THE YANKEE GROUP

THE YANKEE GROUP REPORT

Linux, UNIX and Windows TCO Comparison, Part 1

Executive Summary

Linux is here. Its arrival as a low-cost corporate alternative to UNIX and Windows is accompanied by almost unprecedented hype.

Does Linux live up to the hype? Does it deliver significantly better total cost of ownership (TCO) and faster return on investment (ROI) than the rival Windows and UNIX operating system platforms?

Yes and no.

Yes, *corporate customers report Linux provides businesses with excellent performance, reliability, ease of use and security. Yes, Linux is a viable alternative to UNIX and Windows. In addition, Linux is the most serious competition to Microsoft's dominance in the server operating system market to date.*

No, *despite the hype, Linux is not superior to UNIX and Windows Server 2003. Linux is the technical equivalent of UNIX and Windows Server 2003. In large enterprises, a significant Linux deployment or total switch from Windows to Linux would be three to four times more expensive and take three times as long to deploy as an upgrade from one version of Windows to newer Windows releases.*

Those are the results of a new, independent, non-sponsored Yankee Group survey of 1,000 IT administrators and C-level executives worldwide.

Linux shows measurably improved TCO compared with UNIX and Windows in small firms, in organizations with customized vertical applications and in "greenfield" networking situations where there is no existing software infrastructure.

The most surprising survey revelation: More than 90 percent of the 300 large enterprises with 10,000 or more end users indicated a significant or total switch from Windows to Linux would be prohibitively expensive, extremely complex and time-consuming, and would not provide any tangible business gains for the organization.

The survey further found that although Linux's momentum is undeniable, the open source operating system will not dethrone Microsoft's Windows as the leading server vendor in the next 2 years (see Exhibit 1). Furthermore, between now and 2006, Linux will not make a perceptible dent in the 94 percent desktop market share currently held by Windows.

The survey also indicated that most large enterprises will stick with their current server operating systems and not switch to Linux. Only 4 percent of UNIX customers and 11 percent of Windows businesses plan to replace all their servers with Linux. In addition, less than 5 percent of organizations will replace their Windows desktops with Linux.

However, nearly every organization has a Linux strategy. About 25 percent of those polled said they would add Linux servers for specialized applications—most notably Web servers. The overwhelming majority of the survey respondents said Linux is under evaluation and Linux pilot deployments abound.

Linux proponents justifiably praise the open source desktop and server operating system for its performance, ease of use, reliability and present security—although the latter is relative and changing quickly.

The lure of Linux lies in its appeal as a "free" operating system with none of the expensive licenses that come with the Windows platform. Similarly, Linux affords UNIX users the opportunity to cut costs by exchanging expensive UNIX server hardware and running Linux on low-cost generic servers. The open source nature of Linux also entices users who welcome the opportunity to modify the core OS kernel to suit their specific needs.

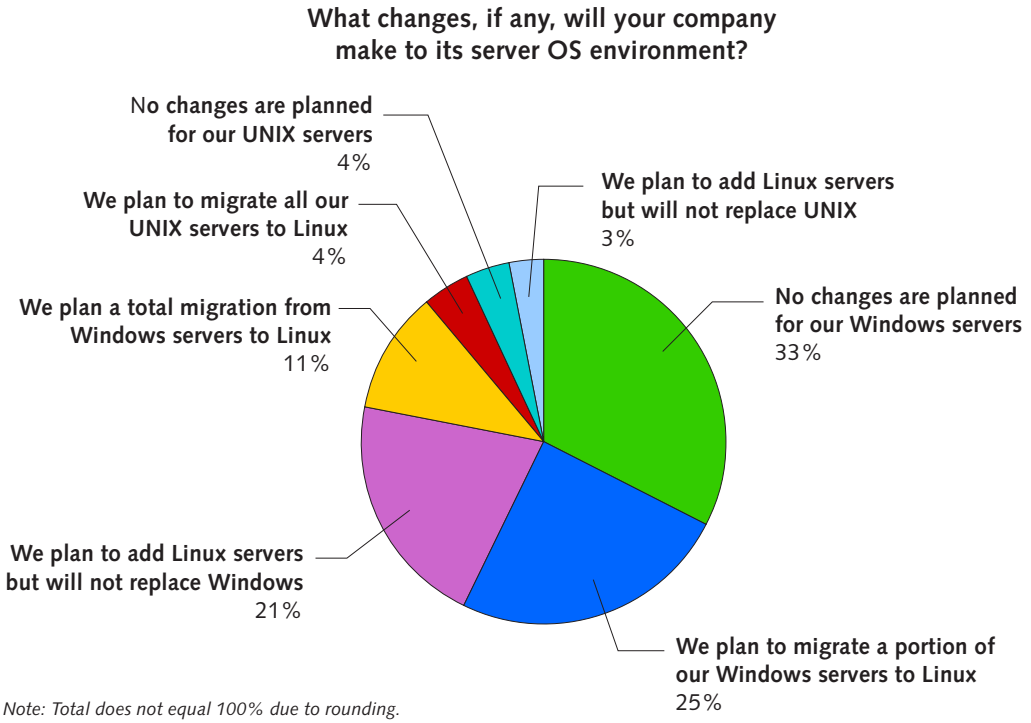
The survey data also showed a clear bifurcation in Linux deployment trends between small and smaller mid-sized organizations and large enterprises. For mid-sized and large organizations, a significant Linux deployment or a switch from an existing or legacy operating system will be neither free nor easily accomplished. Survey respondents at heterogeneous large enterprises with 10,000 or more end users reported that a wholesale switch to Linux from Windows or UNIX would take a bigger bite out of their capital expenditure budget; significantly increase TCO for the near future; and delay ROI for 1 to 2 years.

Licenses aside, Linux is most assuredly **not** *free—a fact that corporations are now starting to realize. TCO encompasses far more than software licenses and server hardware.*

You don't get what you don't pay for.

In Part 1 of the Yankee Group's two-part Linux, Windows and UNIX TCO comparison, we examine the issues and factors that will promote or impede desktop and server operating system deployments at small, mid-sized and large businesses. Part 2 focuses on the case studies and the experiences of large enterprises.

Exhibit 1
Linux Looms but Windows Still Reigns
Source: The Yankee Group, 2004



Note: Total does not equal 100% due to rounding.

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I. Introduction

Survey Methodology

The purpose of this Yankee Group study is to determine the true TCO and ROI of Linux compared with Windows and UNIX in specific corporate user scenarios. To provide our clients with the most unbiased, accurate and reliable information, the Yankee Group accepted no vendor sponsorship money for any of the research surveys done in connection with this project. Additionally, none of the more than two dozen enterprise users interviewed by the Yankee Group received any remuneration.

In early 2004, the Yankee Group initiated three separate, independent corporate customer surveys to compare and contrast the TCO of Linux, Windows and UNIX.

The first survey (a Web-based self-selecting survey of 23 questions) netted 850 responses from corporate IT administrators and C-level executives worldwide. It included demographics to rank the companies by size and vertical markets. The second Web-based survey, which featured the same 23 questions as the first, targeted 300 high-level MIS managers and C-level executives at mid-sized and large corporations with user populations ranging from 5,000 to more than 100,000.

The third survey of approximately 24 businesses in North America and Europe consisted of in-depth interviews with CIOs, VPs of IS, and MIS managers. The goal of the survey was to delve deeply into the TCO and ROI issues.

