVM environment is development-related and is only minimally impacted by OS choice or version. Corporate refresh cycles for server systems are likely to have a larger impact, and these vary between companies.

The primary factors in the low cost of Linux were the lower number of systems involved, and a higher number of systems manageable by one administrator. Solaris also had a high ratio of system to administrators, but this benefit was reduced because more systems were required to support the same workload. Note that most participants used 1- to 4-CPU systems for all three environments. Vertical scaling would reduce support costs by reducing the number of systems involved, and thus the time spent deploying and supporting them.

**Key Take  
Away and  
Actions**

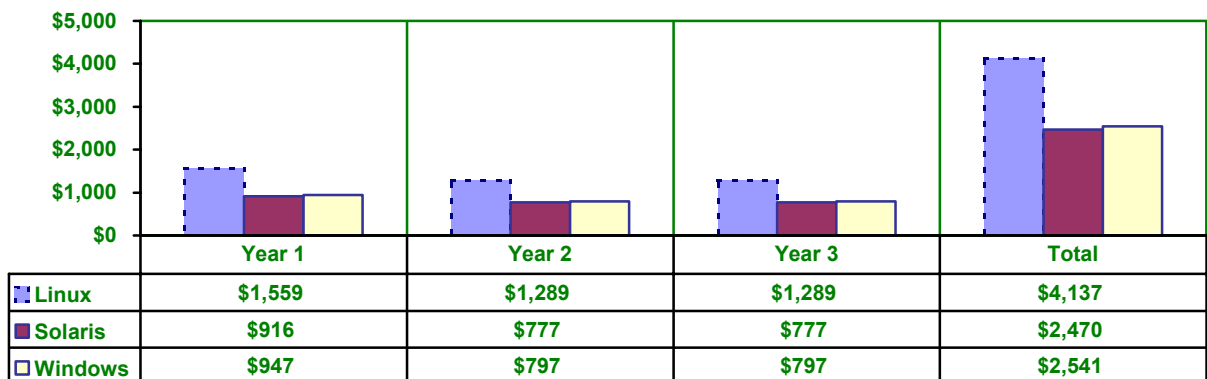
Production results show Linux administrators can often manage more systems than Windows administrators in a given amount of time, resulting in reduced management costs and less overall complexity in management activities.

**Application Server Support and Administration**

Application server support costs cover management of the JVM environment itself, and were calculated similarly to those for the operating system. Most participants employed separate OS and JVM administrators, allowing them to focus employee skill sets and training efforts for maximum benefit and portability. Where this was not the case, RFG split administrator costs based on the amount of time each administrator spent on each task. The high cost of Linux is misleading, and does not indicate a difficulty in managing JVMs on Linux. Instead, while most participants used separate OS and JVM administrators for Solaris and Windows as described above, this was not yet the case for Linux. This number is thus a clear example of the productivity gains possible through specialization of roles and responsibilities, a strategic IT move that has little bearing on the operating system itself.

RFG expects the JVM support cost for Linux to drop to a level comparable to the other options once more companies make this change in skill set usage for their Linux deployments. RFG believes an increasing number of companies will shift to administrator specialization for systems handling standard configuration workloads, as is the case with many J2EE server environments. The architectures of solutions covered in the study fell under two respondent-defined categories:

**Application Server Support and Administration (per Unit of Workload)**



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***Key Take  
Away and  
Actions***

IT executives should consider specialization of their Linux administrators' roles, as this effort has proven effective at reducing management costs on other platforms, and could yield further savings for Linux environments.

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***Qualitative Results***

Most study participants felt that the TCO savings realized were sufficient to justify deploying Linux in production. However, when Linux and other technologies are used to enable strategic architectural changes, such as server consolidation, vertical scaling, administration process streamlining, and sounder infrastructure engineering, additional benefits may be realized. Participants shared significant interest in looking beyond a purely TCO-oriented view to the long-term benefits Linux could yield. Some of the benefits mentioned include:

- ***Extensive hardware platform support*** – Linux may be deployed on a variety of hardware architectures without significantly changing management processes.
- ***ISV Support*** – Linux enjoys broad and growing ISV support. In conjunction with its extensive hardware platform support, in many cases this has yielded a greater number of supported platform combinations, allowing customers to choose the most appropriate option to meet each workload requirement.
- ***Security*** – Participants reported that it was easier to lock down a Linux system and deploy patches, and that patch deployments produced minimal downtime. These factors lead to lower security management overhead and reduced system downtime.
- ***Skill set transfer*** – Because Linux is managed similarly to many other Unix platforms, it is both an ideal counterpart to those products (allowing administrators to manage both Linux and other Unix systems effectively) and an ideal replacement for them. Moving to fewer operating systems ultimately reduces support costs and improves system to administrator ratios.
- ***Vendor diversity*** – Customers may choose the Linux distribution and support provider that is best able to meet their needs. This increases the customer's negotiating power, and the variety of licensing and support options available allow the customer to choose the most appropriate options for their companies.

RFG attempted to collect data regarding Solaris on Opteron, but this product combination in production environments is still relatively new, and RFG did not encounter it during the course of the study. Based on early customer feedback, RFG believes the primary selection criteria for this option should be based on strategic considerations rather than TCO. IT executives should evaluate Sun's ability to build an x86 ecosystem, including ISV support, and whether this combination provides business value advantages over other platforms when evaluating Solaris on Opteron.

***Conclusions***

Linux provides a lower overall TCO compared to Windows or Solaris for J2EE application server environments; RFG found Linux to be 40 percent less expensive than similarly configured Windows on x86 systems, and 54 percent less expensive than Solaris on SPARC. Linux competitors have brought costs down over the last few years. However, deltas in support and management costs, and improvements in how customers manage their Linux systems, will likely allow Linux to retain its position as the lowest-cost option. IT executives faced with shrinking

budgets and increasing workloads should thus evaluate Linux as an alternative to other operating system choices.

Linux also provides a number of strategic benefits not available in Solaris or Windows. It is available for a broad range of hardware platforms, and is cost-competitive when scaled well both horizontally and vertically. Further, it enjoys solid ISV support, and is available from a number of vendors in several licensing and support models. Linux is thus a flexible platform for enterprise application workloads, and IT executives should explore these aspects to maximize the long-term value of their Linux deployments.

Ultimately, RFG believes IT departments must be extremely agile and flexible in order to successfully meet current and future service demands. Data collected in this TCO study shows Linux is not only less expensive, but also provides a range of monetary and strategic benefits that help meet these needs. A move to Linux is thus well-aligned with these goals, and RFG believes IT executives should seriously evaluate Linux for their companies' application server workloads.

*The work involved in performing this study was commissioned by IBM Corp. However, the views expressed herein are those of Robert Frances Group, and do not necessarily reflect or represent those of IBM.*