A Forrester Total Economic Impact™ Study

Commissioned By

Red Hat

Project Director:
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November 2016

The Total Economic Impact™ Of Red Hat Virtualization

User Productivity And Cost Savings Enabled By Red Hat Virtualization

FORRESTER®

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Executive Summary

In November 2016, Red Hat commissioned Forrester Consulting to conduct a Total Economic Impact™ (TEI) study and examine the potential return on investment (ROI) enterprises may realize by deploying Red Hat Virtualization (RHV). The purpose of this study is to provide readers with a framework to evaluate the potential financial impact of RHV on their organizations.

RHV is a virtualization solution that includes a Kernel-based Virtual Machine (KVM) hypervisor and a web-based virtualization resource manager (Red Hat Virtualization Manager). The platform suits organizations starting new virtualization initiatives and those that are migrating from proprietary virtualization technologies. In addition to infrastructure virtualization, RHV sets the foundation for organizations that are considering deploying future technologies like containers and cloud-enabled workloads.

> *"When we were allowed to choose best of breed to virtualize Java app hosting, KVM was brought in because of its usability and maintainability — and Red Hat Virtualization was brought in because we had RHEL and plans for Red Hat Cloud Infrastructure."*
>
> ~ Application hosting service design manager, large European transportation manufacturer

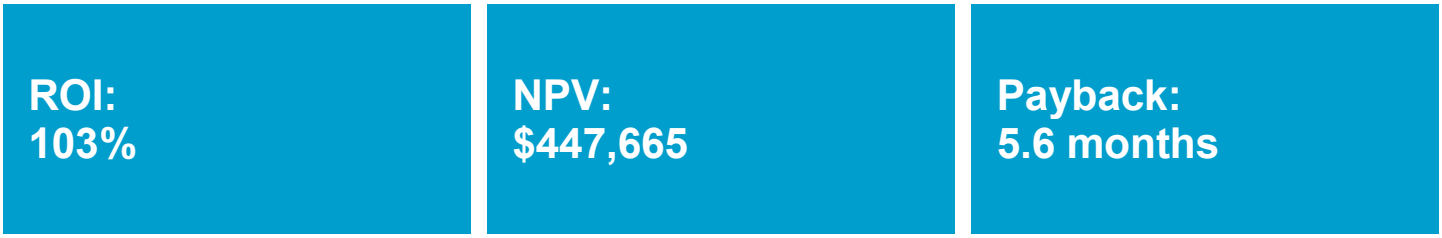
To better understand the benefits, costs, risks, and long-term flexibility associated with RHV, Forrester interviewed an existing customer with at least six months of experience using the solution. Prior to adopting RHV, the interviewed customer, a large European transportation manufacturer, used a single virtualization solution regardless of workload or operating system. As the company took on a reorganization initiative, application hosting teams were given the option to choose best of breed to virtualize their applications. The customer chose to use KVM for virtualizing its Java applications and noted that RHV has better usability and maintainability compared with its legacy virtualization solution. Red Hat was also selected because the customer already had Red Hat Enterprise Linux (RHEL) and had plans to implement Red Hat Cloud Infrastructure (RHCI) in the future.

RED HAT VIRTUALIZATION INCREASES THE EFFICIENCY IN VIRTUALIZATION TASKS AND IMPROVES THE COST EFFECTIVENESS OF VIRTUALIZATION

Our interview with an existing customer and subsequent financial analysis found that the interviewed organization experienced the risk-adjusted ROI, benefits, and costs shown in Figure 1.[1] See Appendix A for a description of the interviewed organization.

The interviewed customer experienced three-year risk-adjusted benefits of $881,113 versus costs of $433,448, resulting in a net present value (NPV) of $447,665.

FIGURE 1
Financial Summary Showing Three-Year Risk-Adjusted Results



Source: Forrester Research, Inc.