All of the aforementioned issues/items factor into a company's decision to remain with its current infrastructure, remain with or migrate away from UNIX and Windows, or adopt Linux.

Survey Highlights

The survey responses and in-depth customer interviews have yielded some surprising and some expected results:

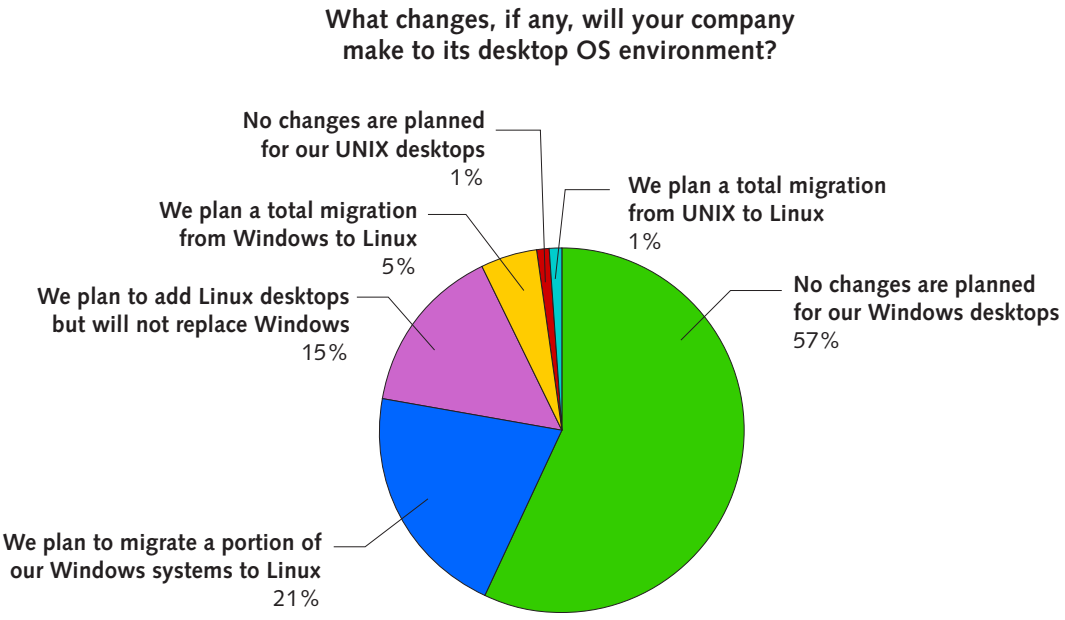
- To date, most of the defections to Linux have come at the expense of mid-range UNIX systems and *not* Windows.
- The lure of Linux for UNIX shops is the extreme cost savings of the hardware. According to customers, Linux hardware is an order of magnitude cheaper than the more expensive UNIX machines.
- UNIX users were overwhelmingly positive, stating that UNIX offers comparable performance, reliability and security to Linux.
- Microsoft currently commands 94 percent of the desktop OS market.
- Microsoft has 66 percent market share in the server OS arena, Linux has 20 percent and UNIX has 8 percent, with all others (e.g., NetWare, Macintosh) accounting for 6 percent.

2004 to 2006 Desktop and Server Operating System Market Share Survey Results

One of the most surprising survey results is that although Linux is making steady gains in the server operating system market, mid-sized and large corporations with more than 5,000 users do not plan to *replace* Windows or UNIX with Linux.

- On the server side, 4 percent said they will do a total server migration from UNIX to Linux and 11 percent said they would do a total migration from Windows to Linux servers.
- Among all customers, 21 percent indicated they would migrate a portion of their Windows desktops to Linux; 15 percent said they will add Linux desktops but will not replace Windows and the majority—57 percent—said they plan no changes to their Windows desktop environment (see Exhibit 2).
- Only 5 percent of customers said they plan a total migration from Windows to Linux desktops within the next 2 years.
- Again, the majority of respondents said they will leave their Windows server intact or migrate *a portion* of their Windows servers to Linux for specialized application tasks.
- Red Hat is the Linux vendor of choice for 46 percent of the respondents, followed by Novell (SuSE and Ximian) with 19 percent. IBM and HP are far back with 9 percent and 4 percent, respectively, among small and mid-sized users. However, HP leads IBM at the high end by a 2-to-1 margin among very large enterprises.

Exhibit 2
Linux Doesn't Dent Windows Desktops
Source: The Yankee Group, 2004



- The chief allure of Linux at this point is not surprisingly the fact that many customers like the idea of "free" licenses. Among customers that already have done a significant Linux migration, 30 percent said they feel Linux is more reliable than Windows; 31 percent said they feel Linux is more secure than Windows; while another 29 percent expressed fears of being locked into an "all-Microsoft environment."

- To date, however, 53 percent of customers have not performed a thorough cost analysis of how much a switch to Linux from UNIX and/or Windows will cost—compared to 47 percent that have netted out the price of a Linux migration.

Linux Market Overview

Linux will make gains on both the server and the desktop within the next 2 years. It commands 20 percent of the worldwide server market. In addition, it is being seriously considered in greenfield networking situations in emerging and developing nations such as the Asia-Pacific rim region, Latin and South America, and Eastern Europe. Additionally, a variety of vertical markets in Western Europe are embracing Linux.

Linux also has great appeal for school districts and small local and state governments, as well as heavily networked companies in North America and Western Europe that are under severe budget restrictions. Many will recall the spate of publicity that greeted the news that the City of Munich, which has 14,000 desktops, abandoned Windows and Office in favor of Linux. Less publicized was the fact that many larger German municipalities, such as the City of Hamburg, were remaining on Linux. Similarly, high-end engineering types of environments are sticking with their current UNIX infrastructure.

The appeal of Linux as a low-cost replacement for Windows or UNIX in smaller organizations and specific verticals that mainly utilize off-the-shelf applications for straightforward administrative functions is obvious. Many of these users told the Yankee Group they simply cannot afford the cost of Microsoft licenses or expensive UNIX hardware.

Larger organizations and companies with complex networking situations should look beyond Linux's initial low capex investment and consider all the TCO and ROI factors.

The commercialization of Linux is well underway.

All of the major Linux vendors and distributors (including Hewlett-Packard, IBM, Novell [SuSE and Ximian] and Red Hat) have begun charging hefty premiums for must-have items such as technical service and support, product warranties and licensing indemnification. It is beginning to look a lot like, well, Windows. Not that there is anything wrong with that. Vendors are not charitable institutions; they are in business to make a profit.

The metamorphosis of Linux from a free, hobbyist software environment to a major revenue-producing operating system is occurring with the same surety and swiftness of a neighborhood undergoing gentrification.

It is true that the free Linux licenses initially require a lower capital expenditure outlay than Windows or UNIX. This is a compelling and often decisive factor in choosing Linux in specific user scenarios.

Although the licenses remain free, the attendant services—aftermarket technical service and support, third-party tools and utilities, management packages, and IT salaries and training—are not free. In some instances, they carry hefty premiums.

Some Linux vendors and distributors are already beginning to experience the backlash from resentful companies that believed Linux truly was devoid of all expenses. Red Hat executives recently told the Yankee Group their firm is unpopular with some Linux users as a result of the company's decision to charge for enterprise support. To cite just one example, Red Hat technical service and support can range from $25 to $2,500 depending on the size and configuration of a business's network.

