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FORRESTER®

Prepared for Virtual Hold Technology

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The Total Economic Impact™ Of Virtual Hold's Virtual Queuing Solutions

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Executive Summary

In January 2006, Virtual Hold Technology commissioned Forrester Consulting to examine the potential return on investment (ROI) companies can realize by deploying its virtual queuing solutions for managing contact center calls. The study focused on the potential cost, revenue, and service level benefits that result from using Virtual Hold to improve the handling of inbound calls during peak traffic periods.

In conducting in-depth interviews with four Virtual Hold clients, Forrester found that these companies were able to improve the level of service provided by their contact centers while avoiding the hiring of additional customer service representatives (CSRs) and reducing toll charges incurred. Use of the solution also resulted in reductions in the number of abandoned calls and improvements in employee satisfaction. All of the companies interviewed were very pleased with the return on their investment in Virtual Hold Technology solutions and plan to expand its use within their organizations.

Virtual Hold's virtual queuing technology enables these benefits by providing contact centers with the means to offer their callers the option of being called back when estimated hold times exceed a predefined threshold that the customer deems to be an unacceptable level of service. Many callers value being given this option, as it allows them to better use their time. By automatically reinserting the called-back callers into the inbound call queue, Virtual Hold's approach allows contact centers to offer the improved level of service without changing any of the processes and tools used by the CSRs, therefore avoiding the additional charges that can result.

Purpose

The purpose of this study is to provide readers with a framework for evaluating the potential financial impact of Virtual Hold's virtual queuing solution 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, develop, and communicate a business case for investing in Virtual Hold.

Methodology

Virtual Hold selected Forrester for this project because of its industry expertise in call center management and Forrester's Total Economic Impact™ (TEI) methodology. TEI not only measures technology costs and cost reductions, it also takes into account the ability of technology to improve the efficiency and effectiveness of the business.

For this study, Forrester employed four fundamental elements of TEI in modeling the financial impact of Virtual Hold:

1. Project costs.
2. Benefits to all areas of the company.
3. Flexibility.
4. Risk.

Given the increasing sophistication of the IT investment analyses being used by enterprises, Forrester's TEI methodology serves an extremely useful purpose by providing 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. Gathered data from existing Forrester research relevant to Virtual Hold specifically, and call management systems in general.

2. Interviewed senior representatives from Virtual Hold to fully understand the potential value proposition of its solutions.

3. Conducted a series of in-depth interviews with four companies that are currently using a Virtual Hold virtual queuing solution.

4. Created a TEI financial model and populated the model using assumptions from a "composite organization," combining the information gained from the four Virtual Hold customers.

Interview Highlights

A total of four interviews were conducted for this study, involving representatives from the following types of companies (all companies are based in the United States):

1. Transamerica, a financial services company and subsidiary of AEGON USA.

2. Cincinnati Bell, a local exchange and wireless provider.

3. A healthcare services provider serving more than 1 million people.

4. A national wireless telecommunications provider.

These companies deployed Virtual Hold primarily to:

- Cost-effectively improve the level of service their contact centers were providing by reducing the amount of time that callers had to remain on the phone while waiting to speak with CSRs during busy call periods.

- Reduce the number of abandoned calls due to frustration with long holding times.

- Reduce the toll charges associated with callers remaining on hold while waiting to speak with CSRs.

- Improve employee satisfaction by reducing the number of annoyed callers that the CSRs had to speak with once they answered their calls.

Key Findings

Forrester's study yielded the following key findings:

- The customers interviewed for this case study all indicated that they have been very satisfied with the return they have received on their investment in Virtual Hold solutions.
- Virtual Hold's technology is of most value to companies with contact centers that experience variable "peaks" of traffic volume, need to improve service levels, and handle callers that perceive "virtual queue time" as being significantly more desirable than traditional "on-phone queue time."
- The primary quantifiable benefits of implementing Virtual Hold for the customers interviewed were: 1) avoiding the cost of additional CSR staff normally required when improving contact center service levels, and 2) decreasing charges for inbound toll calls by reducing the amount of time that callers wait on hold on the phone.
- Achieving these quantifiable benefits was dependent on important related capabilities within the organization and the technology infrastructure. For example, effective workforce management was mentioned by a number of the Virtual Hold customers as being a key dependency.
- The customers indicated that Virtual Hold provided high quality and responsive post-sale support. A few of them indicated that the "wellness checks," in which the Virtual Hold account team helps optimize the way the solution is used, have been especially valuable.