› **Benefits.** The interviewed organization experienced the following risk-adjusted present value benefits:

- **Virtualization task and process efficiency ($731,902).** This benefit focuses on reduction in time and effort to set up a virtual machine (VM). The customer highlighted that achievements in automating workflows reduced the five-day process, which included 1 hour of work, to 20 minutes with minimal to no lead time. The customer estimates that 10% to 20% of an infrastructure developer's time is saved each year by increased virtualization task and process efficiency.
- **Virtualization cost effectiveness ($149,211).** This benefit centers on the ability to get more virtualized performance out of physical hosts. The customer mentioned a higher ratio of overcommit with RHV over the legacy solution. The ratio of cores to VM was 1 to 1 with the legacy solution and 1 to 1.75 with RHV. The customer also found that RHV scaled better and had fewer issues when virtualizing above a certain threshold of cores.

› **Costs.** The interviewed organization experienced the following risk-adjusted present value costs:

- **RHV solution cost ($329,835).** This cost focuses mainly on the licensing cost per socket pair. The cost is based on the customer's estimated virtualization ratios and derived from a subset of the interviewed customer's 3,000 servers hosting Java applications.
- **Internal labor and implementation ($103,613).** This cost centers on the time and effort needed initially and for recurring maintenance and operations. The initial setup time is 1,200 hours, and the ongoing maintenance is 10% of the initial effort.

Disclosures

The reader should be aware of the following:

- The study is commissioned by Red Hat and delivered by Forrester Consulting. It is not meant to be used as a competitive analysis.
- Forrester makes no assumptions as to the potential ROI that other organizations will receive. Forrester strongly advises that readers use their own estimates within the framework provided in the report to determine the appropriateness of an investment in RHV.
- Red Hat reviewed and provided feedback to Forrester, but Forrester maintains editorial control over the study and its findings and does not accept changes to the study that contradict Forrester's findings or obscure the meaning of the study.
- Red Hat provided the customer name for the customer interview but did not participate in the interview.

TEI Framework And Methodology

INTRODUCTION

From the information provided in the interviews, Forrester has constructed a Total Economic Impact (TEI) framework for those organizations considering deploying RHV. The objective of the framework is to identify the cost, benefit, flexibility, and risk factors that affect the investment decision.

APPROACH AND METHODOLOGY

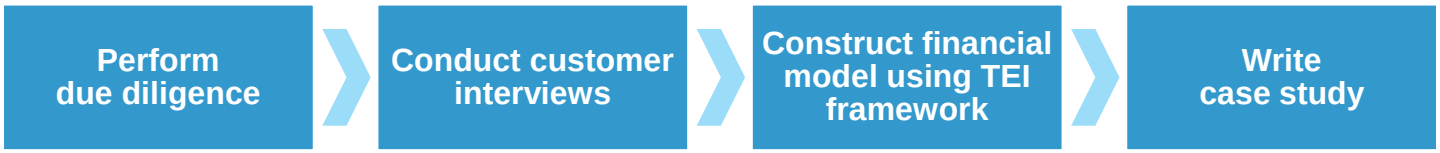
Forrester took a multistep approach to evaluate the impact that RHV can have on an organization (see Figure 2). Specifically, we:

- Interviewed RHV marketing, sales, and/or consulting personnel, along with Forrester analysts, to gather data relative to RHV's marketplace.
- Interviewed one organization currently using RHV to obtain data with respect to costs, benefits, risks, and long-term flexibility.
- Constructed a financial model representative of the interviews using the TEI methodology. The financial model is populated with the cost and benefit data obtained from the interviews.
- Risk-adjusted the financial model based on issues and concerns the interviewed organization highlighted in the interview. Risk adjustment is a key part of the TEI methodology. While the interviewed organization provided cost and benefit estimates, some categories included a broad range of responses or had a number of outside forces that might have affected the results. For that reason, some cost and benefit totals have been risk-adjusted and are detailed in each relevant section.

Forrester employed four fundamental elements of TEI in modeling RHV's value: benefits, costs, flexibility, and risks.

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

FIGURE 2
TEI Approach



Source: Forrester Research, Inc.

