

A Forrester Total Economic
Impact™ Study
Commissioned By
OpenStack

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The Total Economic Impact™ Of OpenStack

Leveraging Open Source Technology
To Build Private Clouds

FORRESTER®

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Executive Summary

The OpenStack Foundation commissioned Forrester Consulting to conduct a Total Economic Impact™ (TEI) study and examine the potential return on investment (ROI) that enterprises may realize by using the OpenStack Cloud Computing Software. The purpose of this study is to provide readers with a framework to evaluate the potential financial impact of OpenStack on their organizations, specifically by leveraging open source technologies to develop and operate private, internal cloud environments.

To better understand the benefits, costs, and risks associated with a direct adoption of OpenStack, Forrester interviewed an existing customer with more than a year of experience using OpenStack. The interviewed organization is a global enterprise that created a private cloud used OpenStack to communicate with hypervisor software, monitoring and metering software, and many other tools.

This organization decided to embrace an open source and commodity based approach. OpenStack was the enabling private cloud platform that enabled them to make this transition, avoiding the cost of software from a proprietary suite. The organization built its own center of competence, avoided vendor lock in, and was able to build this atop a commodity based solution. This combined approach had hardware benefits, software benefits, time-to-market benefits, and staffing optimization. The director of infrastructure stated: “We wanted to move from enterprise grade hardware to commodity-grade, replacing ten boxes with hundreds, but at a lower cost point. We now have elastic capacities within our cloud, which allows us to adapt quickly to changing business requirements.”

OPENSTACK DECREASES HARDWARE MAINTENANCE COSTS BY 59%

From the interview and financial analysis of the customer, Forrester found that the organization experienced results as shown in Figure 1. The analysis shows benefits of more than \$7.2 million versus implementation and ongoing costs of more than \$3.6 million, adding up to a net present value (NPV) of nearly \$3.6 million. Forrester uses a three-year financial model, but readers should note that the benefits of using OpenStack have a longer life than other technologies. The increased time of using OpenStack would allow the benefits to continue for a longer period of time and increase the realized ROI.

The OpenStack Foundation provides open source tools for private clouds. This study focuses on the Cloud Operating System.

Based on a customer interview, the risk-adjusted benefits for an organization, over three years are:

- **Reduced labor to manage infrastructure: \$6,885,000.**
- **Reduced sparing costs: \$1,478,295.**
- **Reduced cost for power and cooling: \$426,431.**

FIGURE 1

Financial Summary Showing Three-Year Risk-Adjusted Results

**Return on investment:
101%**

**Reduction in staff needs:
\$6,885,000**

**Reduction in sparing costs:
\$1,478,295**

**Payback period:
15.5 months**

Source: Forrester Research, Inc.

- › **Benefits.** The organization experienced the following risk-adjusted benefits:
- **Reduced staff needed to manage infrastructure.** After building out a data center with standardized, commodity infrastructure, the number of staff required to manage the infrastructure was reduced by 75%. By shifting 30 staff to other parts activities, the organization reduced the cost to manage infrastructure by \$6,885,000 over three years.
 - **Reduced cost for sparing and hardware maintenance.** The ability to swap out failed hardware on the following business day rather than throughout all hours of the day reduced the cost of paying overtime and holiday pay for employees to be available 7/24, resulting in a cost reduction for sparing of \$1,478,295 over three years.
 - **Reduced cost of data center power and cooling.** Equipping a data center with modern servers and more efficient storage lower power consumption and heat output reduced the cost of power and cooling for the data center by \$426,431 over three years.
- › **Costs.** The organization experienced the following risk-adjusted costs:
- **Equipping data center with standardized, commodity hardware.** The cost to equip a data center with modern, standardized infrastructure totaled a risk-adjusted \$3,150,000.
 - **Time spent by internal staff to architect and implement OpenStack.** Architecting and implementing the private Cloud required the effort of 10 staff for six months, resulting in a total indirect cost of \$467,500.

Disclosures

The reader should be aware of the following:

- › The study is commissioned by The OpenStack Foundation 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 from using OpenStack. Forrester strongly advises that readers use their own estimates within the framework provided in the report to determine the appropriateness of an investment in OpenStack.
- › OpenStack 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.
- › OpenStack provided the customer names for the interview but did not participate in the interviews.