Novell, which recently completed its acquisition of Germany-based SuSE, also charges a price premium for SuSE enterprise edition support. However, Novell is taking a page from Microsoft's licensing plan; the company is trying to take the sting out of the high cost of service by adding business value to the support contracts. Novell recently began offering a year's worth of unlimited electronic technical support, annual upgrade protection and discounts of $1,500 (€1,300) for service certificates for those customers that purchase a minimum of five x86 SuSE Linux Enterprise Servers version 8.

Again, Novell's service and support deal is very similar to Microsoft's incentive-laden Software Assurance upgrade and maintenance program. Novell's technical service and support organization has breadth and depth. It also has a substantial channel presence and partnerships with HP and IBM. All are the result of more than 20 years of experience in the operating system arena with its flagship NetWare platform and its recent SuSE and Ximian acquisitions. Such knowledge does not come cheaply, nor should it. Novell's software business revenue declined 31 percent from $995 million in 2000 to $682 million in 2002. The Waltham, Mass.-based firm is betting Linux will reverse its formerly waning fortunes by jumpstarting revenue. Novell's additional SuSE business licensing incentives do not negate the fact that businesses will pay a price premium for Linux technical support.

Besides the allure of free licenses, two other characteristics hold great appeal for present and potential Linux users:

- The ability to run Linux on multiple hardware platforms
- The freedom to modify and customize the open source code

The ability to run Linux on multiple hardware platforms endows the open source operating system with a greater degree of flexibility. This serves to increase the TCO by an average of 15 to 30 percent and accelerate the ROI by 6 months or more in those leading-edge shops that elect to avail themselves of this functionality. Yankee Group research indicates that at present only a small minority of organizations run Linux on multiple hardware platforms. That may change over time—albeit not significantly from 2004 to 2006, according to Yankee Group TCO research.

The ability to modify and customize the Linux source code affords customers the most intriguing possibilities for custom application development. This ability stands in stark contrast to the closed or proprietary nature of the Windows operating system. In recent years, Microsoft has opened up Windows to a limited extent and released numerous APIs. This enables third-party ISVs to efficiently produce interoperable applications that more

easily integrate with Windows. However, this is nothing like the changes developers can make with Linux, where there is total access. The open source philosophy is deceptively simple: allowing developers, programmers and engineers to read, modify and redistribute the source code via standardized Linux interfaces spurs software development and evolution. Theoretically, such openness also will result in faster bug and security fixes when problems arise.

Open Source vs. Proprietary: Caveat Emptor

Corporations customizing the open source Linux code must be aware that the freedom to modify the code may be a two-edged sword. Source code revisions can *positively or negatively affect TCO and accelerate or hinder ROI.*

Many respondents to the Yankee Group TCO survey—especially those in data-sensitive vertical markets such as healthcare, insurance, legal and defense—noted that Linux's open nature raised the level of risk and liability (in some cases by several orders of magnitude).

During the last 3 years, as the popularity of Linux increased, a debate raged about the merits of open source (Linux) software versus proprietary software (Microsoft, Sun).

The vocal and sometimes hysterical rhetoric emanating from extremist elements in the Linux and open source community have reduced the issue to a facile one-liner: "open source software = good and proprietary software = bad."

This statement is false and misleading. There are advantages and disadvantages to both open source and proprietary solutions. There is room for both in specific user scenarios. However, that reality vanished in hype and near-religious fervor surrounding open source and Linux.

It is possible for in-house application developers to modify the Linux source code to such an extent that operational problems arise. In that case, finding the appropriate technical service and support could be a challenge. Users might be forced to find the fix from multiple sources beyond their core Linux distributors. In addition, a corporation that made significant modifications to the Linux source code might find that standard product enhancements, bug fixes or security patches will not work.

Enterprise respondents to the Yankee Group survey also voiced concern that the inherently open nature of open source was unsuitable to specific data-sensitive networking environments, such as healthcare, insurance, legal, defense and finance.

One IT manager at a large U.S. healthcare company offered two very pragmatic reasons for its staunch support of proprietary software over open source solutions: "Our Windows desktops operate in a mission-critical, patient-confidentiality, data-sensitive environment. It is because of the very nature of Linux's open source architecture that we will never migrate away from a closed-source (Microsoft) solution. The liability is just too great."

A second and equally compelling reason the healthcare firm "will always use Windows is because it is the only OS supported by our primary clinical application provider, Meditech," the IT manager said.

Finally, corporations that modify the Linux source code will not be eligible for

indemnification and product warranties. Linux vendors and distributors have specified that indemnification and product warranties for event-related incidents or from third-party lawsuits (such as The SCO Group's ongoing litigation with IBM) are contingent upon customers making no changes to the source code. Such indemnification generally is not a major cause for concern among small and mid-sized user accounts. However, the TCO risk rises according to the organization's size and the sensitivity of the networked data.

A corporation that modifies the Linux code and still requires indemnification has another option: independent intellectual property insurance. Within the last month, Open Source Risk Management LLC (OSRM), based in New York, launched an insurance-type indemnification offering specifically targeted at safeguarding Linux installations. OSRM Founder and President Daniel Egger said his firm will utilize a combination of copyright infringement detection and code-scanning software to assist corporate end users in identifying any potential code infringement. Companies will thus be able to avert and eliminate any intellectual property risks. Additionally, OSRM will provide a variety of indemnification packages to protect customers against open source litigation. OSRM published its price list for its forthcoming IP protection packages in mid-April and said it will charge 3 percent of the total amounts of coverage corporations wish to purchase. Therefore, $100,000 worth of coverage would cost $3,000, while $1 million worth of coverage would cost a company $30,000.

Customers that elect this option must factor this cost into their overall Linux TCO. Individual businesses must decide for themselves whether they are willing to forego the additional insurance costs and live with the heightened risk factors.

On the plus side, open source advocates note that the freedom to modify the Linux code enables them to build customized applications and roll them out much more quickly. In turn, that also enables organizations to lower their TCO by using less expensive hardware.

In summary, the Yankee Group's TCO survey found that Linux does offer compelling cost savings, economies of scale and technical advantages, as many a satisfied user will attest.

However, the cost savings and benefits are not automatic; they are not achieved without customer due diligence and they do not necessarily apply in every user scenario.

Ultimately, the TCO and ROI of Linux may be less than, comparable to, or more expensive than UNIX or Windows depending on the individual corporate deployment circumstances.

II. Data and Analysis

Determining TCO and ROI

To accurately assess the TCO and ROI of Linux, current and potential Linux adopters must strip away the hype and perform relevant comparisons between Linux and Windows, and between Linux and UNIX. TCO and ROI criteria include:

- Initial capital expenditure costs
- Ongoing maintenance costs
- Licensing
- Licensing indemnification and product warranties
- Reliability (unplanned downtime)
- Performance and scalability
- Security
- Management
- Training and certification of existing staff or hiring costs for experienced Linux administrators
- Aftermarket technical service and support
- Availability of third-party off-the-shelf applications, tools and utilities
- Cost and time to test, certify and deploy custom applications
- Interoperability and integration with existing or legacy hardware and software
- Availability and cost of existing systems integrators

Only after a thorough review and comparison of the aforementioned items can businesses determine whether Linux is more or less economical, reliable, secure and easier to manage than the rival UNIX or Windows platforms in their specific environments.