Disclosures

The reader should be aware of the following:

- The study was commissioned by Virtual Hold and is being delivered by the Forrester Consulting group.
- Virtual Hold reviewed and provided feedback to Forrester, but Forrester maintained editorial control over the study and its findings. Forrester did not accept changes to the study that contradict Forrester's findings or obscure the meaning of the study.
- The client names for the interviews were provided by Virtual Hold.
- Forrester makes no assumptions as to the potential ROI that other organizations will receive with Virtual Hold. Forrester strongly advises that readers use their own estimates within the framework provided in the report to determine the appropriateness of an investment in Virtual Hold.
- The study is not meant to be used as a competitive product analysis.

Virtual Hold Solution

Background

Contact center managers constantly face the often conflicting business demands of improving the level of service delivered by their teams while also increasing operational efficiency. As a result, they need to continually find innovative and cost-effective ways of enhancing the ability of the contact center to meet the evolving needs of the people that it supports.

Since the largest operational cost of a contact center is labor, maximizing the productivity and effectiveness of the contact center staff is a key determinant of its success. One of the greatest challenges in managing labor costs is effectively handling peaks of traffic volume, especially short duration peaks that occur at unpredictable times. Contact center managers must balance the following factors when dealing with these peaks:

- Amount of CSR resources used.
- Average amount of time required to answer individual calls.
- Average amount of time required to handle individual calls once answered.

The amount of time required to handle calls during busy periods generally does not differ significantly from non-peak times. Therefore, contact centers managers must chose between the following options for handling peak traffic volume periods: 1) providing more staff to answer calls; 2) allowing the length of time callers spend waiting in queue to increase; or 3) arranging for the customer to be called back. Selecting the proper approach should be based on the following factors:

- The cost of any additional equipment and resources.
- The cost of developing and deploying any new required processes and skills (e.g., for scheduling and completing callbacks).
- Impact on telephone toll charges incurred.
- Impact on caller satisfaction.
- Impact on satisfaction of the CSRs and other employees.
- Ability to adapt the infrastructure and resources used as needs change.

Overview

Virtual Hold offers a virtual queuing solution that helps contact centers handle their peak volume call periods. Virtual queuing is invoked when the estimated wait time exceeds a customer-defined threshold, and in those cases offers callers three main options: 1) remaining on hold; 2) receiving a return call when it is their turn in line; or 3) scheduling an appointment to be called back later. The option that provides the most immediate help is when callers elect to receive a return call when it is their turn in the same amount of time as if they had waited on hold. In these cases, the virtual queuing system holds the callers' place in the queue with a "virtual placeholder," calls the caller back when it is her turn, and reinserts her in the queue just prior to the point when a CSR is available to handle the call. In all three cases, the CSR handles the call as a standard inbound call.

The Virtual Hold solution can benefit both the caller and the company providing the contact center service. Callers often value having their expectations being properly set and being offered options for how their calls are handled when facing long hold times, as it enables them to make the most effective use of their time. Contact centers using Virtual Hold are able to avoid the costs of the additional staff that would otherwise be needed to improve service while also benefiting from the impacts of improved customer satisfaction.

Some of the important characteristics of the Virtual Hold solution are:

- All return calls are handled as standard inbound calls from the CSR's perspective, therefore avoiding any changes to the CSR processes, scripts, and skills used and the costs associated with those changes.

- The customer does not use a phone line while waiting in the virtual queue, therefore reducing toll charges.

- The configuration can be easily modified to meet various demands, providing important flexibility.

TEI Framework

The following section illustrates an example ROI analysis for Virtual Hold, based on the experience of the Virtual Hold customers who were interviewed for this report. Since this model examines just four customers of Virtual Hold, the calculations and data used should not be seen as a general-purpose quantification of the potential return that other organizations may achieve from investing in Virtual Hold. Companies must use their own information to determine their specific potential return.