Analysis

INTERVIEWED CUSTOMER DESCRIPTION

For this study, Forrester interviewed a large European transportation manufacturer with the following characteristics:

- It has 6,000 staff in IT services, with 70 in Linux infrastructure operations, 18 on the transition team, and 17 in service design.
- It has 3,000 Linux servers, with 80% virtualized, and 10% of the virtualized environment was done with RHV.
- RHV is part of the organization's larger plan to implement a private cloud with RHCI.

INTERVIEW HIGHLIGHTS

The interviewed customer highlighted the following pre-Red Hat Virtualization issues and gaps, technology selection criteria and goals, and post-Red Hat Virtualization deployment results.

Situation

Prior to engaging Red Hat, the customer used a single virtualization solution for all workloads and operating systems. Through a reorganization effort, application hosting teams were given the flexibility to choose best-of-breed virtualization technologies for their respective applications. This flexibility resulted in three main tracks of virtualization for Java, mainframe, and hosting for a third application framework.

Solution

The Java application hosting team decided to investigate further into a new version of KVM for Linux systems. The customer noted KVM's usability and maintainability were better than the legacy solution. As the customer needed an enterprise solution and did not intend to deploy KVM without a centralized VM tool, RHV became the leading option for the customer.

The interviewed customer's prior deployment of RHEL and subsequent vision to deploy RHCI solidified its choice to centralize and adopt RHV. Although RHV quickly became the predominant choice for the customer, readers may also want to consider the following criteria during their technology selection process:

> *"The savings upside of rapid access to dev/test VMs was large. At least 10% to 20% of infrastructure developer time was spent on obtaining test systems when the process was manual, and it also caused a lot of further informal time consumption in other teams to obtain things like IP addresses, DNS names, VM resources, etc."*
>
> ~ Application hosting service design manager, large European transportation manufacturer

> *"We achieved a higher ratio of overcommit with RHV — about 1 to 1 with legacy and 1 to 1.75 with RHV."*
>
> ~ Application hosting service design manager, large European transportation manufacturer

- Capability to automate processes and tasks and how the time and effort compare with the legacy or alternative solution.
- Asset efficiency, virtualization, or physical server limits, and capability to achieve the same or better performance with the same capital investment in infrastructure.
- Alignment with the organization's long-term strategies for virtualization, private cloud, and hybrid cloud deployments.

Based on the criteria above, organizations can select a technology vendor and set up goals related to the selection criteria such as:

- Improve staff productivity by reducing time and effort dedicated to virtualization tasks and setting up environments.
- Increase VM density and reduce long-term infrastructure capital expenditures.
- Create opportunities for natural synergies among solutions from the same vendor.

Results

The interview revealed the following themes:

- **Improved productivity value was material and not only a "minutes saved" soft benefit.** The customer drew an example of how setting up a virtual environment in the past with manual processes could take five days. It required outreach to several different groups, and while the actual work needed from IT staff was 1 hour, the lead time needed was five days. After deploying RHV, the customer reduced the process to 20 minutes. The customer estimates that 10% to 20% of each infrastructure developer's time is saved and a total of three to five full-time equivalents (FTEs) can be reallocated to more value-added work.
- **Cost effectiveness stemmed primarily from virtualization effectiveness.**[2] The customer noted the difference in virtualization performance and scalability between RHV and the legacy solution. The customer used the example that RHV was able to produce 30 VMs with a 20-core blade server, while the legacy solution produced 20 VMs with the same blade server. This difference in isolation may be small, but when the solution is scaled beyond the customer's initial deployment, the long-term infrastructure avoidance will become material.

BENEFITS

The interviewed organization experienced two benefits in this case study:

- Virtualization task and process efficiency.
- Virtualization cost effectiveness.

Virtualization Task And Process Efficiency

The customer started with 70 staff on the infrastructure operations team and scaled with a growth of 10% each year. The model conservatively assumes that only 30% of staff will handle any type of virtualization task or process. Based on the customer's estimation of 10% to 20% of time saved, the model conservatively uses a 10% efficiency gain in Year 1 and scales up to a 15% efficiency gain by Year 3.