The issue is not black and white, and there are no absolute right or wrong choices. Yankee Group TCO research found there are distinct situations in which any of the three platforms—Linux, Windows or UNIX, or a combination of them—can deliver optimal TCO and ROI.

Survey Analysis: What the Results Mean for Your Organization

The numbers don't tell the whole story.

The Yankee Group also delved deeply into ongoing and recurring TCO costs associated with managing and maintaining Linux networks over the long term. Here again the results are mixed. The survey respondents overwhelmingly noted that skilled Linux administrators in the major metropolitan markets command 20 to 30 percent salary premiums over their UNIX and Windows counterparts. Therefore, in the short term, corporations could see an increase in new salaries (or the cost of retraining existing IT staff) associated with a significant Linux migration or deployment. The Yankee Group projects the Linux salaries will level off and be roughly equivalent to Windows and UNIX administrator compensation within 24 to 36 months.

Conversely, the long-range TCO costs associated with managing and maintaining Linux security, which currently are lower than Windows, will increase over the next 2 years. The Yankee Group projects that by 2006, companies will spend just as much money and devote the same amount of resources to securing their Linux networks as they now do in a Windows environment.

There is more than a little irony associated with these findings. The respondents—especially those in large enterprises with more than 10,000 end users—said they were hesitant to undertake a wide-scale Linux deployment, citing the expense, complexity, time and lack of skilled administrators. In a surprising twist, many MIS managers and C-level executives told the Yankee Group they were unable to ascertain that a wholesale switch to Linux would provide their firms with any perceptible or compelling technical advantages over their existing Windows networks.

The heart of any TCO comparison among Linux, Windows and UNIX begins with the licensing costs, which represent the first (and sometimes the largest) line item in the company's capital expenditure budget. Because Linux is based on the open source model in which many individuals and companies contributed components to the source code, the Linux distributors do not levy licensing fees in the manner of proprietary software vendors such as Microsoft—although they do charge annual fees. Unfortunately, this gave rise to the fiction that Linux is free.

To reiterate: The licenses are relatively free, everything else costs money.

To determine TCO, any organization considering a switch or migration to Linux (or any operating system or mission-critical application) must consider the following:

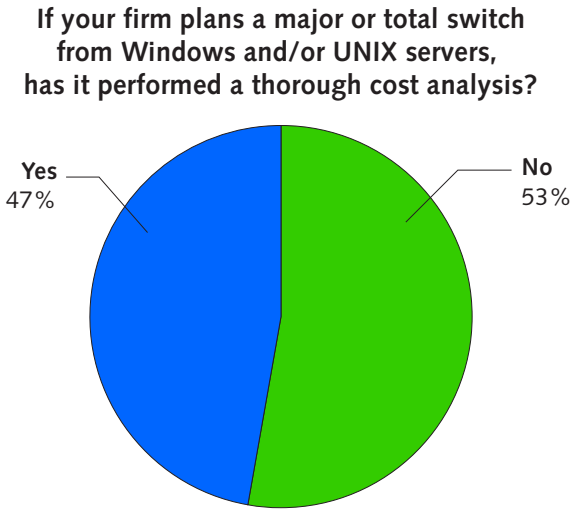
- Initial capital expenditure outlay and one-time costs.
- Ongoing costs (including support, management and maintenance of the environment). Typically, ongoing maintenance costs consume the largest portion of the IT software budget—approximately 60 percent in mid-sized and large organizations.
- Risks and liabilities attendant with each platform. In the Windows environment, this might include the impact of ongoing security hacks against Windows. In the Linux environment, it would incorporate product warranty and licensing indemnification.

- Integration and interoperability with internal software platforms and packages, as well as with business partners', suppliers' and customers' software infrastructure.
- The impact on existing hardware, bandwidth, storage and WAN infrastructure.
- Viability of a particular vendor.
- Business case justification for the migration or switch. This will vary by company. However, anyone considering a migration should always establish what the business will gain and lose by remaining with the current environment or switching to a new software platform. If your organization cannot construct a solid business case for changing its present UNIX or Windows infrastructure, the corporation may be best served by staying put.

As Exhibit 3 illustrates, fewer than half of the companies contemplating a significant or total switch from Windows and UNIX servers have performed a thorough cost analysis.

Previous Yankee Group survey data and anecdotal evidence obtained from customer interviews indicates that roughly 25 percent of businesses that fail to execute a TCO analysis before deployment encounter significant deployment delays ranging from 3 months to 1 year—or more. In several worst-case scenarios, customers were forced to abandon their upgrades altogether. This occurs because either the organization encounters a major technical obstacle that must be addressed before the upgrade can proceed, or the organization failed to budget for a particular line-item cost or consequently runs out of money.

Exhibit 3
Cost Analysis: The Missing Element in a Linux Migration?
Source: The Yankee Group, 2004



TCO Comparison of Linux vs. UNIX in a Small Engineering Firm Company

Overview: Company A is a small organization based in California with approximately 50 users. The company's vertical market is visual effects production. It produces special effects for movies; recent projects included *X-Men 2; Titanic; Red Planet; Me, Myself and Irene; Woman on Top; Romeo and Juliet;* and *Blue Crush*. As such, Company A is an engineering environment; its end users and managers are technically proficient. Most have UNIX backgrounds. The company uses Red Hat versions 8 and 9. The company engineers build their own PCs and custom applications. Technical support and maintenance are likewise done in-house and the company does not need indemnification and product warranties.

Reasons for Choosing Linux: Linux affords Company A all the power, flexibility and openness of UNIX, plus the ability to modify the code and run customized applications on high performance PCs and servers at a fraction of the cost of UNIX hardware.

Company A: Linux User		
Line-Item Costs	**Linux**	**UNIX**
Desktop Client Hardware	$1,100 each; 50 desktops total = $55,000	$3,000 per desktop; 50 desktops = $150,000
Server Hardware	$2,500 each; 5 servers = $12,500	$10,000 per server; 5 servers = $50,000
Technical Support	$0 (done in-house)	$20,000+
Custom Applications	$0 (done in-house)	N/A
Totals	**$67,500**	**$220,000**

Overall: Company A's TCO would have been nearly four times greater if it implemented a UNIX solution rather than Linux.

TCO Comparison of Linux vs. Windows in a Mid-Sized Law Firm

Overview: Company B is a mid-sized law firm with 1,100 end users. Headquartered in New York City, it has eight remote offices, including four international offices. The company has a heterogeneous environment that includes Windows, Linux and UNIX servers. However, Windows is the primary enterprise desktop and server OS.

Strategic Direction: Remain on Windows platforms.

Reason for Remaining on Windows: The cost of maintenance and integration of Linux custom applications would far outweigh the initial savings the company might realize from the free Linux licenses. Additionally, a wholesale conversion from Windows to Linux would quadruple the company's capital expenditure outlay; increase deployment time by several orders of magnitude; and raise the risk of running custom applications in an untried Linux environment to an unacceptable level. The law firm also requires indemnification, which would not be available from vendors if it modified the core Linux kernel, and does not see the logic in purchasing indemnification from a third party when Microsoft offers comprehensive indemnification and 1-year product warranties. Additionally, the company likes the new features and functionality of Office 2003, including OneNote, which it says provides a competitive edge for its attorneys and legal assistants.

