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Total Economic Impact™ Of VMware Virtual Desktop Infrastructure – Healthcare Industry

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Executive Summary

In January 2008, VMware commissioned Forrester Consulting to examine the total economic impact and potential return on investment (ROI) that enterprises may realize by deploying VMware Virtual Desktop Infrastructure (VDI). VMware VDI provides companies with the ability to remotely manage and deliver end user desktops from a centralized server environment. This study illustrates the financial impact of moving from a traditional one-PC-per-user model to a centralized, hosted-virtual-desktop delivery model.

In conducting in-depth interviews with an existing VMware VDI healthcare customer, Forrester found that the organization achieved significant benefits: some easily measured for this ROI study, and others equally valuable that could not be quantified. Specifically, the benefits fall into the following categories:

Quantitative Customer benefits

1. PC replacement savings from repurposing old computers as thin clients and extending the life-cycle replacement time;

2. IT support staff savings because of fewer problems and more efficient, centralized support;

3. Improved worker productivity because of reduced PC downtime and the ability to access desktops from multiple locations;

4. Electricity savings from purchased thin client machines;

Qualitative Customer Benefits

5. Improved data and endpoint security by storing information centrally and locking down computers;

6. Improved user experience for the IT department, hospital staff, and physicians;

7. Better business continuity and disaster recovery capabilities.

To fully understand the potential impact on their organizations, readers should take into consideration all benefits, whether or not they could be quantified for this study.

This customer was able to provide metrics to quantify components of the first four benefits listed above. For the interviewed customer, Forrester found an anticipated ROI of between 122% and 128% with VMware Virtual Desktop Infrastructure.

Purpose

The purpose of this study is to provide readers with a framework to evaluate the potential financial impact of VMware Virtual Desktop Infrastructure on their organizations. Forrester's aim is to clearly show all calculations and assumptions used in the analysis. Readers should use this study to better understand and communicate a business case for investing in VMware VDI.

Methodology

VMware selected Forrester for this project because of its industry expertise in virtualization technologies and Forrester's Total Economic Impact™ (TEI) methodology. TEI not only measures costs and cost reduction (areas that are typically accounted for within IT), but it also weighs the enabling value of a technology in increasing the effectiveness of overall business processes.

For this study, Forrester employed four fundamental elements of TEI in modeling VMware Virtual Desktop Infrastructure:

1. Costs and cost reduction.
2. Benefits to the entire organization.
3. Risk.
4. Flexibility.

Given the increasing sophistication that enterprises have regarding cost analyses related to IT investments, Forrester's TEI methodology provides a complete picture of the total economic impact of purchase decisions. Please see Appendix A for additional information on the TEI methodology.

Approach

Forrester used a four-step approach for this study:

1. Forrester gathered data from existing Forrester research relevant to VMware VDI and the virtualization market in general.
2. Forrester interviewed VMware marketing and sales personnel to fully understand the potential (or intended) value proposition of VMware VDI.
3. Forrester conducted a series of in-depth interviews with one organization currently using VMware VDI.
4. Forrester constructed a financial model representative of the interviews. This model can be found in the TEI Framework section below.

Key Findings

Forrester's study yielded the following key findings:

- **ROI.** Based on the interviews with an existing customer, Forrester constructed a TEI framework and the associated ROI analysis illustrating the financial impact areas. As seen in Table 1, the risk-adjusted ROI for this company is 122% with a breakeven point (payback period) of eight months after deployment.
- **Benefits.** For the purposes of this ROI analysis, only benefits associated with PC savings, reduced support costs, increased worker productivity, and electricity savings were calculated. The risk-adjusted, present value of the benefits for the organization amount to $3.8 Million over a four-year period.

- **Costs.** The hospital had a rapid and large rollout of VMware VDI. The costs described in this study reflect this implementation approach. The license costs described in this study use the current VMware pricing model to give readers information most relevant to any future implementation they may be considering. The risk-adjusted, present value of the costs for the organization amount to $1.7 Million over a four-year period.

Table 1 illustrates the original and risk-adjusted financial results for this customer based on data and characteristics obtained during the interview process. Forrester risk-adjusts these values to take into account the potential uncertainty that exists in estimating the costs and benefits of a technology investment. The risk-adjusted value is meant to provide a conservative estimation, incorporating any potential risk factors that may later affect the original cost and benefit estimates. For a more in-depth explanation of risk and risk adjustments used in this study, please see the Risk section.

Table 1: Company ROI, Original And Risk-Adjusted

Summary financial results	Unadjusted (best case)	Risk-adjusted
ROI — four-year	128%	122%
Payback (months)	Seven	Eight
Total four-year costs (PV)	$1,698,303	$1,715,648
Total four-year benefits (PV)	$3,879,174	$3,812,075
Total four-year net savings (NPV)	$2,180,871	$2,096,428
Internal rate of return (IRR)	244%	231%

Source: Forrester Research, Inc.

Disclosures

The reader should be aware of the following:

- The study is commissioned by VMware and delivered by Forrester Consulting.
- VMware reviewed and provided feedback to Forrester, but Forrester maintained editorial control over the study and its findings and did not accept changes to the study that contradicted Forrester's findings or obscured the meaning of the study.
- The customer name for the interviews was provided by VMware.
- Forrester makes no assumptions as to the potential return on investment that other organizations will receive. Forrester strongly advises that readers should use their own estimates within the framework provided in the study to determine the appropriateness of an investment in VMware Virtual Desktop Infrastructure.
- This study is not meant to be used as a competitive product analysis.