Composite Organization And Assumptions

As the basis of the financial model developed for this study, Forrester has created a composite organization with characteristics that are similar to those of the four companies interviewed. The following assumptions have been made:

Table 1: Composite Organization And Assumptions

Ref.	Assumptions	Value
A1	Average daily calls offered (i.e., total incoming calls)	7,500
A2	CSRs providing the current level of service (full-time equivalents)	110
A3	Average handling time for calls (minutes)	5
A4	Average speed to answer calls (minutes)	1
A5	Percent of calls offered that are given Virtual Hold callback option	25%
A6	Percent of callers given callback option who accept	50%
A7	Percent of Virtual Hold callbacks that are successful	93%
A8	Reduction in hold time for accepted callbacks (minutes)	4
A9	Percent of total offered calls that are abandoned	5%
A10	Percent of abandoned calls that call back	75%
A11	Additional hold time for each abandon that calls back (minutes)	2
A12	CSRs needed to improve service level by 12 points	11
A13	Average fully loaded cost of CSR ($ per year)	$55,000
A14	Cost of toll calls ($ per minute)	$0.02
A15	Discount rate for the net present value (NPV) calculation	15%

Source: Forrester Research, Inc.

When it began the project, the contact center of the composite organization had an average of 7,500 inbound calls offered over the course of a day. The contact center is operational 365 days a year. Before deploying the Virtual Hold solution, 110 CSR full time equivalents (FTEs) were answering 58% of all calls within 30 seconds. Calls were answered in an average of 1 minute over the course of the day. It was taking an average of 5 minutes to handle each call once it was answered. At that time, the contact center used standard automatic call distributor (ACD) equipment and was not using any callback or virtual queuing capability.

The composite organization then implemented Virtual Hold on multiple queues within the contact center in order to increase the percentage of calls that were answered in 30 seconds from 58% to 70%. Following are the average values of three key metrics used for measuring the impact and effectiveness of the Virtual Hold solution:

- Percent of total offered calls to the contact center that are given the option of a Virtual Hold return call when the estimated hold time exceeds the customer defined threshold. (Reference A5: 25%)

- Percent of callers who are given the return call option and accept it — leaving the actual contact center queue and entering the "virtual queue." (Reference A6: 50%)

- Percent of callers accepting the return call option that Virtual Hold is able to reconnect with at the specified time (e.g., the caller answers the phone when called). (Reference A7: 93%)

The remaining assumptions listed in Table 1 will be explained as they are used in the benefit, cost, and analysis summary sections that follow.

Benefits

For the Virtual Hold customers that were interviewed for this case study, the largest quantifiable benefits were:

- Avoiding the cost of hiring additional staff that would otherwise be required to increase the percentage of calls answered within a specified period of time (e.g., 30 seconds).

- Reducing the toll charges incurred when callers remain on the phone while waiting to speak with a CSR.

Three of the customers interviewed also experienced a significant reduction in the percent of calls abandoned before they were answered due to the long hold times. The reduction of abandons can directly impact revenues when these calls involve potential sales or when excessive abandons lead to problems with retention. In addition, a reduction in abandons affects the number of repeat call attempts, and this may positively impact the staffing requirements for peak traffic volume. However, none of the customers interviewed were able to quantify this, so this has been treated as an important but nonquantified benefit in this model.

The Virtual Hold customers also spoke of the positive impact that the system had on employee satisfaction, as the CSRs liked the fact that they had to speak with fewer customers who were annoyed with having been stuck in long hold queues. However, the customers interviewed could not tie this directly to a financial impact (e.g., employee retention), so this is also treated as a nonquantified benefit.

The two benefits that are quantified within this model are described in the following two sections.

Agent Staffing Costs

The largest quantifiable benefit of implementing Virtual Hold for the customers interviewed was the staffing costs avoided when increasing the percentage of incoming calls that were answered in a required period of time. The same benefit can occur when reducing the staff required while maintaining a specified service level. The scale of operations as well as the magnitude of the investment and resultant improvement varied across the different customers interviewed. A "middle of the road" set of assumptions has been used to quantify this benefit.

The composite organization needed to increase the percentage of calls that were answered within 30 seconds from 58% to 70%. The time taken to answer a call was defined as starting from when the call entered the queue to when it was answered by the CSR. Based on the information from the customers interviewed, it is assumed that 11 additional CSRs (a 10% increase) would be needed to achieve the target 12 percentage point increase in the number of calls that are answered in the specified time frame. The customers interviewed used their own proprietary models or calculators, such as Erlang C, to estimate the increased staffing required to meet the improved level of service within their own environments.