Company B: Windows User		
Line-Item Costs	**Windows**	**Linux**
Licenses	$266,000	Free
Custom Applications	$800,000 - $1 million each/$6.4 million	$2.8 million to $3 million each/$22.4 million
Application Deployment Time (Each Application)	18 days	12 to 18 months
Network Admin Salary	$60,000 (average)/$720,000	$78,000/$936,000
Indemnification and Product Warranty	1-year product warranty; no liability cap on indemnification included in Microsoft Licensing	$35,000 annually from third-party insurer, $700 per server annually; indemnification and product warranties not available from Linux distributors when Linux code is modified.
Totals	**$7.8 million**	**$23.4 million**

Overall: Company B's expenses for custom applications and network administrators' salaries would be three to four times as much in a Linux environment as the law firm now spends on its Windows servers and desktops. And the legal firm's own attorneys were unwilling to assume the risks of installing more expensive custom Linux applications that lacked indemnification.

TCO Comparison of Windows vs. Linux in a Large Healthcare Organization

Overview: Company C is a large healthcare organization with 18,000 end users and 25 hospitals and clinics. The healthcare firm has an equal mix of 250 Windows servers and 250 NetWare servers. It is open to adding some Linux servers and have already performed due diligence on various TCO scenarios.

Long-Term Strategy: Still evaluating. The firm is leaning toward switching the majority of NetWare servers to Windows Server 2003 in the next 2 years. However, it is open to Linux via Novell's SuSE acquisition. Thus far, though, the healthcare firm says Novell has been short on specifics of migrating NetWare servers and applications to SuSE Linux. The firm feels that Microsoft's TCO has lowered considerably with the new Windows Server 2003 and Windows XP platforms. The constant security attacks against Microsoft concern the company, but it feels Microsoft is addressing the issue and that Linux will also be at higher risk as its popularity increases.

The healthcare firm also voiced concerns about a significant Linux deployment. "We're hesitant about Linux on several points," a high-level IT manager said. "We're concerned about how easy or difficult Linux is to manage. Third-party support is not as extensible and available and could represent a steep incremental expense. And as we upgrade to new hardware, that will require us to recompile the drivers, which is a substantial undertaking."

Company C's Windows versus Linux TCO has yet to be determined.

Analysis of Survey Findings

- There is a clear bifurcation (according to horizontal and vertical market segments) in Linux, UNIX and Windows deployment and migration trends.
- Small and mid-sized companies in academic, government and niche markets are at the forefront of Linux adoption.
- Mid-sized and large enterprises with a strong investment and a large contingent of Windows and UNIX networks, while also very interested in Linux, are more risk-averse than their smaller and less encumbered customer counterparts.
- Microsoft has established a large ecosystem that works.
- Death by 1,000 cuts: Companies have so modified the Linux code that it is totally non-standard. If something goes wrong, it will be difficult to patch.
- In the interest of obtaining the most objective, detailed and qualitative responses regarding the true TCO and ROI of Linux compared with UNIX, Windows 2000 Server and Windows Server 2003, we asked enterprises with experience to rate the three disparate platforms according to the following criteria:
  - — Reliability
  - — Management
  - — Security
  - — Reduction or increase in full-time equivalent (FTE) support specialists

Reliability

For the purposes of this survey, the Yankee Group defined reliability as the number of unnecessary or unplanned reboots of Linux compared with UNIX, Windows 2000 Server and Windows Server 2003.

The responses were anecdotal and not scientific. They were based not on TPPC benchmarks or laboratory-controlled testing but on users' experience. It is noteworthy that approximately 80 percent of the respondents indicated their UNIX and Windows server workloads were double or triple that of the comparable Linux server loads. That will change over time as Linux matures and is more widely deployed in enterprises. Currently, Linux is most often used as a Web server, a Web hosting application or an Internet gateway.

The reliability data underscored the fact that Linux, UNIX and Windows have achieved a relatively high degree of stability and reliability.

Overall, a 76 percent majority rated Linux and UNIX reliability comparable, while 70 percent of the respondents rated Windows Server 2003 reliability equal to Linux.

However, Windows administrators complained about the amount of network administration time and manpower spent performing security and patch management functions in their environments. In addition, although Windows servers—particularly the newer Windows Server 2003—rarely crashed, the administrators often said installing a critical security patch comes with unplanned downtime. This is because they did not want to risk delay in applying the patch until off-peak hours or the weekend.

Overall, security and patch management were clearly the biggest problems for corporate customers. In addition, from a customer's standpoint, they are the most glaring Windows weaknesses. In this regard, only 12 percent of Windows 2000 customers said that the Microsoft platform was comparable to Linux. Security and patch management-specific reliability improved somewhat for Windows Server 2003—with 18 percent reporting that it is comparable to Linux reliability in terms of unnecessary reboots.

Although reliability and security are two distinct TCO issues, they are inextricably linked in the minds of many network administrators who equate security and patch management with reliability. In fact, reliability as defined by the Yankee Group TCO survey deals specifically with unplanned downtime and unnecessary reboots as a direct consequence of a bug, an operating system failure that crashes the server.

The Yankee Group queried 25 large enterprises in North America and Europe on Windows 2000 and Windows 2003 reliability, and the vast majority—89 percent—said they felt Windows Server 2003 was on par with Linux. Additionally, the administrators and high-level executives told the Yankee Group that the perceived disparity in reliability was a direct consequence of security problems and patch management that require network administrators to reboot the server to apply the security patches.

"The holes in Windows are more well known and much more exploited," observed the CIO of a law firm headquartered in New York City. He added that his IT managers spend more time securing the company's Windows servers than the Linux machines. "But it's also relative to how many servers we have and how many Windows bugs there are out there."

A project manager at a mid-sized healthcare organization in Westchester County, N.Y., with 12,000 end users expressed concern and resignation about the ongoing Windows security hacks. "I'm not sure how we can win the security war," he said. "We have a positive relationship with Microsoft and outside of the security issue we find the reliability of NT 4 and Windows 2000 to be just fine."

Security and Patch Management

In the minds of many corporate IT administrators, security and patch management have become linked. With the potential and real danger posed by viruses and worms, many organizations stop everything to download a new security patch as soon as they find out about it. In many cases, this interrupts the daily business routine. No matter how necessary or warranted, or how planned or unplanned, patch management has a negative connotation for many because it adds to the management workload and time.

Overall, the security and patch management issues both represent a lot of grief, cause for concern, and in some cases a world of hurt for those unlucky enough to have gotten hit by these various viruses, worms and hacks.

In summary, although Microsoft may make a strong and fine distinction between security and patch management, most customers are not doing so, according to both our survey data and in-person interviews. In other words: "security and patch management are one big, giant headache" even if they are two distinct sides of the same coin.

There are exceptions of course.

Security

To reiterate, security will be the biggest problem for Microsoft and its corporate and consumer customers. Many of the C-level executives we interviewed gave Microsoft high marks for its efforts to address the security issues. However, that was little comfort to the network administrators who apply the patches. This is a time-consuming and onerous task. Conversely, the Linux users interviewed by the Yankee Group voiced their concerns regarding the recent increase in Linux specific viruses, worms and hacks.

By 2006, the Yankee Group projects that corporations will expend just as many manpower hours and resources, and will devote equal amounts of their IT maintenance budgets to securing their Linux networks as they now spend on Windows security.

