The Total Economic Impact™ of IBM Rational Service Virtualization and Test Automation Solutions

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July 2013

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About Forrester Consulting

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Executive Summary

In 2013, IBM commissioned Forrester Consulting to examine the total economic impact and potential return on investment (ROI) enterprises may realize by deploying the IBM Rational Service Virtualization and Test Automation solutions. The IBM offerings represented in this analysis include:

- **IBM Rational Test Workbench®**: Provides test automation for complex and highly integrated applications delivering end-to-end functional, regression, load, and integration testing.

- **IBM Rational Test Virtualization Server®**: Models and simulates real-system behavior to eliminate application test dependencies and reduce the set-up and infrastructure costs of traditional testing environments.

- **IBM Rational Performance Test Server®**: Enables application and integration level load generation to provide a complete view of performance and scalability across all application components.

The purpose of this study is to provide readers with a framework to evaluate the potential financial impact of adopting IBM Rational Service Virtualization and Test Automation solutions for their own organizations.

IBM Helps Development Groups Improve Quality, Productivity, And On-Time Delivery

This study highlights the benefits and costs of implementing IBM Rational Service Virtualization and Test Automation solutions, based on the experiences of an existing customer. The customer, a large European bank with more than 30 million customers and 3,500 branches worldwide, implemented two of the IBM testing solutions — Rational Test Workbench (RTW) and Rational Test Virtualization Server (RTVS) — for one division's software development group. The solutions were first implemented in 2009 by Green Hat Software, prior to the acquisition by IBM in 2012. The interviews conducted for this study focused on the initial implementation as well as the experiences of the customer up to the present time.

The solutions were implemented for the division's development group in order to increase the efficiency and reliability of the software development life cycle. Prior to deploying these solutions, the development group had difficulty understanding and aligning around requirements, lacked robust testing tools, relied heavily on manual testing, and had a limited testing environment that constrained its project delivery capacity. These conditions led to a "high-risk" environment for implementing software changes, often leading to revenue-impacting outages for key applications maintained by the division's development group.

The findings in this study are based primarily on in-depth interviews with Sandhata Technologies, a middleware integrator closely involved with the implementation and deployment of RTW and RTVS. Sandhata Technologies was selected by one division of a large European bank to provide specialized consulting support for the planning, piloting, implementation, and deployment of RTW and RTVS. Forrester notes that Sandhata partnered with the bank over the course of three years not only to implement RTW and RTVS, but also to provide staff support with the execution of testing for critical projects. For the purposes of this study, Forrester has focused only on Sandhata's role implementing and deploying RTW and RTVS for the customer organization, and not on Sandhata's role providing staff supplementation for execution of testing activities. This approach has been taken since the delivery model for some customers may not require staffing support from a third-party provider. For more information about Sandhata Technologies, please see the company overview on page 28.

Forrester's interviews with Sandhata Technologies, which focused on the benefits, costs, and associated risks incurred by the European bank's software development group as a result of implementing RTW and RTVS, found that customers are likely to experience the risk-adjusted ROI, costs, and benefits shown in Table 1.

Table 1

Risk-Adjusted ROI Over Three Years[1]

| Year 1 ROI	Year 2 ROI (Cumulative)	Year 3 ROI (Cumulative)	Payback period	Total benefits (PV)	Total costs (PV)	Net present value
398%	860%	1,333%	< 2 months	$6,273,147	($433,149)	$5,839,998

Source: Forrester Research, Inc.

- **Benefits.** According to Sandhata Technologies, a large European bank realized the following benefits as a result of implementing RTW and RTVS:

    o **Increased project delivery capacity.** The customer increased its project delivery capacity by 100% over the three-year analysis (scaling from 40 projects to 80 projects completed annually) as a result of an improved testing environment and reduction in the frequency of production incidents, which freed up resources to execute a larger volume of projects.

    o **Incremental headcount avoided.** The customer was able to avoid hiring three additional FTEs into the development group over the three-year analysis as a result of using RTW and RTVS, enabling the organization to increase the scope, frequency, and consistency of continuous testing throughout the development process without substantially increasing its number of development resources.

    o **Decreased revenue loss from production incidents.** The customer better protected its revenues by reducing the frequency of revenue-impacting production incidents. Prior to implementing RTW and RTVS, approximately 20% of projects had production incidents, which resulted in application outages and cost an average of $100,000 revenue loss per incident.

    o **Reduced costs for resolving production incidents.** With integration testing performed earlier in the software development life cycle and fewer production incidents, the development team spent less time on bug fixing and design/integration rework, allowing developers to focus on new requirements and other high-value projects and initiatives.

    o **Reduced consulting and third-party testing fees.** Equipped with a robust set of testing capabilities offered by RTW and RTVS, the customer reduced its reliance on external consultants and third-party integration testing services to supplement its own internal testing efforts, saving fees previously incurred for external support.