With a $100,000 annual salary and 3% annual salary growth considered, the total three-year risk-adjusted benefit value of virtualization task and process efficiency is $866,186, as shown in Table 1.

TABLE 1
Virtualization Task And Process Efficiency

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
A1	Total operations staff	Year 1: customer provided Years 2 and 3: $A1_{py}$*110%		70	77	85
A2	Ratio of staff that executes virtualization tasks	Assumption		30%	30%	30%
A3	Staff that executes virtualization tasks	A1*A2		21	23	25
A4	Virtualization task efficiency	Customer provided		10.0%	12.5%	15.0%
A5	Hours saved	A3*2,080*A4		4,368	6,006	7,928
A6	FTEs available for reallocation	A5/2,080		2.1	2.9	3.8
A7	Annual salary	Assumption		$100,000	$103,000	$106,090
At	Virtualization task and process efficiency	A7*A6		$210,000	$297,413	$404,362
	Risk adjustment	↓5%				
Atr	**Virtualization task and process efficiency (risk-adjusted)**			**$199,500**	**$282,542**	**$384,144**

Source: Forrester Research, Inc.

Virtualization Cost Effectiveness

The customer noted there were 3,000 Linux servers initially, and the organization would typically decommission 100 existing servers while deploying 200 new servers each month. In Year 1, 80% of the 3,000 servers were virtualized, and only 10% were virtualized with RHV as the customer used it to set up test environments. The model assumes the organization scales this effectiveness and grows its RHV virtualization share to 50% by Year 3. The customer highlighted that RHV produced 30 VMs with a 20-core blade compared with 20 VMs with a 20-core blade using the legacy solution. This creates a difference of a 1 to 1 legacy ratio and a 1 to 1.5 ratio with RHV. As RHV is licensed per socket pair, the model then assumes four cores per socket and takes the difference in licensing costs between RHV and the legacy solution to produce the same amount of VMs.

The total three-year risk-adjusted benefit value of virtualization cost effectiveness is $182,400, as shown in Table 2.

TABLE 2
Virtualization Cost Effectiveness

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
B1	Total Linux servers	Year 1: customer provided Years 2 and 3: $B1_{py}$+100 per month		3,000	4,200	5,400
B2	Virtual ratio	Customer provided		80%	80%	80%
B3	Physical ratio	1-B2		20%	20%	20%
B4	Virtual machines	B1*B2		2,400	3,360	4,320
B5	Ratio of virtual machines that are Red Hat virtualized	Year 1: customer provided Years 2 and 3: assumption		10%	20%	50%
B6	Red Hat virtual machines	B5*B4		240	672	2,160
B7	Red Hat Virtualization virtual machine to cores ratio	Customer provided		150%	150%	150%
B8	Socket pairs	((B6/B7)/4)/2		20	56	180
B9	Legacy virtual machine to cores ratio	Customer provided		100%	100%	100%
B10	Legacy socket pairs	((B6/B9)/4)/2		30	84	270
B11	Cost per socket pair	Assumption		$1,500	$1,500	$1,500
Bt	Virtualization cost effectiveness	(B10-B8)*B11		$15,000	$42,000	$135,000
	Risk adjustment	↓5%				
Btr	**Virtualization cost effectiveness (risk-adjusted)**		**$0**	**$14,250**	**$39,900**	**$128,250**

Source: Forrester Research, Inc.

Total Benefits

Table 3 shows the total of all benefits across the two quantified areas listed above, as well as present values (PVs) discounted at 10%. Over three years, the interviewed customer expects risk-adjusted total benefits to be a PV of $881,113.

TABLE 3
Total Benefits (Risk-Adjusted)

Ref.	Benefit Category	Initial	Year 1	Year 2	Year 3	Total	Present Value
Atr	Virtualization task and process efficiency	$0	$199,500	$282,542	$384,144	$866,186	$731,902
Btr	Virtualization cost effectiveness	$0	$14,250	$39,900	$128,250	$182,400	$149,211
	Total benefits (risk-adjusted)	**$0**	**$213,750**	**$322,442**	**$512,394**	**$1,048,586**	**$881,113**

Source: Forrester Research, Inc.