VMware Virtual Desktop Infrastructure: Overview

According to VMware, VMware Virtual Desktop Infrastructure (VDI) is an integrated desktop virtualization solution that delivers enterprise-class control and manageability with a familiar user experience. Built on the VMware virtualization platform, the VMware VDI solution includes VMware Infrastructure 3 software along with VMware Virtual Desktop Manager (VDM), an enterprise-class desktop management server that securely connects users to virtual desktops in the data center and provides an easy to use web-based interface to manage the centralized environment.

VMware VDI enables desktop administrators to provide:

- **Central administration of desktops:** Manage virtual desktops in a data center to more easily perform upgrades, patches and desktop maintenance.
- **Scalable management:** Store and manage thousands of virtual desktops on hundreds of physical servers from a single management console.
- **Streamlined provisioning:** Deploy new desktops using automatic desktop provisioning.
- **Secure flexible access:** Secure access from a wide variety of client devices.
- **Desktop isolation:** Give each end user an isolated virtual desktop and help to eliminate the availability and performance problems associated with shared application technologies.

With VMware VDI, end users get a complete, unmodified virtual desktop that behaves just like a normal PC. There is no change to the applications or desktop environment, no application sharing and no retraining required. Based on security policies, administrators can allow users to install applications, customize their desktop environment and use local printers and USB devices. Help Desk technicians can perform tasks in the data center that would normally require an in-person visit.

VMware VDI provides the following additional benefits and protection:

- **Unified management of servers and desktops:** Provides a common management interface for administration of desktops and servers throughout the virtual infrastructure.
- **Consolidated backup:** Provide centralized backup for virtual desktops while helping to eliminate backup traffic from the network to improve performance.
- **Automated failover and recovery:** Make it easier to keep desktops running even when server hardware goes down, and recover quickly from natural disasters and unplanned outages.
- **Dynamic load balancing:** Help balance desktop computing resources automatically as user needs and application loads change over time.

Analysis

As stated in the Executive Summary, Forrester took this multistep approach to evaluate the effect that implementing VMware Virtual Desktop Infrastructure can have on an organization:

- Interviews with VMware marketing and sales personnel.
- In-depth interviews with one organization currently using VMware VDI.
- Construction of a financial framework for the implementation of VMware VDI.

Interview Highlights: Healthcare Customer

The customer interviewed for the TEI study is a not-for-profit, US-based healthcare system. The main campus houses the primary hospital with a level 1 trauma center, a separate women and children's hospital, an outpatient center, and various administrative buildings. A remote campus has a wellness center, imaging center, and urgent care facility. The entire system is made up of 850 physicians who work on these campuses and out of their 160 private offices.

This customer has approximately 5,600 employees, including 2,000 nurses. In 2007, the hospital cared for 44,000 in-patients, had 115,000 Emergency Department visits, and had approximately 500,000 outpatient registrations.

The interviews uncovered the following relevant points:

- This customer was implementing an Electronic Medical Records (EMR) solution that would have required replacing more than 1,600 of 3,300 PCs. It decided to implement VMware VDI to avoid purchasing all of these replacement PCs. The hospital also wanted to extend the life cycle of their PCs to avoid future replacement costs.
- Improving data/endpoint security and providing remote access to physicians at their medical practices and other locations were the two other top drivers for implementing VMware VDI.
- In evaluating potential solutions, the three main decision criteria were total cost of ownership, scalability, and security. The hospital compared the leading technology choices against their requirements and determined that VMware VDI best met these criteria and was able to do things that would have been very difficult to do using other competitive technologies.
- Improved data security has helped the hospital with Health Information Portability and Accountability Act (HIPAA) compliance.
- The primary user groups initially targeted were nurses and physicians. Use of VMware VDI has expanded to include back-office functions such as patient accounting. Use in these back-office areas will increase in the future
- The program started with a pilot in January 2007 for one floor of a new hospital tower that was being erected. It was such a success that it expanded the solution to the entire building by February 2007. Rolling out VMware VDI to 140 old PCs took "a couple of weeks."
- VMware and a key channel partner worked very closely to make sure the initial implementation went quickly and successfully. The VMware channel partner was so confident that the project would be a success that it told the hospital to put the solution in on one floor for free and only pay when it was happy. This greatly sped up the procurement process.

- According to the individuals who worked on deploying VMware VDI, the hardest part was convincing the hospital administration and other technology vendors that this would work. Vendors were skeptical that their own products would work on virtual desktops or said that they would not support it. The hospital explained to vendors that they did not have to support anything differently. The hospital now considers compatibility with VMware VDI when selecting new technologies.

- From the hospital's perspective, the "critical success components were getting the right people involved in the project, getting them the necessary training, and taking the time to do planning and design properly."

- Because the virtual desktop looks and acts just like the traditional desktop, users did not notice any difference and did not require any behavioral change or training.

- Applications running on the virtual desktops include Streamline Health's Access, Anywhere, Eclipsys TDS 7000, McKesson PACS, Image Viewer, GE Imagecast, and Centricity Enterprise.

- The virtual desktop and virtual server solutions "go hand in hand." The hospital has realized benefits on the virtual server side through economies of scale and cross-over learning.

- According to the Information Technology Manager responsible for the VMware VDI implementation, "We had high expectations and have been amazed."