- o **Avoidance of hardware expenses.** With service virtualization supported by IBM solutions, the customer avoided incurring incremental hardware and staff expenses to purchase, configure, and maintain additional testing environments required to support the project workload.

  o **Incremental revenue.** By improving team efficiency and reducing production incidents with IBM solutions, the customer was able to deliver new projects that provided additional revenue-generating opportunities.

- **Costs.** The customer incurred the following costs as a result of implementing IBM Rational Service Virtualization and Test Automation solutions:

  o **Licensing fees.** For its 25-person development team, the customer purchased 10 floating licenses of the product known as GH Tester from Green Hat Software. Following the acquisition of Green Hat by IBM in January 2012, these products were repackaged as Rational Test Workbench (RTW) and Rational Test Virtualization Server (RTVS). Under the new packaging, this implementation would require 10 floating user licenses of RTW and 100 PVU capacity of RTVS. For the purpose of this study, we reference the current IBM Rational product naming.

  o **Consulting fees.** The customer engaged an experienced middleware integrator, Sandhata Technologies, to support the planning, piloting, implementation, and deployment of RTW and RTVS.

  o **Internal implementation and maintenance costs.** The customer incurred internal labor costs for time spent by members of the development group on implementation and maintenance of RTW and RTVS.

  o **Hardware expenses.** The customer incurred expenses for servers required to support RTW and RTVS, and for staff time required to set up, configure, and maintain the servers.

Figure 1

Three-Year Risk-Adjusted Cost/Benefit Breakdown

Financial Analysis (risk-adjusted)
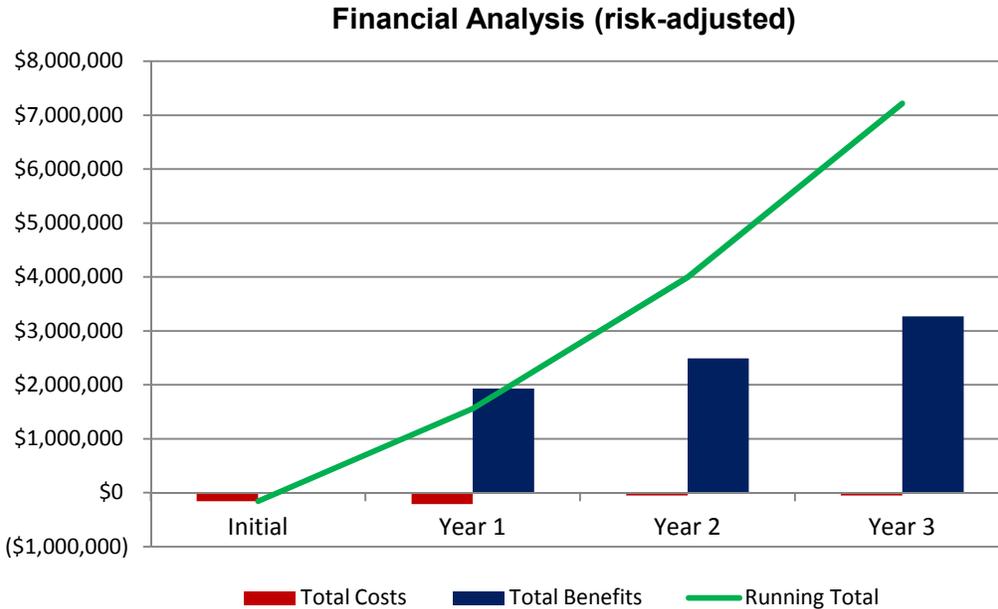
Source: Forrester Research, Inc.

Factors Affecting Benefits And Costs

Table 1 illustrates the risk-adjusted financial results that were achieved by the customer. These values take into account any potential uncertainty or variance that exists in estimating the costs and benefits, producing more-conservative estimates. The following factors may affect the financial results that an organization may experience:

- The configuration of IBM Rational Service Virtualization and Test Automation solutions being implemented and the scope of the relationship with IBM, which may impact licensing fees, consulting and/or integrator expenses, internal implementation costs, hardware requirements, and discount levels.

- The size of the development team, which can influence licensing and training/support costs for deploying IBM testing solutions across a team.

- The extent of planning and implementation support provided by consultants and/or systems integrators, which can impact how quickly IBM Rational Service Virtualization and Test Automation solutions are deployed and how quickly productivity benefits accumulate to an organization.

Disclosures

The reader should be aware of the following:

- The study is commissioned by IBM and conducted independently by the Forrester Consulting group.

- Forrester makes no assumptions as to the potential return on investment 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 IBM solutions.