COSTS

The interviewed organization experienced two costs associated with the solution:

- RHV solution cost.
- Internal labor and implementation.

RHV Solution Cost

The RHV solution cost primarily mirrors Table 2 by outlining the initial volume of Linux servers and the portion that was deployed by RHV. By reducing the 3,000 Linux servers to 20 socket pairs related to RHV in Year 1, readers can replicate the formula to the following years for scale. Based on Red Hat's licensing model, investments related to licensing would be folded into the annual expense as opposed to being an initial capital expenditure. Readers should adjust this portion of the costs based on their scale and if any third-party or Red Hat professional services are needed.

The total three-year risk-adjusted solution cost is $403,200, as shown in Table 4.

TABLE 4
RHV Solution Cost

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
C1	Total Linux servers	B1		3,000	4,200	5,400
C2	Virtual ratio	B2		80%	80%	80%
C3	Physical ratio	B3		20%	20%	20%
C4	Virtual machines	B4		2,400	3,360	4,320
C5	Ratio of virtual machines that are Red Hat virtualized	B5		10%	20%	50%
C6	Red Hat virtual machines	B6		240	672	2,160
C7	Red Hat Virtualization virtual machine to cores ratio	B7		150%	150%	150%
C8	Socket pairs	B8		20	56	180
C9	Cost per socket pair	B11		$1,500	$1,500	$1,500
Ct	RHV solution cost	C8*C9		$30,000	$84,000	$270,000
	Risk adjustment	↑5%				
Ctr	**RHV solution cost (risk-adjusted)**		**$0**	**$31,500**	**$88,200**	**$283,500**

Source: Forrester Research, Inc.

Internal Labor And Implementation

The customer highlighted that deployment would take 800 to 1,500 hours depending on which components of RHCI are deployed. The model conservatively assumes 1,200 hours for initial deployment and a 10% maintenance and operations commitment thereafter.

The total three-year risk-adjusted cost of labor is $107,214, as shown in Table 5.

TABLE 5
Internal Labor And implementation

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
D1	Hourly resource wage	Assumption	$65	$65	$67	$69
D2	Setup hours	Customer provided	1,200	0	0	0
D3	Maintenance ratio	Assumption	0%	10%	10%	10%
D4	Maintenance hours	$D3*D2_{initial}$	0	120	120	120
Dt	Internal labor and implementation	D1*(D2+D4)	$78,000	$7,800	$8,034	$8,275
	Risk adjustment	↑5%				
Dtr	**Internal labor and implementation (risk-adjusted)**		**$81,900**	**$8,190**	**$8,436**	**$8,689**

Source: Forrester Research, Inc.

Total Costs

Table 6 shows the total of all costs as well as associated PVs, discounted at 10%. Over three years, the interviewed organization expects total costs to be a PV of $433,448.

TABLE 6
Total Costs (Risk-Adjusted)

Ref.	Cost Category	Initial	Year 1	Year 2	Year 3	Total	Present Value
Ctr	RHV solution cost	$0	$31,500	$88,200	$283,500	$403,200	$329,835
Dtr	Internal labor and implementation	$81,900	$8,190	$8,436	$8,689	$107,214	$103,613
	Total costs (risk-adjusted)	**$81,900**	**$39,690**	**$96,636**	**$292,189**	**$510,414**	**$433,448**

Source: Forrester Research, Inc.

FLEXIBILITY

Flexibility, as defined by TEI, represents an investment in additional capacity or capability that could be turned into business benefit for some future additional investment. This provides an organization with the "right" or the ability to engage in future initiatives but not the obligation to do so. There are multiple scenarios in which a customer might choose to implement and later realize additional uses and business opportunities. Flexibility would also be quantified when evaluated as part of a specific project (described in more detail in Appendix B).