TEI Framework

Introduction

From the information provided in the in-depth interviews, Forrester has constructed a TEI framework for those organizations considering implementation of VMware Virtual Desktop Infrastructure. The objective of the framework is to identify the cost, benefit, flexibility, and risk factors that affect the investment decision. Most monetary values shown in this study are rounded to the nearest dollar for presentation simplicity. The actual financial calculations may be based on figures carried to more decimal points than shown here.

Framework Assumptions

Table 2 lists the discount rate used in the present value (PV) and net present value (NPV) calculations and the time horizon used for the financial modeling.

Table 2: General Assumptions

Ref.	General assumptions	Value
A1	Discount rate	10%
A2	Length of analysis	Four years

Source: Forrester Research, Inc.

Organizations typically use discount rates between 8% and 16% based on their current environment. Readers are urged to consult with finance to determine the most appropriate discount rate to use within their own organizations.

In addition to the financial assumptions used to construct the cash flow analysis, Table 3 provides salary assumptions used within this analysis. An average salary across the entire hospital was used to calculate a productivity benefit. Salaries in a hospital vary widely. In discussions with the hospital, an assumption was made that an IT salary represents the average. This is discussed in greater detail in the worker productivity benefit section.

Table 3: Salary Assumptions

Ref.	Metric	Calculation	Value
B1	Fully burdened salary* per IT employee (Year 1)	[Increases yearly by 3%]	$44,427
B2	Average fully burdened salary* across hospital	=B1	$44,427

*Includes salary, variable compensation, and all direct benefits (e.g., health insurance)

Source: Forrester Research, Inc.

The hospital deployed virtual desktops for their own employees, physicians' offices, and for physicians to remotely access information from home or other locations. Table 4 show the number of virtual desktops that were deployed for these three different groups, and the maximum number of desktops in concurrent use at any given time. The quick deployment of virtual desktops through year 2 was to meet the hospitals need to replace computers for the Electronic Medical Records project.

Maximum concurrency is used for calculating VMware VDI licenses. That is to say, VMware costs are based on the greatest number of virtual desktops in use at any one time. It is estimated that 75% of the desktops in the hospital are used concurrently since the majority are at nursing stations or individual users' desks. The balance are in patient rooms and are only used when nurses or physicians are in that room. The virtual desktops at the physicians' offices are used by the doctors' staff throughout the day. The desktops for physician remote access are used for brief periods of time from the physician's home or other location. There is very little concurrent use of these virtual desktops.

Table 4: Virtual Desktop Assumptions

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3	Year 4
C1	Increased hospital Virtual desktops		100	900	1,100	200	200
C2	Increased maximum concurrent hospital virtual desktops	C1 * 75%	75	675	825	150	150
C3	Increased physicians office virtual desktops				850	50	50
C4	Increased maximum concurrent physicians office virtual desktops	C3 * 100%	0	0	850	50	50
C5	Increased physician remote access virtual desktops				1,000	500	100
C6	Increased maximum concurrent physician remote access virtual desktops	C5 * 5%	0	0	50	25	5
C7	Total number of virtual desktops	Sum (C1+C3+C5) [through current year]	100	1,000	3,950	4,700	5,050
C8	Total number of *concurrent* virtual desktops	Sum (C2+C4+C6) [through current year]	75	750	2,475	2,700	2,905

Source: Forrester Research, Inc.

Costs

This section describes the overall costs to initially implement, further roll out, and maintain the VMware Virtual Desktop Infrastructure solution.

Initial Internal Implementation Costs

The initial implementation consisted of deploying the required hardware and software to support a pilot on one floor of a new hospital tower then rolling out to the rest of the tower. The pilot involved converting 40 existing PCs to thin client virtual desktop machines running Linux. These machines were used by the clinical staff, and the subsequent rollout expanded the solution to 140 PCs.

Three FTEs worked on the initial implementation for five months. The average fully burdened salary for an IT employee during this period was $3,702 per month. The resulting implementation labor cost is equal to 3 FTEs x 5 months x $3,702 per month, or $55,534.

Table 5: Initial Internal Implementation Costs, Non-Risk-Adjusted

Ref.	Metric	Calculation	Initial
D1	Number of FTEs		3
D2	Monthly fully burdened cost	=B1 / 12 months	$3,702
D3	Number of months		5
Dt	Initial internal implementation costs	D1 * D2 * D3	$55,534

Source: Forrester Research, Inc.

VMware Costs

The software licenses depicted in this study reflect what a new customer implementing VMware VDI could expect to pay. This may not be the same as what this customer paid at the time of its implementation.

The current software pricing model is based on the maximum number of concurrent users and includes all the components necessary to run VMware VDI. $150 is the current list price per concurrent user before any volume discounts. Maintenance is a required part of a VMware VDI contract and begins at 21% of list price. The 17% maintenance cost used in this model reflects a three-year licensing agreement.

The hospital had three employees certified on VMware technologies and used some consulting in designing the solution. These costs were included in the initial contract signed between the hospital and the VMware reseller.

Table 6: Software Licenses And Maintenance, Non-Risk-Adjusted

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3	Year 4
E1	List price per maximum concurrent user		$150	$150	$150	$150	$150
E2	Increased licenses (based on maximum concurrent users)	(C2 + C4 + C6) - sum[previous years]	75	675	1,725	225	205
E3	VDI licenses	E1 * E2	$11,250	$101,250	$258,750	$33,750	$30,750
E4	Maintenance percentage		17%	17%	17%	17%	17%
E5	Annual maintenance and support	E1 * sum E2 [through current year] * E4	$0	$19,125	$63,113	$68,850	$74,078
E6	Training and professional services		$20,000				
Et	VMware costs	E4 + E6 + E 7	$31,250	$120,375	$321,863	$102,600	$104,828

Source: Forrester Research, Inc.