- IBM 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.

- The customer for this case study was provided by Sandhata Technologies.

TEI Framework And Methodology

Introduction

From the information provided in the interviews, Forrester has constructed a Total Economic Impact™ framework for those organizations considering engaging IBM Rational Service Virtualization and Test Automation solutions for software testing. 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 RTW and RVTS can have on an organization (see Figure 2). Specifically, we:

- Interviewed IBM marketing and sales personnel and a Forrester analyst to gather data relative to the company's solutions and its marketplace.
- Interviewed an implementation partner who was involved in deploying RTWand RTVS for an existing customer to obtain data with respect to the costs, benefits, and risks experienced by the customer.
- 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 with the implementation partner.

Figure 2

TEI Approach
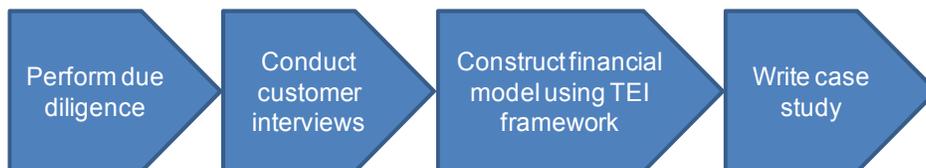
Source: Forrester Research, Inc.

Forrester employed four fundamental elements of TEI in modeling IBM Rational Service Virtualization and Test Automation solutions:

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

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

Analysis

Interview Highlights

For this case study, Forrester interviewed Sandhata Technologies, which was engaged as a specialized consultant by the customer to support the planning and implementation of RTW and RTVS. Sandhata provided the following services during implementation to the IBM customer: assistance with the planning of the software testing architecture, facilitation of the vendor selection process, implementation support for the IBM solutions, and assistance with piloting RTW and RTVS with a subset of projects.

The customer that implemented RTW and RTVS is a large European bank with more than 30 million customers and 3,500 branches worldwide. The software development group of one banking division within the organization sought to update its software testing processes in order to optimize the testing environment to better meet the needs of the business, increase the productivity of the development group, scale project capacity, and reduce the frequency of revenue-impacting incidents.

The development team consisted of 25 staff members, including two architects, three project managers, nine developers, seven QA engineers, and four infrastructure specialists. While implementing IBM Rational Service Virtualization and Test Automation solutions, the development group was also in the process of adopting an Agile approach to software development. Combined with continuous testing, the customer hoped to improve the efficiency, quality, and predictability of its development processes. Implementation of RTW and RTVS began in late 2009 and spanned 20 days for the implementation, piloting, and full deployment of the solutions.

The customer implemented service virtualization and automated integration testing across its 120 interfaces as well as 10 to 15 subsystems that were involved in executing its trading transactions, including components built in Java, EMS, JMS, WebSphere MQ, Sybase, and a SWIFT payment service. By leveraging testing capabilities from IBM, the bank was able to reduce the time it took to perform system integration testing (SIT) from three weeks to half a day. This enabled the bank to do continuous testing to support its Agile development process.

Framework Assumptions

Table 2 provides the model assumptions that Forrester used in this analysis. All figures shown in the case study have been rounded to the nearest whole USD.

Table 2

Model Assumptions

Ref.	Metric	Calculation	Value
A1	Working weeks per year		48
A2	Working hours per year (M-F, 9-5)		2,080
A3	Average salary within the development group (fully loaded)		$122,000
A4	Average hourly rate within the development group	A3/A2	$59
A5	Consultant hourly billing rate		$90

Source: Forrester Research, Inc.

The discount rate used in the PV and NPV calculations is 10%; 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.

Costs

The customer incurred four types of costs for implementing and maintaining Rational Test Workbench and Rational Test Virtualization Server: 1) licensing fees; 2) consulting fees; 3) internal implementation and maintenance costs; and 4) hardware expenses. All costs are shown in USD.

Licensing Fees

The customer purchased the capabilities that are now part of RTW and RTVS. When the customer implemented the solution in 2009, licensing costs were based on legacy per-user pricing from Green Hat Software (IBM acquired Green Hat in January 2012). Costs have since been updated and can be found on the following product websites:

- **Rational Test Workbench (RTW)**: http://www-03.ibm.com/software/products/us/en/rtw/.

- **Rational Test Virtualization Server (RTVS):** http://www.ibm.com/software/products/us/en/rtvs/.

The licensing cost incurred by the customer for IBM Rational Service Virtualization and Test Automation solutions was $185,000. An annual maintenance fee totaling 20% of the license fee (or $37,000) was applied as part of an ongoing customer service agreement. The total costs incurred by the customer for these offerings are summarized in Table 3 below.