TEI Framework And Methodology

INTRODUCTION

From the information provided in the interviews, Forrester has constructed a Total Economic Impact (TEI) framework for organizations considering implementing OpenStack. The objective of the framework is to identify the cost, benefit, flexibility, and risk factors that affect the investment decision and to help those organizations understand how to take advantage of specific benefits, reduce costs, and improve their business goals of winning, serving, and retaining customers.

APPROACH AND METHODOLOGY

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

- › Interviewed OpenStack marketing, sales, and consulting personnel, along with Forrester analysts, to gather data relative to OpenStack and the marketplace for the OpenStack Cloud Computing Software.
- › Interviewed an OpenStack customer currently using OpenStack to obtain data on costs, benefits, and risks.
- › Constructed a financial model representative of the interview using the TEI methodology. The financial model is populated with the cost and benefit data gathered from the interview.
- › Adjusted the financial model for risk based on issues and concerns the interviewed organization highlighted in the interviews. 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 OpenStack: 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 A for additional information on the TEI methodology.

FIGURE 2
TEI Approach



Source: Forrester Research, Inc.

Analysis

INTERVIEW HIGHLIGHTS

Forrester interviewed an OpenStack customer with nearly two years of using OpenStack Cloud Computing Software. The director of infrastructure described the company as a global enterprise with physical (i.e., “brick and mortar”) facilities located around the globe, along with an online presence that is growing 30% per year.

Situation

In the words of the Director of Cloud Infrastructure, the organization was running a “vertically integrated infrastructure and application environment that had reached the limits and boundaries of its current architecture.” Across the organization, some groups used mainframes, others used UNIX servers, and the environment used a mixture of storage technologies which were incompatible from a sparing and maintenance point of view. To grow any one of the environments, the organization had to purchase bigger and more powerful equipment. Prior to using OpenStack:

- › Web site availability across all components averaged 99%.
- › Business units had to plan for and provision hardware capacity.
- › Servers had to be expanded regularly to keep up with changing demand.

Solution

The organization implemented OpenStack Cloud Computing Software and built out a new data center with standardized, commodity servers. The organization also re-architected its applications into a Service Oriented Architecture (SOA) so that the web site operated with hundreds of smaller “widgets” rather than large, integrated applications.

Results

The interview revealed that the organization:

- › **Improved availability of the enterprise sales website from 99% to 99.9%.** By using a private cloud based on standard infrastructure combined with an SOA approach to application components, the organization shifted the average availability of its customer facing website. The organization also reported a measureable improvement in customer loyalty that accompanied the increase in availability.
- › **Reduced costs for sparing, management, and to power and cool data center.** The cost of replacing failed devices and the team of people required to manage the infrastructure declined by 59%. In addition, the organization incurred a lower cost to power and cool the data center itself.
- › **Teams could initiate new projects in days rather than weeks, allowing experimentation.** With the ability to spin up virtual servers, different teams began experimenting with new customer solutions, including a mobile app that began as “an interesting idea” that became part of the mainstream efforts to capture and retain customers in less than six months.

“OpenStack enabled us to build a new infrastructure architecture that would last for many years to come.”

~ Director, infrastructure operations

BENEFITS

The interviewed organization used OpenStack to build a private cloud architecture that supported all components of its global website. The organization is a global enterprise with annual online sales of \$100 million that was growing at 30%. The organization experienced the following quantified benefits in this case study:

- › Reduced staff needed to manage infrastructure.
- › Reduced cost for sparing and hardware maintenance.
- › Reduced cost of data center power and cooling.
- › Increased sales from improved web site availability.



Reduced Staff Needed To Manage Infrastructure

Using standardized hardware reduced the staff required to manage the infrastructure. Given the parameters outlined by the organization, most readers will also experience a significant decline in support personnel. Forrester applied a 10% risk to the benefit. The risk-adjusted benefit from increasing sales by reducing website downtime over the three years totaled more than \$6.8 million.