Hardware Costs

VMware VDI requires servers to host the virtual desktops. The hospital uses IBM HS21XM blades, each has two quad-core CPUs and 16 GB of RAM. These are housed in standard IBM chassis. Server hardware was purchased with a three-year extended warranty, which is included in the costs below. The hospital hosts 60 virtual desktops per blade, and 14 blades sit in each chassis. More blades than were needed were added earlier in the study to support disaster recovery capabilities. There are also additional storage requirements for hosting the desktop and all files on that desktop. This customer had an existing EMC DMX3000 storage area network (SAN) that it expanded by 14 terabytes in each of the first three years of the study.

Most of the computers running VMware VDI are old PCs converted to run as Linux thin client machines. This work was completed by the existing PC support staff, so their was no incremental cost included in this study. In addition to these computers, the customer needed to purchase some Neoware thin client computers. The majority of the thin client machines were the e90 model, and the e140 model with wireless connectivity was used on the mobile carts. To simplify the study, an average cost per blade and thin client machine was used throughout the life of the study.

Table 7: Hardware Costs, Non-Risk-Adjusted

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3	Year 4
F1	Cost per blade		$8,727	$8,727	$6,800	$6,800	$6,800
F2	Blades added		6	22	38	12	6
F3	Blade costs	F1 * F2	$52,362	$191,994	$258,400	$81,600	$40,800
F4	Cost per chassis		$28,000	$28,000	$28,000		
F5	Chassis added		1	2	4		
F6	Chassis costs	F4 * F5	$28,000	$56,000	$112,000		
F7	Additional SAN storage			$14,000	$14,000	$14,000	
F8	Thin clients added			160	200	40	100
F9	Cost per thin client			$321	$321	$321	$321
F10	Thin client costs	F8 * F9		$51,360	$64,200	$12,840	$32,100
Ft	Hardware Costs	F3 + F6 + F7 + F10	$80,362	$313,354	$448,600	$108,440	$72,900

Source: Forrester Research, Inc.

Ongoing Operations

One FTE is responsible for the technical administration of the VMware VDI solution. In addition, there is some part-time effort over the course of the year from various other IT areas, i.e., networking, making up another .5 FTE.

Other ongoing support costs, such as server hosting and maintenance, are included in the hardware costs above.

Table 8: Ongoing Operations, Non-Risk-Adjusted

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3	Year 4
G1	Number of FTEs			1.5	1.5	1.5	1.5
G2	Annual fully burdened cost	= B1		$44,427	$45,760	$47,133	$48,547
Gt	Ongoing operations	G1 * G2		$66,641	$68,640	$70,699	$72,820

Source: Forrester Research, Inc.

Total Costs

Table 9 summarizes this customer's costs associated with its implementation and ongoing operation of VMware Virtual Desktop Infrastructure.

Table 9: Total Costs Of VMware VDI, Non-Risk-Adjusted

Ref.	Costs	Initial	Year 1	Year 2	Year 3	Year 4	Total	Present value
Dt	Initial internal implementation costs	$55,534					$55,534	**$55,534**
Et	VMware costs	$31,250	$120,375	$321,863	$102,600	$104,828	$680,915	**$555,367**
Ft	Hardware costs	$80,362	$313,354	$448,600	$108,440	$72,900	$1,023,656	**$867,237**
Gt	Ongoing operations		$66,641	$68,640	$70,699	$72,820	$278,800	**$220,164**
	Total	**$167,146**	**$500,370**	**$839,103**	**$281,739**	**$250,548**	**$2,038,905**	**$1,698,303**

Source: Forrester Research, Inc.

Benefits

Not all the benefits that this healthcare customer realized are easily quantified in this ROI analysis. Therefore, the first half of this section details the benefit calculations that go into the ROI analysis, and the second half describes qualitative benefits that are not included in the ROI analysis. The qualitative benefits are potentially even more valuable than the quantitative ones and should be taken into consideration when analyzing the total return on investment offered by VMware VDI.

PC Replacement Savings

As discussed earlier, the main reason for implementing VMware VDI was to avoid purchasing 1,600 new PCs for the hospital as part of an Electronic Medical Records rollout. Instead, the hospital redeployed aging, existing PCs as thin client machines running Linux. In addition to the 1,600 PCs for the hospital, the hospital would have also had to purchase some of the computers needed in physicians' offices. Other computer purchases have been avoided over the life of this study as the rollout increased. The typical replacement life cycle of a computer has increased from three to four years up to seven to 10 years. This is reflected in year four, when many of the PCs that would have been replaced in year one would have been replaced again.

There was some need to purchase thin client computers. This offsetting cost is covered in the hardware costs sections of this study.

Table 10: PC Replacement Savings, Non-Risk-Adjusted

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Year 4
H1	Hospital PCs not replaced		1,000	1,100	200	1,200
H2	Physicians office PCs not replaced by hospital		0	505	25	25
H3	Cost per PC		$600	$600	$650	$675
Ht	PC replacement savings	(H1 + H2) * H3	$600,000	$963,000	$146,250	$826,875

Source: Forrester Research, Inc.