Table 3

Licensing Fees — Non-Risk-Adjusted

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
B1	Licensing fees for Service Virtualization and Test Automation functionality (originally through Green Hat)			$185,000		
B2	Percent maintenance fee				20%	20%
B3	Annual maintenance fee	B1*B2			$37,000	$37,000
Bt	Licensing fees	B1+B3	$0	$185,000	$37,000	$37,000

Source: Forrester Research, Inc.

Consulting Fees

Around the time that the customer implemented RTW and RTVS, the customer was undergoing a transformation of its software development and testing approaches (e.g., adopting Agile). This transformation was part of a larger initiative to update the division's development and testing approaches, increase the productivity of the development organization, and decrease the likelihood of revenue-impacting incidents in the production environment.

To ensure the successful implementation of RTW and RTVS, the customer engaged middleware integrator Sandhata Technologies for assistance implementing, piloting, configuring, and deploying the solutions. Sandhata was selected by the customer due to its specialized experience working with customers implementing and using RTW and RTVS. According to Sandhata, the implementation for RTW and RTVS lasted approximately 20 working days. To meet the customer's accelerated delivery schedule, Sandhata created an implementation team comprised of eight consultants, with each spending approximately 8 hours per day supporting implementation and deployment at an hourly billing rate of $90.

Following the initial implementation period, Sandhata also provided ongoing annual maintenance support. Sandhata estimated that approximately five days were spent annually on performing updates and maintenance for RTW and RTVS. Two consultants supported these efforts.

The total consulting fees over the three-year analysis were $136,800 (PV of $133,105).

Note that Sandhata Technologies also provided staff supplementation for testing activities completed on behalf of the customer organization in order to facilitate its adoption of Agile techniques. However, the consulting fees shown in the TEI case study are limited to the staff required to support the implementation and maintenance of RTW and RTVS only. This approach has been used since it is assumed that most organizations will not require staff supplementation unless they are undergoing a broader process transformation initiative.

Table 4

Consulting Fees — Non-Risk-Adjusted

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
C1	Number of days for implementation		20			
C2	Number of consultants supporting implementation		8			
C3	Hours per day per consultant		8			
C4	Consultant hourly billing rate	A5	$90			
C5	Number of days for annual maintenance			5	5	5
C6	Number of consultants supporting annual maintenance			2	2	2
C7	Hours per day per consultant			8	8	8
C8	Consultant hourly billing rate	A5		$90	$90	$90
Ct	Consulting fees	(C1*C2*C3*C4)+ (C5*C6*C7*C8)	$115,200	$7,200	$7,200	$7,200

Source: Forrester Research, Inc.

Internal Implementation And Maintenance Costs

In partnership with consultants from Sandhata, members of the customer's internal software development group spent time supporting implementation and maintenance of the IBM solutions. During initial implementation, members of the development group collectively spent 80 hours on implementation activities. At an average hourly rate of $59 per team member per hour, the internal labor cost for supporting initial implementation was $4,720.

Members of the customer's internal software development group also spent time on ongoing maintenance of the IBM Rational Service Virtualization and Test Automation solutions, including installing updates, resolving queries and issues, and adapting test configurations and settings on an ad hoc basis. Members of the development team collectively spent 40 hours annually supporting these efforts. At an average hourly rate of $59 per development resource, the annual internal cost for maintaining the IBM solutions was $2,360, as shown in Table 5.

Table 5

Internal Implementation And Maintenance Costs — Non-Risk-Adjusted

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
D1	Development hours required to support implementation		80			
D2	Development hourly rate	A4	$59			
D3	Development hours required annually for maintenance			40	40	40
D4	Development hourly rate	A4		$59	$59	$59
Dt	Internal implementation and maintenance costs	(D1*D2)+(D3*D4)	$4,720	$2,360	$2,360	$2,360

Source: Forrester Research, Inc.

Hardware Expenses

The customer incurred expenses for acquiring, setting up, configuring, and maintaining servers required to conduct testing with RTW and RTVS. To ensure sufficient redundancy and capacity to support testing, the customer purchased two servers. While only one server was required to support testing requirements using RTW and RTVS, the customer purchased a second server for redundancy — a standard approach for the bank. At a cost of $5,000 per server, the customer spent $10,000 for the two servers dedicated to testing with RTW and RTVS.

The customer also incurred costs for the internal time required for setup, configuration, and maintenance of the servers. Each server required 6 hours for setup and configuration during initial implementation. In addition, members of the customer's internal development group spent time maintaining the two servers, with each server requiring 15 hours of maintenance annually. The total hardware acquisition and maintenance expenses were $16,018 (PV of $15,110), as shown in Table 6 below.