Microsoft is addressing its security issues via the Trustworthy Computing Initiative and Windows Server 2003 is more secure by design. Windows Server 2003 will be shipped to customers in a locked-down state, providing them with a platform that is more secure by default. Among the new initiatives:

- **Internet Information Services (IIS) 6.0** has been designed to allow the execution of worker processes that run applications or Web services using a low-privilege user account. The restriction of network access reduces the potential for network attacks.

- **A common language runtime software engine** helps ensure a safe computing environment by reducing the number of bugs and security holes caused by common programming mistakes.

- **Nonessential out-of-the-box services, including IIS 6.0,** will be turned off by default when shipped in Windows Server 2003.

- **Microsoft Internet Explorer technologies** in Windows Server 2003 will have a default security setting of High.

- **Password security** has been strengthened so users cannot log on remotely using any account with a blank password. This reduces the potential of remote network attacks due to poor password practices.

- **Public key infrastructure (PKI) services** have been significantly enhanced to provide customers with a simple certificate infrastructure that improves security in Internet protocol security (IPsec)-based virtual private networks and network communications, wireless authentication using 802.1x, smart-card logon, file system encryption, and other services.

There is no doubt that Microsoft is locked in an ongoing struggle to harden its core software packages and shore up customer confidence, which has been badly shaken by the constant assault against Windows and Office.

Linux Security: Hacks Rising Along with Popularity

The security issue is nowhere near as critical in the Linux environment—yet. But Linux hacks are on the rise.

In February 2004, London-based security research organization mi2G Intelligence published a study called "The World's Safest Operating System," in which it analyzed 17,450 successful overt digital attacks. The survey data indicated that Linux had the dubious distinction of being number one with 11,780 attacks (or 67 percent), followed by Windows, which accounted for only 22 percent of the attacks (with 3,843 hits). The Apple Mac OS X and BSD UNIX environments provided customers with the safest haven. Together they accounted for 4.5 percent of all hacks during that same period.

It is clear from recent alerts that the number of Linux hacks is rising steadily and will continue to do so.

Linux-specific worms and viruses are every bit as pernicious as their UNIX and Windows counterparts—and in many cases they are much more stealthy. In contrast to most Windows worms, which are slow- or fast-moving e-mail mailers, Linux worms are automated so they require no user interaction. These worms exploit security vulnerabilities such as buffer overflows to gain access to the victim system.

Of course, it is all relative. An infecting worm or virus will do far more damage to Windows (the most widely deployed and widely networked operating system) in a much shorter time than the nastiest Linux bug.

The worst Linux rogue code was the Slapper virus that first appeared in 2002. It affects Linux machines that run Apache Web servers with OpenSSL enabled. Apache installations account for nearly 70 percent of public Web sites on the Internet. According to antivirus vendor F-Secure, the Linux-based Slapper infected 20,000 machines in more than 100 countries. Still, that infection pales by comparison to the most pernicious Windows bug: MyDoom. The MyDoom virus and its several variants infected more than 2 million PCs in less than a month.

The moral: Consumer and corporate PC users connected to a network are vulnerable to malicious code no matter what OS is running.

Management

This is another area of incremental expense, particularly for mid-sized and large organizations contemplating a significant Linux deployment. At this stage of its development, Linux is simply not as mature as UNIX, Windows or NetWare. Hence, Linux distribution platforms lack the same level of embedded management and performance enhancement tools found in the more mature UNIX and Windows systems. Microsoft, for example, bundles NetIQ's Active Directory Management Toolset (ADMT) at no extra charge into the baseline Windows 2000 Server and Windows Server 2003 operating systems. Even with such embedded functionality, mid-sized and large Windows and UNIX installations typically deploy from two to six add-on

management and performance enhancement packages. Such third-party software can have a per-user seat price ranging from a low of $5 per seat for a more simple utility to $25 or higher for a more complex management package. The server component for a management package can list for from $2,000 to $10,000 or more. Again, pricing will depend on both the size and scope of the organization and the licensing package it receives from its vendors.

Historically, the addition of performance enhancement utilities and management packages can add from 10 to 35 percent to the IT software budget.

The Linux environment will be no exception. Here the rule of "free licenses" does not apply.

Small businesses of up to 50 employees will have much simpler requirements. In addition, companies with technically proficient Linux administrators, who can build and fix their own systems, can also lower their Linux TCO considerably. However, rank-and-file Linux users should review the inherent feature set available in the Linux distributions and weigh that against the needs of their environment. In some cases, add-on packages may not yet be available from third-party vendors, so organizations may be forced to build their own or do without.

Alternatively, corporations contemplating a Linux migration should determine the cost and the number of add-ons they will need to achieve functionality comparable to their current UNIX and Windows installations.

To cite one example, startup Emu Software plans to debut its Net Director Linux Configuration Manager—one of the first granular, real-time configuration management tools for enterprise Linux shops—later this year. The company will sell two versions of its product: a standard edition and an enterprise edition. List pricing will range from $3,300 for the standard edition to $5,800 for the enterprise version. In addition, Emu's one-time maintenance upgrade plan will list at 10 percent of the product price. This is just one package but it is an indicator of just how quickly Linux goes from "free" to expensive.

Based on customer feedback, the Yankee Group advises mid-sized and large enterprises planning a significant Linux deployment to plan on performance enhancement and network management packages costing a conservative 15 to 25 percent more than the equivalent packages in a UNIX or Windows environment.

Reduction in Number of FTE Support Specialists

The Yankee Group also polled corporations on another critical TCO and ROI element: the reduction, increase or comparability in the amount of time required to perform a variety of management functions. To obtain the most focused response, the Yankee Group asked the respondents to rate each platform according to the following criteria:

- Backup restore and recovery
- Application management
- Desk and file management
- Software deployment

- Repository management
- User administration
- Maintenance and labor
- Hardware deployment
- Hardware configuration and reconfiguration
- OS/NOS support
- Security and patch management

This question elicited the most widely divergent responses of any of the survey queries. Customers were equally divided on the network management economies of scale among Linux, UNIX and Windows. In other words, there was no clear corporate customer consensus as to whether or not a Linux deployment would enable organizations to reduce the number of FTE support specialists compared with existing Windows and UNIX networks.

The survey respondents had the opportunity to respond to this question with a simple percentage of the increase or reduction in FTEs, or alternatively write an essay-type response. Approximately 40 percent chose to give detailed written responses—which were frank and lively.

Of the 60 percent of respondents who provided just a percentage figure, 52 percent said there was no reduction or increase in FTEs required to manage UNIX networks in comparison to Linux installations. The remaining group that compared the support needs of their UNIX and Linux networks was divided. Most indicated that UNIX required from 50 percent less hands-on management than Linux to 20 to 30 percent more managers.

However, several IT managers voiced their opinion that Linux custom deployments required far more human intervention than established UNIX environments.

"Our Linux support people end up doing twice as much work as those supporting our commercial UNIX distributions such as IBM's AIX or HP's UX," the IT manager noted.

Another IT manager observed that the immaturity of Linux makes it more resource-intensive than UNIX in his shop. "Linux requires 25 percent more FTE support specialists than our UNIX networks. This is primarily because of application and driver issues," he said. The IT manager added that Linux is now experiencing many of the growing pains UNIX did in its early years. "These types of problems are expected and will likely be resolved and/or overcome within the next 2 years," he said.