PC Management and Support Savings

Centrally managing users' computers has greatly reduced the time and cost to keep these computers running properly. Related support calls have decreased by 70%, and the time to provision or reimage a computer has decreased from 30 minutes to 8 minutes. Under the old model, it was especially difficult to service computers that were not on the hospital's central campus but in remote locations.

The PC management and support team used to have 14 individuals. Some of these employees have been redeployed to the network support team, and the remaining resources are also working on other projects and non PC support activities with their extra time – approximately 10% of their total effort. This has resulted in avoided additional hires and fewer total resources for the PC management and support team. In addition, the hospital is now able to implement a multi-tier support structure that provides greater service.

Table 11: PC Management And Support Savings, Non-Risk-Adjusted

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Year 4
I1	Total PC support headcount		14	13	11	11
I2	Additional hires avoided			2.0	3.0	3.5
I3	Resources redeployed	I1[Year 1] –I1 [current year]		1.0	3.0	3.0
I4	Time spent on other activities (FTEs)	I1 * 10% [Year 2 onwards)		1.3	1.1	1.1
I5	Fully loaded cost per employee	= B1		$45,760	$47,133	$48,547
It	PC management and support savings	(I2 + I3 + I4) * I5		$196,768	$334,643	$368,956

Source: Forrester Research, Inc.

Increased Worker Productivity

Before VMware VDI was deployed, worker productivity was frequently negatively affected by computer crashes and other PC-related problems. Users would have to find another computer or wait for the IT department to fix the problem. With the implementation of VMware VDI these problems have largely been eliminated, both in the patient care and back-office areas of the hospital.

Salaries vary widely in a hospital. To simplify the model, it was agreed with the hospital to use the IT workers' salary as an average salary across the hospital. It falls somewhere in the middle of salaries for nurses and for general administrative workers.

Depending on the type of company, not all of the time gained back will always translate into increased output. Given the nature of the work at a hospital, an assumption was made that 85% of the time gained is converted into productive work.

Table 12: Increased Worker Productivity, Non-Risk-Adjusted

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Year 4
J1	Hospital employees using virtual desktops		1,000	2,100	2,400	2,800
J2	Fully loaded cost per hour	= B2 / (220 days * 8 hours) [rounded]	$25.24	$26.00	$26.78	$27.58
J3	Number of hours (saved) per worker		8	8	8	8
J4	Percent captured		85%	85%	85%	85%
Jt	Increased worker productivity	J1 * J2 * J3 * J4	$171,632	$371,280	$437,050	$525,123

Source: Forrester Research, Inc.

Electricity Savings

Running virtual desktops on the Neoware thin clients uses less electricity than operating full PCs. The hospital calculated that each traditional PC consumes 96 watts per year. Between the electricity consumed in the data center and the Neoware thin clients, the new solution consumes only 21 watts per year per thin client. Based on what the hospital pays for electricity, this comes out to an average savings of $43.56 per thin clients.

Table 13: Electricity Savings, Non-Risk-Adjusted

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Year 4
K1	Number of thin clients	=sum F8[through current year]	160	360	400	500
K2	Electricity savings per thin client		$43.56	$43.56	$43.56	$43.56
Kt	Electricity savings	K1 * K2	$6,970	$15,682	$17,424	$21,780

Source: Forrester Research, Inc.

Total Quantified Benefits

Table 14 summarizes the total quantified benefits realized by implementing VMware VDI.

Table 14: Total Quantified Benefits of VMware VDI, Non-Risk-Adjusted

Ref.	Benefits	Year 1	Year 2	Year 3	Year 4	Total	Present value
Ht	PC replacement savings	$600,000	$963,000	$146,250	$826,875	$2,536,125	**$2,015,969**
It	PC management and support savings		$196,768	$334,643	$368,956	$900,366	**$666,042**
Jt	Increased worker productivity	$171,632	$371,280	$437,050	$525,123	$1,505,085	**$1,149,900**
Kt	Electricity savings	$6,970	$15,682	$17,424	$21,780	$61,855	**$47,263**
	Total	**$778,602**	**$1,546,730**	**$935,366**	**$1,742,734**	**$5,003,431**	**$3,879,174**

Source: Forrester Research, Inc.

Qualitative Benefits

Improved Data/Endpoint Security

One of the main reasons the hospital cited for implementing VMware VDI was to improve data and endpoint security. Using thin clients makes it harder for data to be inappropriately removed from the hospital on USB memory sticks or other portable storage devices. Additionally, all information resides in secure data centers instead of on standalone PCs, making it easier to protect from external intrusions. As a result, the hospital's "Health Information Portability and Accountability Act (HIPAA) regulatory concerns evaporated."

Having locked-down computers and desktops also helped protect the network from inappropriate breaches and the introduction of malware or other security threats. It also prevented inappropriate use of the hospital's computer resources, including users installing personal applications or storing personal files on the hospital PCs.

The hospital has also been able to use VMware VDI to easily improve security at public access computers in cafeterias and lounges. Each night, all these computers are automatically and remotely reimaged, ensuring that all malware or other security threats are completely removed.

Quantifying security risks and their associated costs can be very difficult. A company often doesn't know that a breach has taken place, particularly in the case of data leakage. A report often cited to estimate the cost of a security breach is the "CSI/FBI Computer Crime And Security Survey".[1] According to the 2007 survey, the average cost per security breach was $350K, up from $168K in 2006. Average losses associated with the theft of confidential information, except from mobile devices, were $5.7 million per incident. The loss associated with data or network sabotage were $1.1 million per incident.