Table 6

Hardware Expenses — Non-Risk-Adjusted

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
E1	Servers purchased		2			
E2	Cost per server		$5,000			
E3	Hours per server for setup and configuration		6			
E4	Development hourly rate	A4	$59			
E5	Servers maintained annually			2	2	2
E6	Hours per server for annual maintenance			15	15	15
E7	Development hourly rate	A4		$59	$59	$59
Et	Hardware expenses	(E1*E2)+(E1*E3*E4)+ (E5*E6*E7)	$10,708	$1,770	$1,770	$1,770

Source: Forrester Research, Inc.

Total Costs

As discussed in the sections above, costs incurred by the customer included one-time implementation costs as well as recurring maintenance expenses. Table 7 shows the total of all costs mentioned above as well as associated present values, discounted at 10%.

Table 7

Total Costs — Non-Risk-Adjusted

Ref.	Metric	Initial	Year 1	Year 2	Year 3	Total	Present Value
Bt	Licensing fees	$0	($185,000)	($37,000)	($37,000)	($259,000)	($226,559)
Ct	Consulting fees	($115,200)	($7,200)	($7,200)	($7,200)	($136,800)	($133,105)
Dt	Internal implementation and maintenance costs	($4,720)	($2,360)	($2,360)	($2,360)	($11,800)	($10,589)
Et	Hardware expenses	($10,708)	($1,770)	($1,770)	($1,770)	$16,018	$15,110
	Total costs (original)	($130,628)	($196,330)	($48,330)	($48,330)	($391,582)	($355,144)

Source: Forrester Research, Inc.

Benefits

The customer experienced six quantified benefits as a result of implementing RTW and RTVS: 1) increased project delivery capacity; 2) incremental headcount avoided; 3) decreased revenue loss from production incidents; 4) reduced costs for resolving production incidents; 5) reduced consulting expenses; and 6) avoidance of hardware purchases to support an increased number of projects. A seventh benefit, additional revenue generated from the rollout of additional projects, was not quantified since data was not available for the customer, but remained a strategic consideration for the customer in the decision to implement the IBM solution.

Increased Project Delivery Capacity

The customer increased its project delivery capacity significantly as a result of implementing RTW and RTVS. Prior to implementing the two IBM solutions, the software development group completed approximately 40 projects annually, when considering projects completed by internal development resources only and not staff augmentation from external consultants. With RTW and RTVS, the project delivery volume increased to 60 projects in Year 1, 66 projects in Year 2, and 80 projects in Year 3.

To calculate the increased project delivery benefit, which assumes the customer would have required additional staff to deliver additional projects, Forrester assumed that each project required an average of 60 hours per month. At an average hourly rate of $59 per person, the incremental productivity from increased project delivery capacity was $1,217,760 (PV of $987,264). Table 8, below, summarizes the value associated with increased project delivery capacity.

Table 8

Increased Project Delivery Capacity — Non-Risk-Adjusted

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
F1	Annual number of projects completed with IBM testing solutions			60	66	80
F2	Annual number of projects completed without IBM testing solutions			40	40	40
F3	Incremental projects per year	F1-F2		20	26	40
F4	Average project duration (months)			4	4	4
F5	Development hours spent per month per project			60	60	60
F6	Development hourly rate	A4		$59	$59	$59
Ft	Increased project delivery capacity	F3*F4*F5*F6	$0	$283,200	$368,160	$566,400

Source: Forrester Research, Inc.

Incremental Headcount Avoided

Another benefit experienced by the customer as a result of implementing RTW and RTVS was the avoidance of hiring several incremental staff into the development group. Without the IBM solutions, the size of the development group ranged between 25 and 27 full-time employees (which represents the addition of one FTE per year as the development group continues to scale its project delivery volume). However, to execute the same level and quality of integration testing without RTW and RTVS, the development group would have required one additional FTE in Year 1 (for 26 FTEs), one more FTE in Year 2 (for 28 FTEs), and a third incremental FTE in Year 3 (for 30 FTEs). Over time, the size of the development group would have increased to accommodate a larger number of projects undergoing earlier testing and to account for relatively manual processes required to stand up test environments. At an average fully loaded salary of $122,000 per development team member, the customer saved between $122,000 and $366,000 in additional salary costs annually. Table 9 summarizes the cost savings from incremental headcount avoided.

Table 9

Incremental Headcount Avoided — Non-Risk-Adjusted

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
G1	Development staff required without IBM testing solutions			26	28	30
G2	Development staff required with IBM testing solutions			25	26	27
G3	Development staff hires avoided	G1-G2		1	2	3
G4	Development average salary (fully loaded)	A3		$122,000	$122,000	$122,000
Gt	Incremental headcount avoided	G3*G4	$0	$122,000	$244,000	$366,000

Source: Forrester Research, Inc.