An important principle used for this model is that the time required to offer the Virtual Hold return call option to callers and the time spent by the caller waiting while not on the phone are not included in the measurement of the time taken to answer the call when calculating time spent in queue as it relates to the service level. Therefore, with our example, if the call is answered by a CSR within 30 seconds of the time that it is placed back in the ACD queue by Virtual Hold, the service level is considered to have been met for that call. This approach is consistent with that used by the customers interviewed for their own assessments of virtual queuing.

Given that the fully loaded cost (including salary, benefits, and training) of each CSR was $55,000 annually, the labor saved by using Virtual Hold instead of 11 CSR full-time equivalents is $605,000, as illustrated in Table 2 below.

Table 2: Benefits — Avoided Costs Of Hiring Additional CSRs

Ref.		Year 0	Year 1
A12	CSRs needed to improve service level by 12 points		11
A13	Average fully loaded cost of CSR ($ per year)		$55,000
B1	Total labor saved (Ref A12 * A13)		$605,000

Source: Forrester Research, Inc.

Toll Charges

The costs incurred by the contact center for inbound toll charges are reduced when callers do not wait as long on hold. The primary savings come from the hold time that is eliminated when callers select the option to be called back. A secondary savings results from a reduction in the number of callers that abandon and then call back later and re-enter the queue. While the business impact of the reduction in toll charges has been steadily declining with falling toll prices, it still can be significant in situations where there are very high call volumes and long hold times. The toll charge benefit for the composite organization is summarized in Table 3.

Table 3: Benefits — Reduced Toll Charges

			(US$)
Ref.		Year 0	Year 1
B5	Total Virtual Hold callbacks accepted		342,188
B6	Total hold time saved (minutes)		1,368,750
B7	Toll savings - reduced hold time ($)		$27,375
B8	Number of avoided abandons		136,875
B9	Total hold time saved - avoided abandons (minutes)		205,313
B10	Toll savings - abandons ($)		$4,106
B11	Toll savings - total ($)		$31,481

Source: Forrester Research, Inc.

The first step in assessing the savings that result from reducing hold time is determining the number of incoming calls for which the caller is both given and accepts the option of a callback over the course of 365 days. For the composite organization, this was 342,188 calls during the first year (Reference B5 = A1 * A5 * A6 * 365). The total hold time saved is then calculated by multiplying the number of callbacks accepted by the average hold time (Reference B6 = B5 * A8). The total savings for this benefit of $27,375 is calculated by multiplying the total minutes of hold time saved by the toll charge (Reference B7 = B6 * A14).

A similar approach is used to determine the savings that result from eliminating the additional hold time associated with callers that abandon and then redial the contact center at a later time. The total number

of avoided abandoned calls is calculated by multiplying the total calls offered by the reduction in the percentage of total calls that abandon in one year (Reference B8 = A1 * A9 * 365). The total hold minutes is calculated by multiplying the number of avoided abandoned calls by the average number of abandons that call back and by the average number of incremental hold minutes generated by a caller who waits in the queue, abandons, and then calls the contact center again in the future and waits on hold before speaking with a CSR (Reference B9 = B8 * A11). The total savings for this benefit of $4,106 is calculated by multiplying the additional hold minutes by the average toll charge per minute (Reference B10 = B9 * A14). The total for these two benefits combined for the composite organization is $31,481 (Reference B11 = B7 + B10).

Costs

A very comprehensive review of project costs is undertaken with the TEI methodology to determine the total investment required to achieve the benefits outlined in the previous section. This includes all costs associated with hardware, software, internal IT/business resources, and external resources. The costs are summarized in Table 4.

Table 4: Total Project Costs Of Implementing Virtual Hold

Ref.		(US$) Year 0	Year 1
C1	Virtual Hold software licenses	$191,000	
C2	Virtual Hold software maintenance fees	$32,470	$32,470
C3	Virtual Hold professional services	$55,000	
C4	Training	Included	
C5	Hardware	$30,000	
C6	Internal labor expenses	$10,000	
C7	Total	$318,470	$32,470

Source: Forrester Research, Inc.