The customer's initial RHV deployment only included setting up test environments for Java application hosting. As the customer grows the RHV footprint, the organization will experience the scaled benefits of both staff productivity and long-term infrastructure cost avoidance. Also, RHV plays into the organization's longer-term plan to implement RHCI and achieve virtualization and private cloud goals.

RISKS

Forrester defines two types of risk associated with this analysis: "implementation risk" and "impact risk." Implementation risk is the risk that a proposed investment in RHV may deviate from the original or expected requirements, resulting in higher costs than anticipated. Impact risk refers to the risk that the business or technology needs of the organization may not be met by the investment in RHV, resulting in lower overall total benefits. The greater the uncertainty, the wider the potential range of outcomes for cost and benefit estimates.

TABLE 7
Benefit And Cost Risk Adjustments

Benefits	Adjustment
Virtualization task and process efficiency	↓ 5%
Virtualization cost effectiveness	↓ 5%
Costs	**Adjustment**
RHV solution cost	↑ 5%
Internal labor and implementation	↑ 5%

Source: Forrester Research, Inc.

Quantitatively capturing implementation risk and impact risk by directly adjusting the financial estimates results provides more meaningful and accurate estimates and a more accurate projection of the ROI. In general, risks affect costs by raising the original estimates, and they affect benefits by reducing the original estimates. The risk-adjusted numbers should be taken as "realistic" expectations since they represent the expected values considering risk.

The following impact risks that affect benefits are identified as part of the analysis:

- Containing benefits of RHV only to the test environment and not scaling.
- Lack of organizational readiness and ability to reallocate staff to alternate value-added work.
- Lack of long-term strategy and vision for virtualization, private cloud, and hybrid cloud.

The following implementation risks that affect costs are identified as part of this analysis:

- Scaled-up infrastructure and virtualization demands.
- Investment in ancillary or complementary solutions.
- Deployment delays and lack of resources.

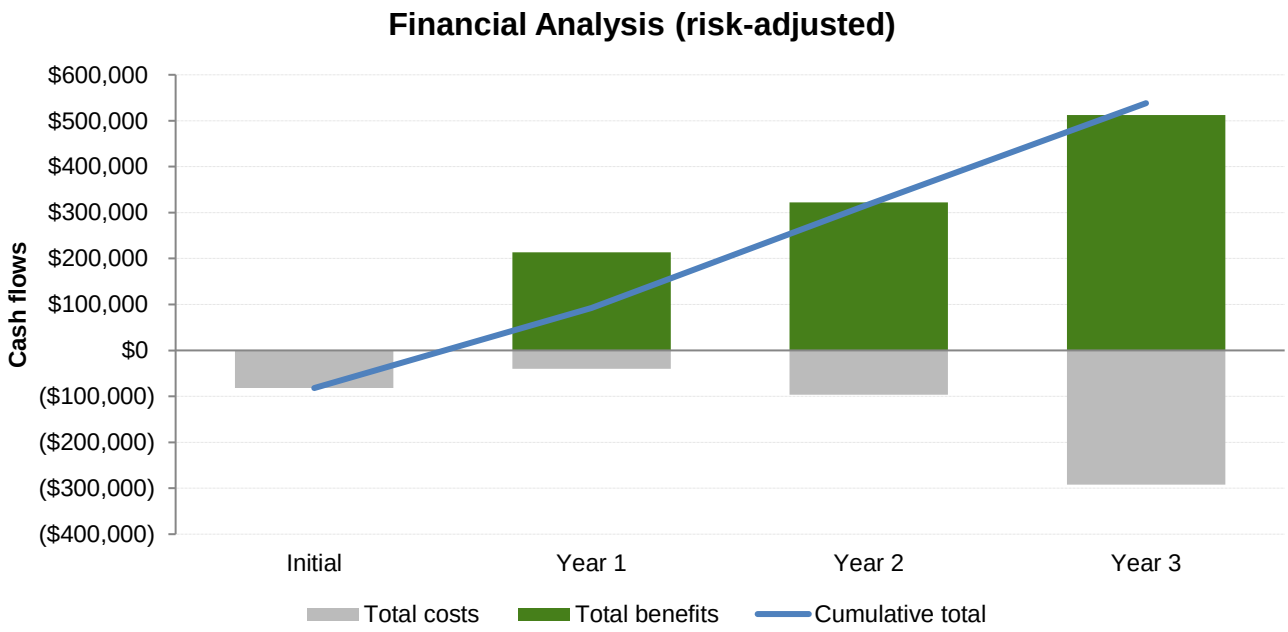
Table 7 shows the values used to adjust for risk and uncertainty in the cost and benefit estimates for the interviewed organization. Readers are urged to apply their own risk ranges based on their own degree of confidence in the cost and benefit estimates.