Decreased Revenue Loss From Production Incidents

A key driver for the customer was to reduce the rate of issues in the production environment. These issues typically resulted in outages, which led to a loss of revenue during the downtime period. Prior to the implementation of IBM solutions, approximately 20% of projects had production issues. With an average loss of $100,000 per incident (a conservative estimate based on customer experience), the total revenue preserved as a result of reduced production incidents over the three-year analysis was $4,120,000 (PV of $3,383,922).

Table 10

Decreased Revenue Loss From Production Incidents — Non-Risk-Adjusted

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
H1	Projects completed per year			60	66	80
H2	Percent of production incidents with revenue loss potential without IBM testing solutions			20%	20%	20%
H3	Revenue loss per production incident (average)			$100,000	$100,000	$100,000
Ht	Decreased revenue loss from production incidents	H1*H2*H3	$0	$1,200,000	$1,320,000	$1,600,000

Source: Forrester Research, Inc.

Reduced Costs For Resolving Production Incidents

In addition to preserving revenue by reducing the frequency of downtime in revenue-generating applications, the customer also reduced its internal labor costs for resolving production incidents. This freed up staff time to focus on more-important software development projects and initiatives. Prior to implementing Rational Test Workbench and Rational Test Virtualization Server, the rate of production incidents was 2.5 incidents per project. As a result of implementing the IBM solutions, the customer decreased the rate of production incidents to 0.3 over a three-year period (with the incident rate decreasing steadily over the three-year analysis as the scope, sophistication, and frequency of integration testing conducted increased over time).

Forrester conservatively estimated that members of the development group collectively spent an average of 40 hours per production incident. At an average hourly rate of $59 per development team member, the annual labor cost savings from a decreased number of production incidents ranged between $70,800 and $415,360. The total cost reduction for resolving production incidents was $719,800 (PV of $569,521), as summarized in Table 11 below.

Table 11

Reduced Costs for Resolving Production Incidents — Non-Risk-Adjusted

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
I1	Projects completed per year			60	66	80
I2	Production incidents per project without IBM testing solutions			2.5	2.5	2.5
I3	Production incidents per project with IBM testing solutions (average)			2.0	1.0	0.3
I4	Avoided production incidents per project	I2-I3		0.5	1.5	2.2
I5	Development hours required per production incident			40	40	40
I6	Development hourly rate	A4		$59	$59	$59
It	Reduced costs for resolving production incidents	I1*I4*I5*I6	$0	$70,800	$233,640	$415,360

Source: Forrester Research, Inc.

Reduced Consulting And Third-Party Testing Fees

With the implementation of RTW and RTVS, the customer reduced the frequency with which it engaged external consultants and third-party testing services. Formerly, due to limited internal resources, the customer regularly engaged external consulting support to complete testing; approximately 40% of its projects had consulting or third-party tester involvement. Before implementation of the IBM solutions, approximately four consultants were engaged per project. After implementation of RTW and RTVS, the average number of consultants per project decreased to between two and three consultants per project, as more integration testing could be completed by internal staff. With an average of 40 hours spent per consultant per project and an hourly billing rate of $90, the customer saved between $86,400 and $230,400 annually. Table 12 summarizes the cost savings from reduced consulting and third-party testing fees.

Table 12

Reduced Consulting And Third Party Testing Fees — Non-Risk-Adjusted

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
J1	Projects completed per year			60	66	80
J2	Percent of projects with consulting/third-party tester involvement			40%	40%	40%
J3	Consultants engaged per project without IBM testing solutions			4	4	4
J4	Consultants engaged per project with IBM testing solutions			3	2	2
J5	Consultant staff avoided per project	J3-J4		1	2	2
J6	Hours spent per consultant per project			40	40	40
J7	Consultant hourly billing rate	A5		$90	$90	$90
Jt	Reduced consulting and third-party testing fees	J1*J2*J5*J6*J7	$0	$86,400	$190,080	$230,400

Source: Forrester Research, Inc.

Avoidance Of Hardware Expenses

The customer saved on infrastructure expenses by implementing RTW and RTVS. With service virtualization and more robust integration testing capabilities, the software development team required less hardware to build and stand up test environments even though they added additional projects. Without the IBM solutions, the development group would have required additional hardware to support the project capacity necessary for non-virtualized testing in a full physical preproduction environment. With the IBM solutions, the customer avoided purchasing 12 servers in total over the three-year analysis, as estimated by Sandhata. At a cost of $5,000 per server, this saved the customer $60,000.

In addition to the cost avoidance of the additional servers, the customer saved on labor costs for maintaining these servers, estimated as 15 hours of labor per server annually. With the service virtualization approach, the organization was able to avoid setting up and managing disk space that was no longer required. According to Sandhata, the customer saved an additional $14,000 in avoided costs for disk space. Finally, the customer also saved on labor costs for configuring a physical full-production test environment, saving approximately $250,000 annually. Table 13 summarizes the cost savings from avoided hardware expenses for the customer.