The price of the Virtual Hold software licenses for the capacity and functionality needed to support the composite organization was $191,000 (Reference C1). Virtual Hold license pricing is based on the number of ports required to interact with callers during peak traffic volume, with each port being able to handle an incoming call in approximately 50 seconds. The annual maintenance for the software was 17% of the license fee or $32,470 per year (Reference C2). The cost of Virtual Hold professional services to help with implementation and project management was $55,000 (Reference C3). The cost for Virtual Hold to train the customer's staff to configure and manage the system was included in the software license fee. The composite organization spent $30,000 in computer hardware and telecom equipment (Reference C5).

The expenses for the customer's internal IT and contact center staff to assist with the implementation were $10,000 (Reference C6). This included efforts by: 1) the telecommunications staff to integrate Virtual Hold technology with the contact center ACD; 2) the IT staff to help build and integrate the servers; 3) the contact center staff to develop the IVR prompts to be used when Virtual Hold was invoked for a call; and 4) the workforce management team to complete a few hours of training to learn how to incorporate virtual queuing into their planning, reporting, and procedures. In addition, the CSRs had to be made aware of the implementation of Virtual Hold so that they could answer any questions from callers and track caller feedback. Since this only took a few minutes of time as part of the normal process of updating CSRs, it did not result in any incremental costs being associated with the project.

Risks

A key component of the TEI process is factoring in the inherent uncertainty involved in estimating the expected costs and benefits of a technology project. This uncertainty results from numerous potential

risk factors related to the vendors and products involved, the architecture being used, the culture of the organization, the impact of potential project delays, and the sheer size of the project. A TEI analysis of a future project would quantify this risk using ranges for each cost and benefit. Each range is entered in the form of a low estimate, a most likely value, and a high estimate.

Since this study is dealing with the actual historical costs and benefits of the composite organization, uncertainty is not factored into the calculations. However, for those estimating expected costs and benefits, the following potential impacts should be taken into consideration.

Use And Effectiveness Of Virtual Queues

An important source of uncertainty to be aware of when considering the implementation of a Virtual Hold solution is the extent to which the virtual queues will be used and the effectiveness of the callback mechanism. The extent of use can be measured by the number of calls that are given the option of Virtual Hold callbacks and the number of callers that accept the option once offered. The effectiveness of the callback mechanism is assessed by measuring the percent of attempted callbacks that result in a caller being successfully reconnected to the inbound call queue. Determining the expected benefit prior to implementation requires that assumptions be made for each of these factors. The actual benefits gained are highly dependent on the actual results of these metrics.

The customers interviewed explained that uncertainty can be managed by assigning conservative initial estimates and then closely monitoring the three metrics once the solution is deployed. The system can be adjusted over time to offer the callback at the appropriate time for each of the queues involved. Contact centers should also be sure to have their trunking and outbound caller ID capability (i.e., informing caller that it is the contact center calling back) set up properly to maximize the number of successful attempted callbacks.

One customer observed that there was a learning curve involved in getting callers to use the callback option. Therefore, in situations in which call centers are handling regular repeat callers, the percentage of calls for which the return call option is accepted may increase over time.

People And Process Improvement

As with any major technology project, an important source of uncertainty to consider is the extent to which the organization is able to make the necessary improvements to people and processes. With the Virtual Hold approach of implementing callbacks by bringing callers back into the standard inbound call queue, the impact on people and processes is greatly reduced. However, there are some important considerations. For example, Virtual Hold should be implemented in contact centers that have effective workforce management processes and procedures in place. The solution should not be relied on to handle the majority of the contact center's inbound call volume.

Flexibility

Flexibility, as defined by TEI, represents an investment in additional capacity or capability that could, for some future additional investment, be turned into business benefit. Flexibility would also be quantified when evaluated as part of a specific project (described in more detail in Appendix A). For this study, the potential options for flexibility are identified and described qualitatively.

Flexibility options with Virtual Hold for these customers include the following:

- Expanding the use of the capability into other queues within the current contact center as well as other contact centers within the company, including use within internal help desks.

- The implementation of other services on the Virtual Hold platform, such as ResQueue that gives callers a second chance to request a return call.

- Using Virtual Hold to provide callback capability within Web sites using WebConnect.

Summary Of TEI Analysis

The quantified financial return of the investment in the Virtual Hold solution by the composite organization is summarized in Table 5.

Table 5: Summary Of Financial Calculations

Ref.	Category	Value
S1	Present value of benefits	$553,462
S2	Present value of costs	$346,705
S3	Net present value	$206,757
S4	Return on investment	60%
S5	Payback period	Fewer than 10 months

Source: Forrester Research, Inc.