TABLE 1
Reduced Staff Needed To Manage Infrastructure

Ref.	Metric	Calculation	Year 1	Year 2	Year 3
A1	FTEs previous to OpenStack		40	40	40
A2	FTEs after implementing OpenStack		10	10	10
A3	Average burdened salary		\$85,000	\$85,000	\$85,000
At	Reduced staff needed to manage infrastructure	$(A1-A2)*A3$	\$2,550,000	\$2,550,000	\$2,550,000
	Risk adjustment		↓ 10%		
Atr	Reduced staff needed to manage infrastructure (risk-adjusted)		\$2,295,000	\$2,295,000	\$2,295,000

Source: Forrester Research, Inc.



Reduced Cost For Sparing And Hardware Maintenance

With a data center built using standardized, commodity hardware, the organization was able to shift its sparing procedures. Rather than paying for a 7/24 service with a four-hour response time, the organization was able to automatically configure around failing devices, which allowed sparing activities to occur the following business day during regular business hours. The savings for the change in sparing requirements totaled more than \$1.5 million over three years. Forrester applied a 5% risk to the benefit. The risk-adjusted benefit from increasing sales by reducing website downtime over three years totaled more than \$1.4 million.

TABLE 2
Reduced Cost For Sparing And Hardware Maintenance

Ref.	Metric	Calculation	Year 1	Year 2	Year 3
B1	Value of capital value for hardware to support annual sales	A1 * 3%	\$3,000,000	\$3,900,000	\$5,070,000
B2	Cost for 7/24 sparing; 4 hour response time	B1 * 22%	\$660,000	\$858,000	\$1,115,400
B3	Cost for next day, business hours response	B1 * 9%	\$270,000	\$351,000	\$456,300
Bt	Reduced cost for sparing and hardware maintenance	B2-B3	\$390,000	\$507,000	\$659,100
	Risk adjustment		↓ 5%		
Btr	Reduced cost for sparing and hardware maintenance (risk-adjusted)		\$370,500	\$481,650	\$626,145

Source: Forrester Research, Inc.



Reduced Cost Of Data Center Power And Cooling

Implementing modern, standard hardware reduced the average cost of power and cooling by 10% for a total savings of \$448,875 over three years. Forrester applied a 5% risk to the benefit. The risk-adjusted benefit from increasing sales by reducing website downtime over the three years totaled \$426,431.

TABLE 3
Reduced Cost Of Data Center Power And Cooling

Ref.	Metric	Calculation	Year 1	Year 2	Year 3
C1	Value of capital value for hardware to support annual sales	$D1 * 3\%$	\$3,000,000	\$3,900,000	\$5,070,000
C2	Cost of power and cooling		15%	15%	15%
C3	Savings from upgraded infrastructure		10%	10%	10%
Ct	Reduced cost of data center power and cooling	$C1 * C2 * C3$	\$112,500	\$146,250	\$190,125
	Risk adjustment		↓ 5%		
Ctr	Reduced cost of data center power and cooling (risk-adjusted)		\$106,875	\$138,938	\$180,619

Source: Forrester Research, Inc.



Unquantified Benefits

In addition to the benefits quantified thus far, Forrester's interview with the customer organization highlighted additional benefits that it was unable to quantify. The customer had not been tracking some existing probable benefits and was just beginning to realize improvement in other areas. These unquantified benefits include:

- › **Improved customer loyalty.** The organization measures the impact of website availability and quality of experience on customer loyalty. The director of infrastructure told Forrester that the impact on customer loyalty is measurable and significant, but that the company considers the information too proprietary to share outside the company, even in an anonymous case study.
- › **Improved agility in launching customer-facing solutions.** With a private cloud infrastructure in place, the organization is finding that it is more nimble with experimental projects. The executive described a mobile app that was created during a brainstorming session by a small group of developers. The team was able to put in place the infrastructure in a few hours and launch an experimental project. The result is that this mobile app has now been launched globally and is proving highly popular with customers and making an impact on customer loyalty.

Total Benefits

Table 2 shows the total benefits as well as present values (PVs) discounted at 10%. Over three years, the customer organization expects risk-adjusted total benefits to be a PV of more than \$7.4 million.