An April 2007 Forrester study, "Calculating The Cost Of A Security Breach," provides metrics to calculate the potential cost of a security breach for any given company.[2] The study calculates the "cost per record" for three different company profiles:

- Low-profile breach in a non-regulated industry ($90).
- Low-profile breach in a regulated industry ($155).
- High-profile breach in a highly regulated industry ($305).

As a healthcare provider in a highly regulated industry, any significant breach is likely to be high profile. Given the number of patients the hospital treats each year and the records held, at $305 per record, any security breach would result in a very significant cost to the hospital.

Improved User Experience

Implementing VMware VDI has improved the user experience for several groups across the healthcare system.

- **IT department:** The amount of effort needed to support PCs has been greatly reduced. This means that the team can focus on "more engaging work" and has a greater "sense of empowerment." Additionally, there are fewer middle of the night IT emergencies requiring someone to go into the office and fix machines. The IT department is using these freed-up resources to completely redesign their user support function. Instead of specialized resources for desktop, networks, etc., they are implementing a multitier support structure.
- **Clinical workers and back-office staff:** A productivity benefit for hospital workers was discussed previously. A related benefit is the improved work experience for hospital employees. They no longer have to deal with the frustration of finding another computer to use or waiting for their computer to be fixed and falling behind in their work. For clinical

[1] "2007 CSI/FBI Computer Crime And Security Survey." Robert Richardson, et al. Computer Security Institute, 2007.

[2] "Calculating The Cost Of A Security Breach," Khalid Kark, et al. Forrester Research, April 2007.

workers, they have easy access to their own desktop and information while moving around the ward or other parts of the hospital

- **Physicians and their staf**f: Prior to implementing VMware VDI, physicians' staff would often have to drive to the hospital to retrieve reports and other information. Now it can easily be viewed from the offsite office. Physicians can also access necessary patient information from home, freeing up time from their already busy schedules. Because of the importance placed on supporting physicians, the hospital has made a significant investment in making information easily available to physicians via virtual desktops. This is despite the fact that the hospital does not realize an offsetting direct financial benefit.

Better Business Continuity And Disaster Recovery Capabilities

A benefit that the hospital is beginning to realize is improved business continuity and disaster recovery capabilities. In the past, information might reside on a single computer. Even with tape backups and other safety measures, there was always a risk of information being lost or difficult to recover. Now that information resides in central, secure data centers, this concern is largely removed.

The hospital has designed its VMware VDI solution so that if it loses a chassis, no information is lost, and workers can continue on with their duties without any problems. They accomplished this by geographically distributing their data centers and by installing additional hardware capacity to handle their disaster recovery needs. This additional capacity is included in this study's costs.

Having desktops and information remotely accessible also means that if a part of the hospital had to be closed in an emergency, workers could relocate and easily get access to their desktops. This can be accomplished without the need for building specialized disaster recovery centers.

Risk

Risk is the third component within the TEI model. It is used as a filter to capture the uncertainty surrounding different cost and benefit estimates. If a risk-adjusted ROI still demonstrates a compelling business case, it raises confidence that the investment is likely to succeed because the risks that threaten the project have been taken into consideration and quantified. The risk-adjusted numbers should be taken as "realistic" expectations, since they represent the expected values considering risk. In general, risks affect costs by raising the original estimates, and they affect benefits by reducing the original estimates.

Each benefit and cost is assigned either a "low," "medium," "high," or "none" risk rating. The following benefits and costs were rated as either low, medium, or high risk:

- **Hardware costs: low risk.** The hospital hosts more virtual desktops per blade than other organization may be able to. This can result in higher hardware costs.

- **PC replacement savings: low risk.** PC-related savings is one of the main benefits an organization should achieve when implementing VMware VDI. However, a reader's organization may not face the need to replace as many PCs and, therefore, not realize as large a benefit as the organization profiled in this study. A higher replacement cost per PC may partially offset this risk.

- **Increased worker productivity: low risk.** Computer downtime almost always affects worker productivity. Another company implementing VMware VDI may not have as wide a

rollout and, therefore, not benefit as many workers. However, the productivity gain per worker may be greater, offsetting some of this risk.

- **Electricity savings: medium risk.** Another company may require more server space to host all of the virtual desktops. This would require more electricity per virtual desktop. If another organization installs more purpose built thin client machines, there will greater electricity savings that partially or completely offset this risk.

For the purpose of this analysis, Forrester risk-adjusts cost and benefit estimates to better reflect the level of uncertainty that exists for each estimate. The TEI model uses a triangular distribution method to calculate risk-adjusted values. To construct the distribution, it is necessary to first estimate the low, most likely, and high values that could occur within the current environment. The risk-adjusted value is the mean of the distribution of those points.

For example, the risk associated with hardware costs is defined as "low." This risk level was chosen because other companies may have to purchase slightly more hardware than this company did. The original estimated cost in the Initial period is $80,362. To calculate the risk-adjusted cost, the "most likely" scenario was set at 100% of cost, the "high" scenario was assigned 105% of cost, and the "low" scenario was assigned 100% of cost. The rounded mean of these three values is 102%. The resulting benefit used in the risk-adjusted table is $81,969, or 102% of $80,362.

The following tables show the values used to adjust for uncertainty in cost and benefit estimates. Readers are urged to apply their own risk ranges based upon their own degree of confidence in the cost and benefit estimates.