The present value of the benefit and cost cash flows are calculated using the assumed discount factor of 15% (Reference A15) to reflect the time value of money. The present value of the total benefits of $553,462 (Reference S1) is calculated by summing the benefits of avoided hiring (Reference B1) and toll charge savings (Reference B11) and then discounting to reflect the time value of one year. The present value of the costs is $346,705 (Reference S2) applying the discount factor to the Year 1 cost of $32,470 and adding it to the Year 0 cost of $318,470.

The present value of the costs is subtracted from the present value of the benefits to derive the net present value (NPV) of $206,757 (Reference S3). The NPV is then divided into the present value of the costs to calculate the return on investment (ROI) of 60% (Reference S4).

The payback period is the time required for the discounted stream of total monthly benefits to equal the discounted stream of total monthly costs. For the Virtual Hold customers interviewed, this occurred in less than one year. The payback for this example business case is fewer than 10 months, allowing for a slight ramp-up period.

As with any analysis of a potential investment, these values should be considered in combination. The NPV provides insight into the overall magnitude of the expected return. The payback period indicates the expected amount of time before the net returns from the use of Virtual Hold first exceed the investment in the solution. The ROI shows what the expected return would be, in percentage terms, relative to the upfront investment.

Study Conclusions

All of the customers interviewed for this case study are extremely pleased with the overall return on its investment in Virtual Hold's solution, and the related improvements in both customer and employee satisfaction. The companies have been able to increase the service level provided to the people calling into their contact centers without increasing contact center staff. They also have been able to reduce the toll charges that incur when callers remain on hold waiting to speak with a CSR. Each of the customers described plans to expand their Virtual Hold platform with additional capability on existing queues as well as applying the technology in other areas of their companies.

Appendix A: Total Economic Impact™ Overview

Total Economic Impact is a methodology developed by Forrester Research, Inc., 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, cost, flexibility, and risk.

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 for analysis of the impact of the technology to the entire organization. The TEI methodology and resulting financial model place equal weight of the measure of benefits to that of costs, allowing for a full examination of the impact of the technology on the entire organization. Calculation of benefits 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 benefits estimates after the project has been completed. This ensures that benefits 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. These may be in the form of fully burdened labor, subcontractors, or materials. Costs consider all the investments and expenses necessary to deliver the value proposed. In addition, the costs category within TEI captures any incremental costs over the existing environment due to 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. An embedded collaboration feature may translate to greater worker productivity if it is activated. Having the ability to capture that benefit has a present value that can be estimated. The flexibility component of TEI captures that value.

Risk

Risk is the fourth component of the TEI methodology. It is a measurement of the uncertainty to benefits and costs estimates contained within the investment. Uncertainty is measured in two ways: the likelihood that the costs and benefits estimates will meet the original projections, as well as 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 estimate. The expected value — the mean of the distribution — is used as the risk-adjusted cost or benefit number. The risk-adjusted costs and benefits are then summed to yield a complete risk-adjusted summary and ROI.

Appendix B: Glossary

Discount rate: The interest rate used in cash flow analysis to take into account the time value of money.

Present value/net present value (NPV): The present or current value of (discounted) future net cash flows given an interest rate (the discount rate). Present value often refers to individual cost and benefit cash flows, and NPV is the sum of the present values. A positive NPV normally indicates that the investment should be made, unless other projects have higher NPVs.

Payback period: The breakeven point for an investment, which is the point in time at which net benefits (benefits minus costs) equal initial investment or cost. Other things being equal, the better investment is usually the one with the shorter payback period. The example below illustrates the concept:

Payback period = A + (B / C) where:

- A = Last year in which the net cash flow is negative = Year 1
- B = The absolute value of the net cash flow of A = Year 1 = 30
- C = The yearly net cash in the year following A = Year 2 = 90
- Payback period = 1 + (30 / 90) = 1.3 years (or about 16 months)

	Initial	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Total costs	(100)	(10)	(10)	(10)	(10)
Total benefits		80	100	100	100
Yearly net cash (Total benefits – Total costs)	(100)	70	90	90	90
Net cash flow (Net cash flow in previous year + yearly net cash)	(100)	(30)	60	150	240

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