Financial Summary

The financial results calculated in the Benefits and Costs sections can be used to determine the ROI, NPV, and payback period for the interviewed organization's investment in RHV.

Table 8 below shows the risk-adjusted ROI, NPV, and payback period values. These values are determined by applying the risk-adjustment values from Table 7 in the Risks section to the unadjusted results in each relevant cost and benefit section.

FIGURE 3
Cash Flow Chart (Risk-Adjusted)



Source: Forrester Research, Inc.

TABLE 8
Cash Flow (Risk-Adjusted)

Summary	Initial	Year 1	Year 2	Year 3	Total	Present Value
Total costs	($81,900)	($39,690)	($96,636)	($292,189)	($510,414)	($433,448)
Total benefits	$0	$213,750	$322,442	$512,394	$1,048,586	$881,113
Total	**($81,900)**	**$174,060**	**$225,806**	**$220,205**	**$538,171**	**$447,665**
ROI			**103%**			
Payback period (months)			**5.6 months**			

Source: Forrester Research, Inc.

Red Hat Virtualization: Overview

The following information is provided by Red Hat. Forrester has not validated any claims and does not endorse Red Hat Virtualization or its offerings.

Red Hat Virtualization is an open, secure platform for virtualized Linux and Windows workloads, built on Red Hat Enterprise Linux and Kernel-based Virtual Machine technologies. It allows customers to virtualize traditional applications and build a foundation for cloud-native workloads, reducing IT expenses while improving workload performance, scalability, and security.

RED HAT VIRTUALIZATION HOST

Red Hat Virtualization Host offers:

- A high-performance, open source hypervisor based on the Red Hat Enterprise Linux kernel with the KVM hypervisor technology.
- An image-based hypervisor with a minimized security footprint.

RED HAT VIRTUALIZATION MANAGER

Red Hat Virtualization Manager:

- Offers a centralized web-based enterprise-grade virtualization management engine with a graphical administration console and programming interfaces.
- Is built on Red Hat Enterprise Linux and Red Hat JBoss Enterprise Application Platform for performance and scalability.
- Provides virtual workload life-cycle and operations management, visibility into shared storage and network resources, and infrastructure management of compute and hardware resources.

For more information, please visit https://www.redhat.com/rhv.

Appendix A: Interviewed Customer Description

For this study, Forrester interviewed a large, European transportation manufacturer with the following characteristics:

- It has 6,000 staff in IT services, with 70 in Linux infrastructure operations, 18 on the transition team, and 17 in service design.
- It has 3,000 Linux servers, with 80% virtualized, and 10% of the virtualized environment was done with RHV.
- RHV is part of the organization's larger plan to implement a private cloud with RHCI.

Situation

Prior to engaging Red Hat, the customer used a single virtualization solution for all workloads and operating systems. Through a reorganization effort, application hosting teams were given the flexibility to choose best-of-breed virtualization technologies for their respective applications. This flexibility resulted in three main tracks of virtualization for Java, mainframe, and hosting for a third application framework.

Solution

The Java application hosting team decided to investigate further into a new version of KVM for Linux systems. The customer noted that KVM's usability and maintainability were better than the legacy solution. As the customer needed an enterprise solution and did not intend to deploy KVM without a centralized VM tool, RHV became the leading option for the customer.