Table 15: Risk Adjustments To Costs

Ref.	Risk adjustments to costs	Risk scoring	Low	Most likely	High	Risk-adjusted
L1	Initial internal implementation costs	None	100%	100%	100%	100%
L2	VMware costs	None	100%	100%	100%	100%
L3	Hardware costs	Low	100%	100%	105%	102%
L4	Ongoing operations	None	100%	100%	100%	100%

Source: Forrester Research, Inc.

Table 16: Risk Adjustments To Benefits

Ref.	Risk adjustments to benefits	Risk scoring	Low	Most likely	High	Risk-adjusted
M1	PC replacement savings	Low	90%	100%	105%	98%
M2	PC management and support savings	None	100%	100%	100%	100%
M3	Increased worker productivity	Low	90%	100%	105%	98%
M4	Electricity savings	Medium	75%	100%	100%	92%

Source: Forrester Research, Inc.

Flexibility

Flexibility, as defined by TEI, represents an investment in additional capacity or capability that could be converted into business benefit for some additional future investment. Flexibility would also be quantified when evaluated as part of a specific project (Please see Appendix A for more detail).

The hospital has the option to easily roll out VMware VDI to additional users. Its long-term goal is to move upwards of 4,500 of its 5,600 employees onto VMware virtual desktops. For the purposes of the ROI calculations, this expanded rollout of VMware VDI was not included.

TEI Framework: Summary

Considering the financial framework constructed above, the results of the costs, benefits, and risk sections can be used to determine a return on investment, net present value, and payback period. Table 17 and Table 18, below, show the risk-adjusted cost and benefit values, applying the risk-adjustment method indicated in the Risks section and the values from Table 15 and Table 16 to the numbers in Table 9 and Table 14, respectively.

Table 17: Risk-Adjusted Costs

Ref.	Costs	Initial	Year 1	Year 2	Year 3	Year 4	Total	Present value
N1	Initial imple-mentation costs	$55,534					$55,534	**$55,534**
N2	VMware costs	$31,250	$120,375	$321,863	$102,600	$104,828	$680,915	**$555,367**
N3	Hardware costs	$81,969	$319,621	$457,572	$110,609	$74,358	$1,044,129	**$884,582**
N4	Ongoing operations		$66,641	$68,640	$70,699	$72,820	$278,800	**$220,164**
	Total	**$168,753**	**$506,637**	**$848,075**	**$283,908**	**$252,006**	**$2,059,378**	**$1,715,648**

Source: Forrester Research, Inc.

Table 18: Risk-Adjusted Benefits

Ref.	Benefits	Year 1	Year 2	Year 3	Year 4	Total	Present value
O1	PC replacement savings	$588,000	$943,740	$143,325	$810,338	$2,485,403	**$1,975,649**
O2	PC management and support savings		$196,768	$334,643	$368,956	$900,366	**$666,042**
O3	Increased worker productivity	$168,199	$363,854	$428,309	$514,621	$1,474,983	**$1,126,902**
O4	Electricity savings	$6,412	$14,427	$16,030	$20,038	$56,907	**$43,482**
	Total	**$762,611**	**$1,518,789**	**$922,307**	**$1,713,951**	**$4,917,659**	**$3,812,075**

Source: Forrester Research, Inc.

The values used throughout the TEI Framework are based on in-depth interviews with one organization. Forrester makes no assumptions as to the potential return that other organizations will receive within their own environment. Forrester strongly advises that readers use their own estimates within the framework provided in this study to determine the expected financial impact of implementing VMware Virtual Desktop Infrastructure.

Study Conclusions

Forrester's in-depth interviews with a healthcare company currently using VMware Virtual Desktop Infrastructure (VMware VDI) yielded several important observations:

- It realized benefits in five general ways:

  1. Greatly reduced PC hardware, support, and electricity costs;
  2. Improved data and endpoint security;
  3. Enhanced business continuity and disaster recovery capabilities;
  4. Improved worker productivity; and
  5. Better working experience for physicians, IT staff and hospital workers;

- VMware VDI has exceeded the hospital's high expectations in terms of ease of deployment, cost savings, and the ability to provide flexible access to individual desktops and information.

- The hospital has realized crossover benefits between VMware VDI and VMware VI solution in terms of shared learnings and costs.

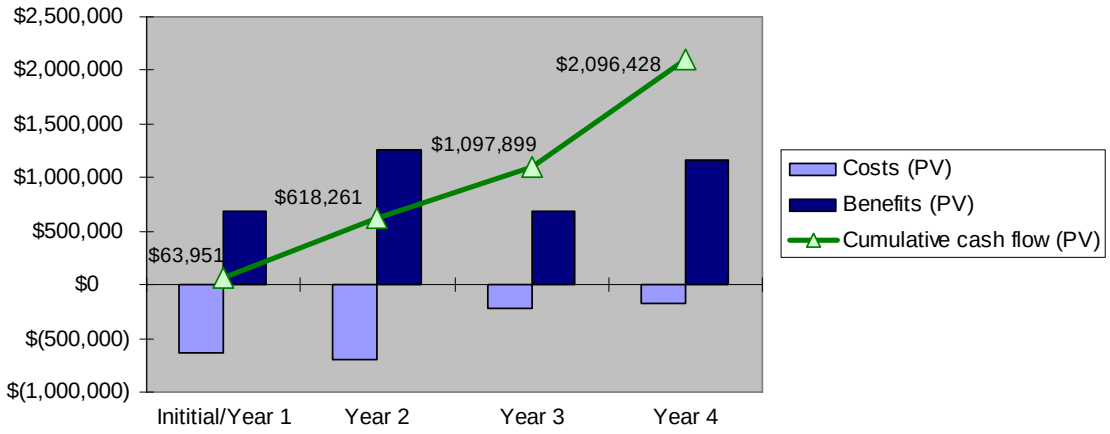
The financial analysis provided in this study illustrates the potential way in which an organization can evaluate the value proposition of the VMware Virtual Desktop Infrastructure solution. Based on information collected in in-depth interviews with one existing healthcare customer, Forrester calculated a four-year, risk-adjusted ROI of 122% with a payback period of eight months. All final estimates are risk-adjusted to incorporate potential uncertainty in the calculation of costs and benefits.

