The Total Economic Impact™ Of IBM Automation For Application Management

Cost Savings And Business Benefits Enabled By IBM Automation

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Table Of Contents

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ABOUT FORRESTER CONSULTING

Forrester Consulting provides independent and objective research-based consulting to help leaders succeed in their organizations. Ranging in scope from a short strategy session to custom projects, Forrester's Consulting services connect you directly with research analysts who apply expert insight to your specific business challenges. For more information, visit forrester.com/consulting.

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Key Benefits

Reduction in service desk tickets:
70% fewer tier 1 tickets

Improved capital efficiency:
10% of IT support budget shifted to proactive work

Improved system availability:
80% reduction in system recovery time and costs

Executive Summary

IBM provides a set of automation solutions using artificial intelligence and robotic automation solutions that helps customers reduce costs and improve the application maintenance function within IT organizations. IBM commissioned Forrester Consulting to conduct a Total Economic Impact™ (TEI) study and examine the potential return on investment (ROI) enterprises may realize by deploying IBM Automation to automate tasks associated with application maintenance and monitoring. This study provides readers a framework to evaluate the potential financial impact of IBM Automation on their organizations.

To better understand the benefits, costs, and risks associated with this investment, Forrester interviewed several customers with experience using IBM Automation to enhance a larger IBM Services application management engagement. While IBM Automation, spans business and IT operations, this study focuses on the application management. IBM Automation provides tools that include Automated Service Requests, Self-Healing, Agent Assist, as well as Cognitive Service Analytics that automate basic application management and monitoring functions.

Prior to using IBM Automation, the customers relied on manual processes for the monitoring and management enterprise applications. However, as the size of the environments grew with the growth of organizations, so did the complexity of the application environment and the costs of managing and maintaining that environment. As a result, it took longer to respond to changes and events within the environment because a greater number of individuals would have to be involved to identify and fix an issue. This resulted in productivity impacts to both the IT and line-of-business organizations.

With IBM Automation, the clients Forrester interviewed leverage robotic automation and artificial intelligence technology to automate common support queries, monitoring tasks, and maintenance tasks to significantly reduce manual effort, by support teams, and improve user experience. Early incident alerting reduces remediation time and cost, increasing system availability. The overall result is improved efficiency in application management, higher uptime, and the ability to shift staff from reactive to proactive functions.

Key Findings

Quantified benefits. The following risk-adjusted quantified benefits are representative of those experienced by the companies interviewed:

› **Seventy percent reduction in service desk tickets by year 3.** Interviewees use cognitive technology and robotic automation to automate: responses to common user queries; preventative maintenance; application self-healing; and the reduction process of service desk tickets that get created.

› **Re allocation of support staff: Ten percent of IT support budget spend on Application Development and Management (ADM) shifted from reactive maintenance to proactive development work by year 3.** By automating repetitive manual tasks, support teams shift resources away from reactive problem resolution and towards proactive, innovative work.

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**ROI
64%**

**Benefits PV
$3 million**

**NPV
$1.2 million**

**Payback
15 months**

"I had a question that I couldn't find the answer to. One of our engineers couldn't find it either. We put in three hours of effort looking through the artifacts to try to find the answer. So, I asked Watson my question, and in five minutes the answer was on the screen. It recognized that the question that was asked didn't have a procedure. It searched our entire sub-documentation and found that the answer wasn't in the core design. It was in a related alternate design. It identified it within the 2,000-plus design artifacts we have. So that's about two hours and 55 minutes of time that I didn't have to spend."

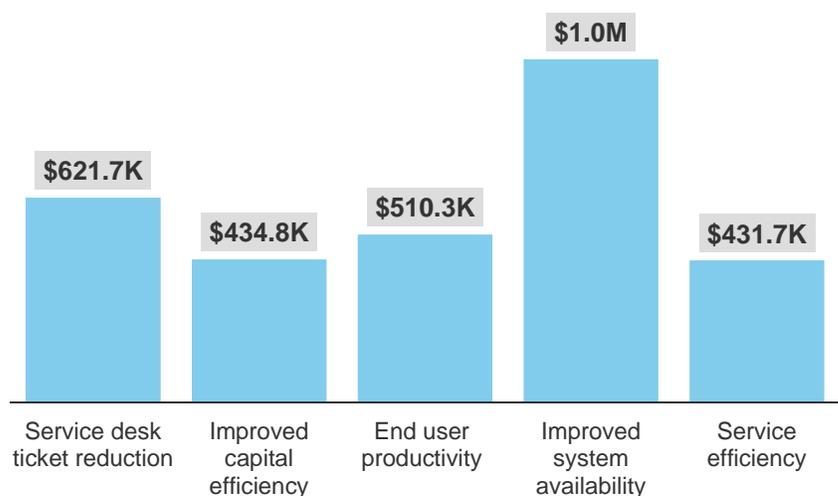*Senior manager application development, healthcare*

› **Improved user experience through automated self-service query responses and improved application availability.** End users spend less time submitting service desk tickets and waiting for query resolution with automated self-service responses. Improved system availability further reduces time spent on service desk support.