The responses were especially variable when customers compared FTE requirements between Linux and Windows 2000 Server and Windows Server 2003 networks.

Again, while roughly 50 percent of customers rated the Windows and Linux platforms equal in terms of FTE support requirements, the remaining 50 percent offered extreme opposing views.

Write-in essay respondents opined that Linux required an extreme 300 percent *fewer* FTEs to manage to 200 percent more FTEs than Windows—particularly Windows

Server 2003.

Businesses that had straightforward Linux networks praised Linux reliability. “They just work, there’s no rebooting,” said one IT manager.

Another IT manager noted that different management issues affected his Linux and Windows support specialist, resulting in no FTE reduction. “Our Linux support people end up doing twice as much work as those supporting the Windows Server environment. However, Windows servers are the subject of determined attacks from all angles. So in the end, with the increased [Windows] vigilance, the support time for Linux and Windows is the same,” the manager said.

Corporations raised several common themes with respect to the current management requirements for Linux networks:

- **Demand for skilled Linux administrators currently exceeds supply.** It is currently difficult to find skilled Linux administrators who do not command significant salary premiums of 20 percent, 30 percent or even higher than equivalent UNIX and Windows FTEs. In addition, although several survey respondents noted that Linux required fewer FTEs than Windows, because of the higher salaries paid to the Linux administrators, the companies were unable to reduce overall salary TCO costs.

- **Heterogeneous network environments will not be able to reduce IT headcount by installing Linux.** Companies that maintain Windows, UNIX and Linux networks noted the need to hire additional support staff because Linux management requires a different skill set than the other OS platforms.

- **Linux networks require more add-on management packages and utilities than Windows or UNIX.** In this early stage of development, IT managers reported that Linux distributions require their organizations to purchase anywhere from 2 to 10 or more add-on packages or utilities to achieve the same degree of functionality they currently receive from baseline Windows or UNIX operating systems. The more add-ons, the more FTEs, time and money are needed to manage the Linux installations. This situation will improve as Linux matures. Realistically, however, it will take the third-party Linux ISV market 2 to 3 years to mature.

- **There is currently less documentation from Linux distributors or on the Web compared with UNIX or Windows.** The lack of Linux documentation increases the time customers spend searching for and implementing management solutions.

Finally, about 15 percent of respondents said they will not be able to lower their TCO management costs with a switch to or addition of Linux in their sites, because “one person does it all.”

Actual Costs of a Total Switch from Windows, UNIX to Linux

Linux lacks many of the embedded management and performance enhancement capabilities of UNIX, Windows or even NetWare for that matter. That means—as one customer pointed out—organizations have to buy several (sometimes dozens) more utilities to get the same level of functionality of their current OS environments. Of course, these extras cost money—anywhere from $5 to $25 per client or from $300 to $1,500 for server licenses. The incremental utilities/management packages can, on average, add from 10 to 35 percent to the capital expenditure budget, excluding training and retraining of IT staff for Linux and hiring skilled Linux administrators (who, depending on geographic location, can command from 20 to 30 percent price premiums compared with Windows, UNIX, NetWare and Macintosh IT administrators).

Aftermarket technical service and support (premium pricing for premium services) and indemnification and product warranties are other big-ticket items for mid-sized and large enterprises. Novell, Red Hat, JBoss and HP are all charging for IP protection—*if* they offer it at all (IBM does not and will not)—and that is contingent on using their services and *not* modifying the source code. If you do change the source code, you are not indemnified. If you absolutely must have indemnification, you can buy it from a third party such as New York-based Open Source Risk Management.

OSRM is only selling liability protection covering copyright infringement suits. However, Founder and President Daniel Egger said OSRM plans to offer patent protection liability insurance for an additional premium at a later date.

SCO proposes to charge customers $700 per server, per year.

In addition, another interesting switching cost is new, compatible drivers for Linux, if they exist, that is.

The Yankee Group concludes that a wholesale or significant switch to Linux could cost mid-sized and large enterprises with an existing investment in UNIX or Windows three to four times as much and not deliver tangibly better performance or business gains.

Testing and Certification

The expense of having to recertify applications for Linux is another potentially big expense cited by mid-sized and large enterprises as a reason for retaining UNIX and Windows. This also affects third-party software suppliers considering building applications for the Linux market.

Certification can last months and it can cost anywhere from $20,000 to $40,000 to certify even routine third-party utilities. ISVs must take into account the cost of the baseline testing as well as the staff hours and resources needed to devote to the testing. On the surface, the baseline testing charges are fairly economical. VeriTest, for example, charges from $2,000 to $6,000 to test client applications. Server applications range from $4,000 to $16,000.

Organizations also must factor in the hours of their in-house IT staff. The average network administrator is paid from $40 to $80 (or even higher) per hour over a period of weeks. Again, it is easy to see how quickly the costs add up.

Application Compatibility

Corporations planning a Linux migration or deployment should perform due diligence and poll their third-party application providers to determine which versions of their applications will support Linux and how customization of the Linux distribution source code will affect the application's performance. Even in the more mature Windows and UNIX environments, many ISVs elect to support Sun Solaris or Windows Server 2003 on the most current versions of their applications.

Do not expect niche market suppliers such as graphics card supplier NVIDIA to make inexpensive open source versions of their products. In markets controlled by one or two vendors, it is highly unlikely that suppliers will cut their profit margins to accommodate the open source community.

Application compatibility or lack thereof can ease a migration to Linux (or any OS environment) or act as a formidable impediment that delays or derails software infrastructure deployments. Again, Windows and UNIX currently hold a clear advantage over Linux in this area. Red Hat recently announced that 750 applications are certified and available for its platform. This is a real milestone for the Linux market, but that figure pales in comparison to the tens of thousands of available UNIX and Windows applications. It could take Linux 2 to 3 years to catch up.

Act wisely and pragmatically:

- Know where your ISV stands on support for the latest versions of UNIX, Windows Server 2003 and the various Linux distributions such as SuSE 8.1 and Red Hat 8, 9 and 10. If support for a line of business or mission-critical application is delayed or nonexistent, the company may also have to defer upgrade or migration plans.

- Understand that if an ISV is slow to support Windows 2000, it may necessarily delay your deployment. If you cannot wait, you may have to switch vendors.

If your firm chooses to install a third-party application that is not fully Linux certified, understand you may have little recourse if your company encounters problems.

Always test before you deploy. Do not accept claims of Linux, UNIX or Windows Server 2003 certification at face value, no matter how trusted and reliable the vendor. Although the third-party application may be fully Windows 2000-compliant, it is impossible to predict how or when a particular application will behave in all environments with myriad configurations.

Organizations, regardless of OS environment, should thoroughly investigate third-party ISV software, question their vendors about features and when to expect key pieces of functionality (if missing from an initial release), and always check for known anomalies. Once again, organizations that elect to take advantage of the ability to modify the Linux distribution source code should be prepared for anything. Thoroughly query your third-party ISVs on missing software functionality or known anomalies.

III. Conclusions

There is no denying Linux's appeal. There is no denying that many disaffected customers view Linux as the "un-Microsoft" solution.

Linux definitely has a place in small, mid-sized and large corporations.