TABLE 5
Total Benefits (Risk-Adjusted)

Ref.	Benefit	Initial	Year 1	Year 2	Year 3	Total	Present Value
Atr	Reduced staff needed to manage infrastructure	\$0	\$2,295,000	\$2,295,000	\$2,295,000	\$6,885,000	\$5,707,325
Btr	Reduced cost for sparing and hardware maintenance	\$0	\$370,500	\$481,650	\$626,145	\$1,478,295	\$1,205,308
Ctr	Reduced cost of data center power and cooling	\$0	\$106,875	\$138,938	\$180,619	\$426,431	\$347,685
	Total benefits	\$0	\$2,772,375	\$2,915,588	\$3,101,764	\$8,789,726	\$7,260,318

Source: Forrester Research, Inc.

COSTS

The interviewed organization experienced a number of costs associated with OpenStack:

- › Equipping data center with standardized, commodity hardware.
- › Time spent by internal staff to architect and implement OpenStack.

These represent the mix of internal and external costs experienced by the organization for initial planning, implementation, and ongoing maintenance associated with the solution. Because OpenStack Cloud Computing Software is open source software, the organization did not pay license fees or incur other software expenses. The cost for private cloud suites commonly costs \$1.5 million per year for a 1,000 virtual machine environment.



Equipping Data Center With Standardized, Commodity Hardware

The interviewed organization populated a data center with standardized commodity servers that it managed using OpenStack's Cloud Computing Software. The initial purchase of hardware for the data center was a capital expense incurred by the organization in the amount of \$3,000,000. The interviewed organization chose to purchase "medium-grade commodity hardware" meaning that it did not purchase the absolute cheapest in the market, but purchased the assets from name-brand providers with better quality assurance, but at a slightly higher price than the absolute bottom of the market.

Forrester risk-adjusted the subscription cost upward by 5% to account for uncertainty about the cost of infrastructure that organization may choose to purchase. The risk-adjusted total was \$3,150,000.

TABLE 6

Equipping Data Center With Standardized, Commodity Hardware

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
E1	Cost of hardware to populate new data center		\$3,000,000			
Et	Equipping data center with standardized, commodity hardware		\$3,000,000			
	Risk adjustment		↑ 5%			
Etr	Equipping data center with standardized, commodity hardware (risk-adjusted)		\$3,150,000			

Source: Forrester Research, Inc.



Time Spent By Internal Staff To Architect And Implement OpenStack

Architecting and implementing the private Cloud required a small team of people that were already employed by the organization. For a period of six months, a group of 10 employees worked to prepare the organization to operate in a new environment. The indirect cost of labor for this team totaled \$425,000.

Readers from other companies may find that architecting and implanting a private Cloud with OpenStack requires more time. As such, Forrester risk-adjusted this cost upward by 10% to account for the risk. The risk-adjusted total cost was \$467,500.

TABLE 7

Time Spent By Internal Staff To Architect And Implement OpenStack

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
F1	Number of FTEs		10			
F2	Time spent architecting and implementing OpenStack (years)	6 months	.5			
F3	Average burdened salary		\$85,000			
Ft	Time spent by internal staff to architect and implement OpenStack	$F1 * F2 * F3$	\$425,000			
	Risk adjustment		↑ 10%			
Ftr	Time spent by internal staff to architect and implement OpenStack (risk-adjusted)		\$467,500			

Source: Forrester Research, Inc.

Total Costs

Table 5 shows the total of all costs as well as associated present values, discounted at 10%. Over three years, the interviewed organization expects costs to total a net present value of more than \$3.6 million.

TABLE 8
Total Costs (Risk-Adjusted)

Ref.	Cost	Initial	Year 1	Year 2	Year 3	Total	Present Value
Etr	Equipping data center with standardized, commodity hardware	\$3,150,000				\$3,150,000	\$3,150,000
Ftr	Time spent by internal staff to architect and implement OpenStack	\$467,500				\$467,500	\$467,500
	Total costs	\$3,617,500	\$0	\$0	\$0	\$3,617,500	\$3,617,500

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 OpenStack 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 A.

The organization reported its greatest flexibility came from the ability of teams within the company to ramp up (and ramp down) projects more quickly. Being able to spin up virtual servers in hours allowed the organization to experiment with new projects in days and weeks rather than multiple months. Business leaders are able to test new ideas without tedious, long lead times and at a much lower cost than was ever possible previously.