Table 13

Avoidance Of Hardware Expenses — Non-Risk-Adjusted

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
K1	Number of server purchases avoided			3	4	5
K2	Cost per server			$5,000	$5,000	$5,000
K3	Number of servers maintained annually			3	7	12
K4	Hours required per server for maintenance			15	15	15
K5	Development hourly rate	A4		$59	$59	$59
K6	Value of disk purchases avoided			$14,000	$14,000	$14,000
K7	Labor costs for configuring a physical full-production test environment			$250,000	$250,000	$250,000
Kt	Avoidance of hardware expenses	(K1*K2)+(K1*K3*K4)+ K6+K7	$0	$281,655	$290,195	$299,620

Source: Forrester Research, Inc.

Incremental Revenue

Forrester acknowledges that one other benefit of increased project delivery capacity is the business value of being able to deliver an expanded range of products and services to customers at a more rapid pace. According to Sandhata, the customer was able to increase its revenue in certain products and services as a result of continuous testing using RTW and RTVS. However, because the business impact varies based on project requirements, and will vary significantly based on the industry, size, offering, and distribution/service models, Forrester has not included incremental revenue from increased project delivery capacity in the ROI model. Even factoring in conservative estimates, this benefit alone could easily reach tens of millions of dollars and remains an important consideration for organizations considering IBM solutions.

Total Benefits

Table 14 shows the total of all benefits mentioned above as well as associated present values.

Table 14

Total Benefits — Non-Risk-Adjusted

Ref.	Metric	Initial	Year 1	Year 2	Year 3	Total	Present Value
Ft	Increased project delivery capacity	$0	$283,200	$368,160	$566,400	$1,217,760	$987,264
Gt	Incremental headcount avoided	$0	$122,000	$244,000	$366,000	$732,000	$587,543
Ht	Decreased revenue loss from production incidents	$0	$1,200,000	$1,320,000	$1,600,000	$4,120,000	$3,383,922
It	Reduced costs for resolving production incidents	$0	$70,800	$233,640	$415,360	$719,800	$569,521
Jt	Reduced consulting and third-party testing fees	$0	$86,400	$190,080	$230,400	$506,880	$408,739
Kt	Avoidance of hardware expenses	$0	$281,655	$290,195	$299,620	$871,470	$720,990
	Total benefits (original)	$0	$2,044,055	$2,646,075	$3,477,780	$8,167,910	$6,657,978

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 in the future. 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 engage with IBM solutions and later realize additional benefits and business opportunities. Flexibility would also be quantified when evaluated as part of a specific project (described in more detail in Appendix A).

At the time interviews for this case study were completed, the customer had not implemented the load generation capabilities of IBM Rational Performance Tester, which are included as part of IBM Rational Test Virtualization Server. A potential flexibility opportunity for the customer is the adoption of the IBM Rational Performance Test Server, which would provide the development group with a more robust view of performance and scalability across all application components. This additional functionality can be particularly useful for the development group as it continues to consider how to optimize its customers' experience with banking applications and as the number of customers served by the organization grows.

Risk

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

Quantitatively capturing investment and impact risk, by directly adjusting the financial estimates, results in more-meaningful and more-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 implementation risks that affect costs are identified as part of this analysis:

- A longer than anticipated implementation timeline, impacting consulting fees and/or internal labor costs.

- Additional infrastructure and hardware requirements.

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

- Minimal or no increase in project delivery capacity.

- Little or no reduction in incremental headcount requirements.

- Persisting rate of production incidents and associated revenue loss.

- Minimal or no reduction in costs for resolving production incidents.

Table 15 shows the values used to adjust for risk and uncertainty in the cost and benefit estimates. The TEI model uses a triangular distribution method to calculate risk-adjusted values. To construct the distribution, it is necessary to first estimate the low, most likely, and high values that could occur within the current environment. The risk-adjusted value is the mean of the distribution of those points.

Table 15

Cost And Benefit Risk Adjustments

Costs	Low	Most likely	High	Mean
Licensing fees	100%	100%	125%	108%
Consulting fees	100%	100%	200%	133%
Internal implementation and maintenance costs	100%	100%	125%	108%
Hardware expenses	100%	100%	125%	108%
Benefits	**Low**	**Most likely**	**High**	**Mean**
Increased project delivery capacity	80%	100%	103%	94%
Incremental headcount avoided	80%	100%	103%	94%
Decreased revenue loss from production incidents	50%	100%	110%	94%
Reduced costs for resolving production incidents	80%	100%	103%	94%
Reduced consulting and third-party testing fees	50%	100%	110%	87%
Avoidance of hardware expenses	80%	100%	103%	94%

Source: Forrester Research, Inc.