Table 20: ROI, Original And Risk-Adjusted

Summary financial results	Unadjusted (best case)	Risk-adjusted
ROI — four-year	128%	122%
Payback (months)	Seven	Eight
Total four-year costs (PV)	$1,698,303	$1,715,648
Total four-year benefits (PV)	$3,879,174	$3,812,075
Total four-year net savings (NPV)	$2,180,871	$2,096,428
Internal rate of return (IRR)	244%	231%

Source: Forrester Research, Inc.

Figure 1: Summary Financial Results, Risk-Adjusted



Source: Forrester Research, Inc.

Appendix A: Total Economic Impact Overview

Total Economic Impact is a methodology developed by Forrester Research that enhances a company's technology decision-making processes and assists vendors in communicating the value proposition of their products and services to clients. The TEI methodology helps companies demonstrate, justify, and realize the tangible value of IT initiatives to both senior management and other key business stakeholders.

The TEI methodology consists of four components to evaluate investment value: benefits, costs, risks, and flexibility. For the purpose of this analysis, the impact of flexibility was not quantified.

Benefits

Benefits represent the value delivered to the user organization — IT and/or business units — by the proposed product or project. Often product or project justification exercises focus just on IT cost and cost reduction, leaving little room to analyze the effect of the technology on the entire organization. The TEI methodology and the resulting financial model place equal weight on the measure of benefits and the measure of costs, allowing for a full examination of the effect of the technology on the entire organization. Calculation of benefit estimates involves a clear dialogue with the user organization to understand the specific value that is created. In addition, Forrester also requires that there be a clear line of accountability established between the measurement and justification of benefit estimates after the project has been completed. This ensures that benefit estimates tie back directly to the bottom line.

Costs

Costs represent the investment necessary to capture the value, or benefits, of the proposed project. IT or the business units may incur costs in the forms of fully burdened labor, subcontractors, or materials. Costs consider all the investments and expenses necessary to deliver the proposed value. In addition, the cost category within TEI captures any incremental costs over the existing environment for ongoing costs associated with the solution. All costs must be tied to the benefits that are created.

Risk

Risk measures the uncertainty of benefit and cost estimates contained within the investment. Uncertainty is measured in two ways: the likelihood that the cost and benefit estimates will meet the original projections and the likelihood that the estimates will be measured and tracked over time. TEI applies a probability density function known as "triangular distribution" to the values entered. At a minimum, three values are calculated to estimate the underlying range around each cost and benefit.

Flexibility

Within the TEI methodology, direct benefits represent one part of the investment value. While direct benefits can typically be the primary way to justify a project, Forrester believes that organizations should be able to measure the strategic value of an investment. Flexibility represents the value that can be obtained for some future additional investment building on top of the initial investment already made. For instance, an investment in an enterprisewide upgrade of an office productivity suite can potentially increase standardization (to increase efficiency) and reduce licensing costs. However, an embedded collaboration feature may translate to greater worker productivity if activated. The collaboration can only be used with additional investment in training at some future point in time. However, having the ability to capture that benefit has a present value that can be estimated. The flexibility component of TEI captures that value.

Appendix B: Glossary

Discount rate: The interest rate used in cash flow analysis to take into account the time value of money. Although the Federal Reserve Bank sets a discount rate, companies often set a discount rate based on their business and investment environment. Forrester assumes a yearly discount rate of 10% for this analysis. Organizations typically use discount rates between 8% and 16% based on their current environment. Readers are urged to consult their organization to determine the most appropriate discount rate to use in their own environment.

Net present value (NPV): The present or current value of (discounted) future net cash flows given an interest rate (the discount rate). A positive project NPV normally indicates that the investment should be made, unless other projects have higher NPVs.

Present value (PV): The present or current value of (discounted) cost and benefit estimates given at an interest rate (the discount rate). The PV of costs and benefits feed into the total net present value of cash flows.

Payback period: The payback period is the breakeven point for an investment — the point in time at which net benefits (benefits minus costs) equal initial investment or cost.

Return on investment (ROI): A measure of a project's expected return in percentage terms. ROI is calculated by dividing net benefits (benefits minus costs) by costs.

A Note On Cash Flow Tables

The following is a note on the cash flow tables used in this study (see the Example Table below). The initial investment column contains costs incurred at "time 0" or at the beginning of Year 1. Those costs are not discounted. All other cash flows in Years 1 through 3 are discounted using the discount rate shown in [Table 2] at the end of the year. Present value (PV) calculations are calculated for each total cost and benefit estimate. Net present value (NPV) calculations are not calculated until the summary tables and are the sum of the initial investment and the discounted cash flows in each year.

Example Table

Ref.	Category	Calculation	Initial cost	Year 1	Year 2	Year 3	Total

Source: Forrester Research, Inc.