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 OpenStack 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 OpenStack, resulting in lower overall total benefits. The greater the uncertainty, the wider the potential range of outcomes for cost and benefit estimates.

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.

TABLE 9
Benefit And Cost Risk Adjustments

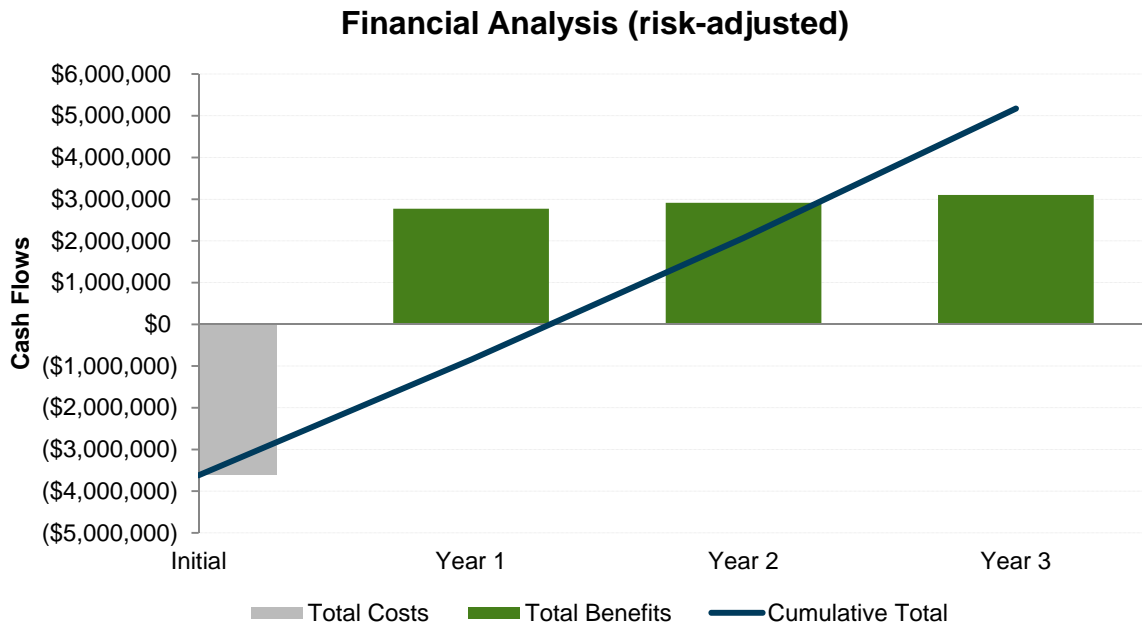
Benefits	Adjustment
Reduced cost for sparing and hardware maintenance	↓ 5%
Reduced staff needed to manage infrastructure	↓ 10%
Reduced cost of data center power and cooling	↓ 5%
Costs	Adjustment
Equipping data center with standardized, commodity hardware	↑ 5%
Time spent by internal staff to architect and implement OpenStack	↑ 10%

Source: Forrester Research, Inc.

Financial Summary

The financial results calculated in the Benefits and Costs sections can be used to determine the ROI and NPV for the organization's investment. Table 7 below shows the risk-adjusted ROI and NPV.

FIGURE 2
Cash Flow Chart (Risk-Adjusted)



Source: Forrester Research, Inc.

TABLE 10
Cash Flow (Risk-Adjusted)

	Initial	Year 1	Year 2	Year 3	Total	Present Value
Costs	(\$3,617,500)	\$0	\$0	\$0	(\$3,617,500)	(\$3,617,500)
Benefits	\$0	\$2,772,375	\$2,915,588	\$3,101,764	\$8,789,726	\$7,260,318
Net benefits	(\$3,617,500)	\$2,772,375	\$2,915,588	\$3,101,764	\$5,172,226	\$3,642,818
ROI						101%
Payback						15.5 months

Source: Forrester Research, Inc.

OpenStack: Overview

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

OpenStack is open source software for building clouds. Enterprises use OpenStack to support rapid deployment of new applications and features, reduce costs, and improve internal IT systems while reducing technology lock-in by avoiding proprietary solutions. OpenStack works with popular enterprise and open source technologies.