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 Costs and Benefits sections can be used to determine the ROI, net present value, and payback period for an investment in IBM Rational Service Virtualization and Test Automation solutions. These are shown in Table 16.

Table 16

Cash Flow — Non-Risk-Adjusted

Cash flow — Original estimates						
	Initial	Year 1	Year 2	Year 3	Total	Present value
Costs	($130,628)	($196,330)	($48,330)	($48,330)	($391,582)	($355,144)
Benefits	$0	$2,044,055	$2,646,075	$3,477,780	$8,167,910	$6,657,978
Net benefits	($130,628)	$1,847,725	$2,597,745	$3,429,450	$7,776,328	$6,302,835
ROI (cumulative)	N/A	523%	1,096%	1,775%		
Payback period	< 1 month					

Source: Forrester Research, Inc.

Table 17, below, shows the risk-adjusted ROI, NPV, and payback period values. These values are determined by applying the risk-adjustment values from Table 15 in the Risk section to the cost and benefits totals in tables 7 and 14.

Table 17

Cash Flow — Risk-Adjusted

Cash flow — Risk-adjusted estimates						
	Initial	**Year 1**	**Year 2**	**Year 3**	**Total**	**Present value**
Costs	($169,878)	($213,836)	($53,996)	($53,996)	($474,407)	($433,149)
Benefits	$0	$1,932,263	$2,491,417	$3,270,962	$7,694,642	$6,273,147
Net benefits	($169,878)	$1,718,427	$2,437,420	$3,216,966	$7,220,235	$5,839,998
ROI (cumulative)	N/A	398%	860%	1348%		
Payback period	< 2 months					

Source: Forrester Research, Inc.

IBM Rational Service Virtualization And Test Automation Solutions: Overview

According to IBM, the IBM Rational Service Virtualization and Test Automation solutions help organizations accelerate software delivery, reduce project risk, and increase software quality by enabling continuous integration testing of complex applications. These offerings may be used individually or in combination with IBM development and deployment automation solutions to address the full DevOps life cycle.

IBM Rational Service Virtualization and Test Automation solutions, leveraging technology acquired from Green Hat Software in 2012, includes the following products:

- **Rational Test Workbench:** Delivers a comprehensive test automation solution including regression, load, integration, and performance testing across web, mobile, and traditional applications. By providing an end-to-end solution in a single offering, Rational Test Workbench allows teams to significantly improve team agility, maximize productivity, and deliver software at the pace the business demands.

- **Rational Test Virtualization Server:** Enables the deployment of virtual services in order to simulate real system behavior so teams can perform integration testing earlier and more frequently in the development cycle. Virtual services can be reused and shared easily across teams to significantly reduce the expense of creating and maintaining test environments.

- **Rational Performance Test Server:** Provides application and integration level load generation to provide a complete view of performance and scalability across all application components. This workload test engine maximizes the use of your test infrastructure to quickly deploy load scenarios and create large-scale system tests to avoid the costly impact of poor application performance.

For more information, visit http://www.ibm.com/software/rational/servicevirtualization.

Sandhata Technologies: Company Overview

According to Sandhata Technologies, it is an experienced, professional middleware integrator, encompassing SOA, ESB, BPM, and analytics. It has developed its own integration methodology that can offer simple and flexible solutions to complex issues such as regulatory compliance. Sandhata has experience in capital markets, telecommunications, and retail, and its on-staff specialists have a minimum of five years' middleware project experience. This underlines the company's aim to provide quality and reliability in every customer interaction. With a head office in London, and EMEA onshore and APAC offshore delivery centers, its global presence can provide a mix of onshore and offshore resourcing.

Sandhata has developed its own internal methodology (the MDLC) that joins together architecture, infrastructure, application development, project management, QA, and application support. Its library, navigated via SharePoint, covers process, procedures, templates, best practice, project, and implementation plans.

For more information about Sandhata, please visit: http://www.sandhata.com/.

Appendix A: Total Economic Impact™ Overview

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

The TEI methodology consists of four components to evaluate investment value: benefits, costs, risks and flexibility.

Benefits

Benefits represent the value delivered to the employee 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 employee 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.

Risk

Risk measures 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 applies a probability density function known as "triangular distribution" to the values entered. At minimum, three values are calculated to estimate the underlying range around each cost and benefit.

Flexibility

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

Appendix B: Glossary

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

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

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

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

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

A Note On Cash Flow Tables

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

Table [Example]

Example Table

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

Source: Forrester Research, Inc.

Appendix C: 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 on Risk, please refer to Appendix A.