The interviewed customer's prior deployment of RHEL and subsequent vision to deploy RHCI solidified its choice to centralize and adopt RHV. Although RHV quickly became the predominant choice for the customer, readers may also want to consider the following criteria during their technology selection process:

- Capability to automate processes and tasks and how the time and effort compare with the legacy or alternative solution.
- Asset efficiency, virtualization or physical server limits, and capability to achieve the same or better performance with the same capital investment in infrastructure.
- Alignment with the organization's long-term strategies for virtualization, private cloud, and hybrid cloud deployments.

Results

The interview revealed the following themes:

- **Improved productivity value was material and not only a "minutes saved" soft benefit.** The customer drew an example of how setting up a virtual environment in the past with manual processes could take five days. It required outreach to several different groups, and while the actual work needed from IT staff was 1 hour, the lead time needed was five days. After deploying RHV, the customer reduced the process to 20 minutes. The customer estimates 10% to 20% of each infrastructure developer's time is saved, and a total of three to five FTEs can be reallocated to more value-added work.
- **Cost effectiveness stemmed primarily from virtualization effectiveness.**[2] The customer noted the difference in virtualization performance and scalability between RHV and the legacy solution. The customer used the example that RHV was able to produce 30 VMs with a 20-core blade server, while the legacy solution produced 20 VMs with the same blade server. This difference in isolation may be small, but when the solution is scaled beyond the customer's initial deployment, the long-term infrastructure avoidance will become material.

FRAMEWORK ASSUMPTIONS

Table 9 provides the model assumptions that Forrester used in this analysis.

The discount rate used in the PV and NPV calculations is 8%, and the time horizon used for the financial modeling is three years. Organizations typically use discount rates between 8% and 16% based on their current environment. Readers are urged to consult with their respective company's finance department to determine the most appropriate discount rate to use within their own organizations.

TABLE 9
Model Assumptions

Ref.	Metric	Value
X1	Hours per week	40
X2	Weeks per year	52
X3	Hours per year (M-F, 9-5)	2,080
X4	Hours per year (24x7)	8,760
X5	Annual salary (IT FTE)	$100,000
X6	Contractor hourly wage	$65
X7	Salary growth	3%
X8	Company/infrastructure growth	10%
PY	Previous year	

Source: Forrester Research, Inc.

Appendix B: 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, flexibility, and risks.

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 form 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.

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. However, having the ability to capture that benefit has a PV that can be estimated. The flexibility component of TEI captures that value.

RISKS

Risks measure the uncertainty of benefit and cost estimates contained within the investment. Uncertainty is measured in two ways: 1) the likelihood that the cost and benefit estimates will meet the original projections and 2) the likelihood that the estimates will be measured and tracked over time. TEI risk factors are based on a probability density function known as "triangular distribution" to the values entered. At a minimum, three values are calculated to estimate the risk factor around each cost and benefit.

Appendix C: Glossary

Discount rate: The interest rate used in cash flow analysis to take into account the time value of money. Companies set their own 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 respective organizations 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 NPV of cash flows.

Payback period: The breakeven point for an investment. This is 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 the Framework Assumptions section) at the end of the year. PV calculations are calculated for each total cost and benefit estimate. NPV calculations are not calculated until the summary tables are the sum of the initial investment and the discounted cash flows in each year.

Sums and present value calculations of the Total Benefits, Total Costs, and Cash Flow tables may not exactly add up, as some rounding may occur.

TABLE [EXAMPLE]
Example Table

Ref.	Metric	Calculation	Year 1	Year 2	Year 3

Source: Forrester Research, Inc.

Appendix D: Endnotes

[1] Forrester risk-adjusts the summary financial metrics to take into account the potential uncertainty of the cost and benefit estimates. For more information, see the section on Risks.

[2] In addition to virtualization performance and scalability, there is an expected benefit related to the cost of licensing or initial subscription fee that folds into cost effectiveness. This area may be more apparent for certain users and was not realized by the interviewed customer due to size and use case. Readers should be aware that this benefit area may apply to their organization and should further scope the solution with Red Hat for a tailored “cost per unit” comparison.