OpenStack powers clouds for many of the world's largest brands, including Best Buy, AT&T, Tapjoy, PayPal, Bloomberg, Cisco Webex, Hubspot, Intel, TRUSTe, Cigna, American Express, Disney, Fidelity, and Walmart. Nearly 500 companies worldwide have signed on as corporate supporters.

OpenStack is developed and managed by a thriving community of developers and users who gather twice annually at OpenStack Summits to design the next iteration of the software. The OpenStack Foundation supports the project and has nearly 25,000 members and nearly 500 companies in 160 countries who have written 20+ million lines of code in less than four years.

Appendix A: Total Economic Impact™ Overview

Total Economic Impact is a methodology developed by Forrester Research to enhance a company's technology decision-making processes and assist 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. TEI assists technology vendors in winning, serving, and retaining customers.

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 present value (PV) that can be estimated. The flexibility component of TEI captures that value.

RISKS

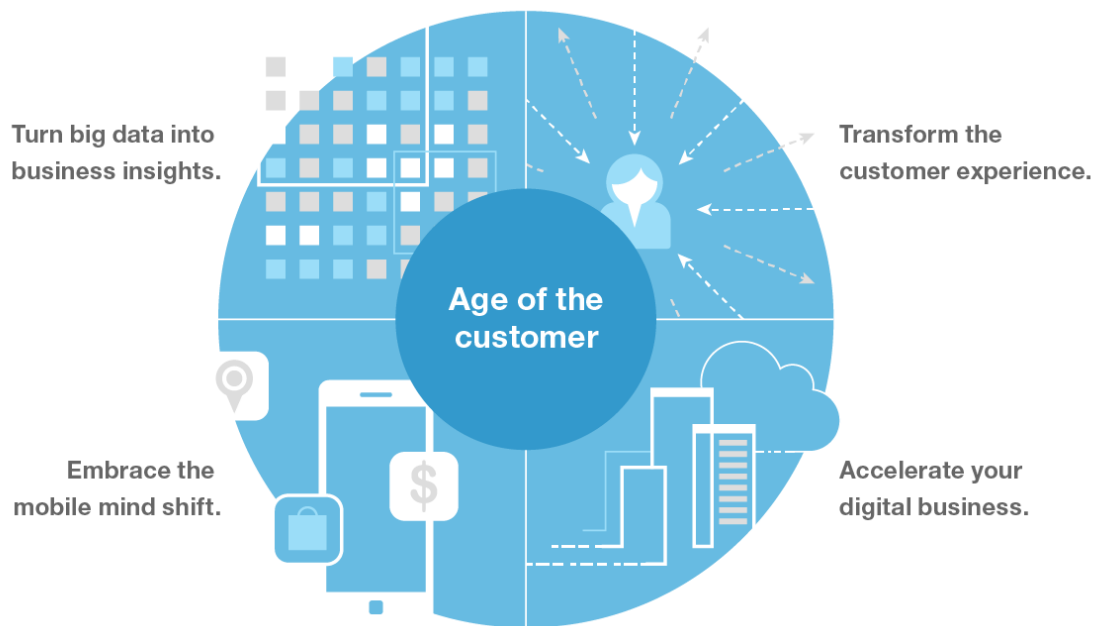
Risks measure the uncertainty of benefit and cost estimates contained within the investment. Uncertainty is measured in two ways: 1) the likelihood that the cost and benefit estimates will meet the original projections and 2) the likelihood that the estimates will be measured and tracked over time. TEI 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 B: Forrester And The Age Of The Customer

Your technology-empowered customers now often know more than you do about your products and services, pricing, and reputation. Your competitors can copy or undermine the moves you take to compete. The only way to win, serve, and retain customers is to become customer-obsessed.

A customer-obsessed enterprise focuses its strategy, energy, and budget on processes that enhance knowledge of and engagement with customers and prioritizes these over maintaining traditional competitive barriers.

CMOs and CIOs must work together to create this companywide transformation.



Forrester has a four-part blueprint for strategy in the age of the customer, including the following imperatives to help establish new competitive advantages:



Transform the customer experience to gain sustainable competitive advantage.



Accelerate your digital business with new technology strategies that fuel business growth.



Embrace the mobile mind shift by giving customers what they want, when they want it.



Turn big data into business insights through innovative analytics.

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 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.