However, Linux desktops do not constitute a significant threat to Windows deployments. In the server arena, Linux is making great inroads, primarily at the expense of mid-range UNIX deployments. Microsoft Windows is experiencing only minor defections in mid-sized and large enterprises. The majority of customers (in all vertical and horizontal markets) indicate they do not intend to totally replace Windows with Linux. Instead, the migration from Windows to Linux servers appears to be confined to specific application server replacements.

Like Windows and UNIX, Linux delivers high performance and reliability. However, it is most assuredly not free. Corporations are just now beginning to discern the true TCO and ROI of Linux and are discovering that although the licenses may be free, Linux is not without costs.

The true TCO and ROI of Linux will vary by company according to the specific organization's existing and planned infrastructure and business needs. It is incumbent upon individual corporations to perform their due diligence and make an informed decision based upon the organization's business needs and financial and technical means.

Each of the three major operating system environments has achieved a reasonable degree of performance and reliability. Each has distinct strengths and weaknesses.

From a customer perspective, the two biggest disadvantages of Microsoft software are:

- Licensing costs
- Ongoing security issues

From a customer perspective, the biggest drawback of the UNIX environment is:

- Expensive hardware

From a customer perspective, the biggest disadvantages of the Linux environment are:

- Fewer off-the-shelf applications
- Paucity of skilled administrators
- A 20 to 30 percent salary premium for skilled administrators
- Open source software increases liability and exposure in data sensitive networks
- Limited and conditional product warranties and indemnification

For the near future, ongoing security issues will be the most problematic for Microsoft and its Windows customers. Microsoft is making a concerted effort to make Windows more inherently secure by default and design. However, it will continue to be the number-one target for hackers. In addition, the near-constant barrage of attacks undeniably undermines customer confidence. However, Microsoft is not alone: As Linux gains popularity and its adoption rate ascends, it will be the focus of concerted and determined hacks.

Linux licensing indemnification and product warranties are an increasing concern for mid-sized and large organizations with more than 5,000 end users. Although 55 percent of businesses said it is *not a concern,* 45 percent indicated it is an issue. The most notable thing about this statistic is the 37 percent jump of those concerned within the last 12 months. When the Yankee Group posed this same question a year ago, only 8 percent of organizations said they were concerned about the lack of Linux indemnification.

Recommendations

To achieve the highest TCO and fastest ROI, corporations must perform a thorough analysis of their current operating system infrastructure and identify the strengths and weaknesses of their environment.

Because individual business needs, goals and budgets vary, no single TCO model will work for all businesses. To determine whether Linux, Windows or UNIX is the most appropriate primary platform for your firm—or alternatively, which combination of the three is right for your business—corporations should:

- **Construct a detailed list of the business's tactical and strategic goals.** This includes making a list of your criteria for achieving TCO and ROI and rates. Include the factors (e.g., capital expenditure outlay, performance, specific features) that will influence your decision in order of importance.

- **Review the budget.** If UNIX or Windows is currently your primary platform, how and where can you save money by a switch to Linux? What does your organization spend on hardware, software licenses and third-party tools? If you switch to Linux and spend less on licenses, will you have to spend more on indemnification, product warranties and third-party tools in the Linux environment? Consider all these issues.

- **Assess your IT staff.** Determine your organization's expertise in existing OS management and the amount of time and budget necessary to retrain or certify your in-house staff on Linux or to hire skilled Linux administrators or third-party outsourcers. Linux is not as mature as UNIX or Windows. Therefore, there are fewer skilled Linux administrators available; but the higher their proficiency, the greater their salary premium. This situation will change over time, but do not expect it to ease perceptibly in the next 12 to 15 months. Additionally, Yankee Group TCO survey data indicated that mid-sized and large enterprises are unlikely to lower their management TCO when they add Linux to the environment because Linux requires a different administrative skill set from UNIX or Windows.

  — **Security:** Although Windows is taking the brunt of the hack attacks, Linux and UNIX are not immune. Fifty percent of all security is attributable to the "human element." When assessing the organization's security TCO, you must include security practices and policies as well as the current level of staff security training. Before undertaking any upgrade or migration, perform a risk analysis and assessment of your current environment, eliminate the vulnerabilities and reduce your risks. Next, perform a rigorous evaluation of your planned upgrade environment and include a cost/risk comparison of Linux, Windows and/or UNIX.

— **Application infrastructure:** Are most of your applications off-the-shelf or customized? If your current Windows or UNIX infrastructure is mainly off-the-shelf applications, are these same applications available in the Linux environment? If not, do you have the expertise or budget to replicate a customized version in Linux in a reasonable time frame? How much will it cost?

— **Indemnification and product warranty:** If your business is small or mid-sized, the risk of litigation or liability because of IP, trade secret, copyright or patent infringement is much lower than an enterprise. However, your company's TCO may still be affected by event-driven indemnification. In this scenario, you must determine whether your firm has the means to cope in the event of a network outage or disaster if it is not indemnified by its Linux vendors or a third-party IP insurance provider. In an enterprise environment, however, strict attention must be paid to the very real threat of having no indemnification and product warranty if the company elects to modify the Linux source code. In this case, your organization will have to purchase outside indemnification insurance or do without. Proprietary software such as Windows has a distinct advantage over a customized open source implementation in this instance. Microsoft has the broadest, most comprehensive indemnification provisions in the industry: no limits on liability and customers are fully covered. By contrast, Linux vendors such as Novell have capped liability. It is possible for individual companies to negotiate for better terms and conditions. If your organization is committed to a significant Linux deployment, it is wise to lobby long and hard for better indemnification and product warranty terms.

— **Third-party tools:** Linux is not as mature as UNIX or Windows. Therefore, the baseline operating systems may not incorporate all the embedded performance and management capabilities of those OS environments. Your organization may have to purchase and install several third-party tools at an incremental cost. These packages may range from simple utilities to more complex management functions—and this could potentially raise the cost of your initial capital expenditure outlay by 10 to 35 percent depending on the size and scope of your organization. Customers considering a Novell SuSE and Ximian Linux implementation should check with Novell, which has a slew of add-on products, such as ZENworks and eDirectory from its legacy NetWare environment. These same products may be available for the SuSE and Ximian offerings. If so, we urge customers to lobby for their inclusion into a new Novell Linux contract.

Finally, it is incumbent upon individual organizations to determine which operating system (or systems) best suits their firm's technology needs, budget and business goals. With proper planning, training and budgeting, any one of the three (Linux, Windows or UNIX) can provide the best TCO and fastest ROI.

IV. Further Reading

Yankee Group Application Infrastructure & Software Platforms Reports

Enterprises Worldwide Finally Plan to Increase IT Spending on Long-Overdue Software Upgrades, March 2004

Microsoft Readies Longhorn but Tells Users Not to Hurry Up and Wait, February 2004

Top Vendors Already Stake Their Claims in Web Services, December 2002

Microsoft Licensing: Pay Now or Pay More Later, October 2002

The Desktop OS: Are There Real Alternatives to Microsoft?, July 2002

Yankee Group Application Infrastructure & Software Platforms Research Notes

Security Flaws Shadow Windows Operating Systems, February 2004

Microsoft Launches New Security Initiatives, November 2003

Microsoft Offers Six-Figure Bounty for Capture of Outlaw Virus Writers, November 2003

Is Windows XP Business Ready?, September 2002

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