› **Improved system availability, including an 80% reduction in recovery costs for major incidents by year 3.** Interviewees automate monitoring, alerting, and maintenance tasks, to leverage self-healing capabilities and provide early detection of incidents, allowing for faster and more cost-effective remediation.

› **Reduction in overall IBM Services contract costs.** The use of automation reduces labor costs, providing contract savings.

Costs. The interviewed organizations experienced the following risk-adjusted costs:

› **Incremental software and hardware costs.** Organizations make incremental software investments based on the number of robots and scope of the artificial intelligence deployed in both the production and development environments. Additional hardware is needed to support the investment.

› **Change management costs.** Interviewees require professional services spend and training to identify and deploy automation use cases and to teach users how to leverage automation.

› **Incremental administration time.** Additional administration time is needed to manage the IBM Services contract.

Forrester's interviews with four existing customers and subsequent financial analysis found that a composite organization based on these interviewed organizations experienced benefits of $3 million over three years versus costs of $1.8 million, adding up to a net present value (NPV) of $1.2 million and an ROI of 64%.

Benefits (Three-Year)

Service desk ticket reduction	Improved capital efficiency	End user productivity	Improved system availability	Service efficiency
$621.7K	$434.8K	$510.3K	$1.0M	$431.7K

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TEI Framework And Methodology

From the information provided in the interviews, Forrester has constructed a Total Economic Impact™ (TEI) framework for those organizations considering implementing IBM Automation.

The objective of the framework is to identify the cost, benefit, flexibility, and risk factors that affect the investment decision. Forrester took a multistep approach to evaluate the impact that IBM Automation can have on an organization:

DUE DILIGENCE
Interviewed IBM stakeholders and Forrester analysts to gather data relative to IBM Automation.

CUSTOMER INTERVIEWS
Interviewed four organizations using IBM Automation to obtain data with respect to costs, benefits, and risks.

COMPOSITE ORGANIZATION
Designed a composite organization based on characteristics of the interviewed organizations.

FINANCIAL MODEL FRAMEWORK
Constructed a financial model representative of the interviews using the TEI methodology and risk-adjusted the financial model based on issues and concerns of the interviewed organizations.

CASE STUDY
Employed four fundamental elements of TEI in modeling IBM Automation's impact: 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.

The TEI methodology helps companies demonstrate, justify, and realize the tangible value of IT initiatives to both senior management and other key business stakeholders.

DISCLOSURES

Readers should be aware of the following:

This study is commissioned by IBM and delivered by Forrester Consulting. It is not meant to be used as a competitive analysis.

Forrester makes no assumptions as to the potential ROI that other organizations will receive. Forrester strongly advises that readers use their own estimates within the framework provided in the report to determine the appropriateness of an investment in IBM Automation — specific to application management scope only.

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.

IBM provided the customer names for the interviews but did not participate in the interviews.

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The IBM Automation Customer Journey

BEFORE AND AFTER THE IBM AUTOMATION INVESTMENT

Interviewed Organizations

For this study, Forrester conducted four interviews with IBM Automation customers. Interviewed customers include the following:

INDUSTRY	REGION	INTERVIEWEE	USE OF AUTOMATION
Telecommunications	Europe	Director of enterprise applications	1 year
Food and beverage	Europe	Manager, application support	1 year
Healthcare	North America	Senior manager application development	5 years
Manufacturing	Europe	Director, infrastructure support	2 years

Key Challenges

Interviewed organizations identified the following key challenges prior to the IBM Automation investment:

› **Support teams were highly dependent on manual processes to manage tickets and monitor the environment.** Several interviewees noted the time-consuming, repetitive manual work needed to monitor and maintain systems, create tickets from email requests, and respond to common user queries.

› **Costly manual processes were exacerbated by organizational growth and the increasing complexity of the environment.** Interviewed organizations found that support teams spent more and more time on manual tasks as the environment grew more complex. Time spent on low-value manual work kept support teams in reactive mode, worsening system availability and preventing innovation.

› **Incidents were often not caught until end user tickets were submitted, resulting in greater impact to business-critical services.** End users would have to submit tickets to alert support teams to system incidents, and longer response times to common user queries further affected user productivity. The organizations wanted more proactive management, higher uptime, and a better experience for users.

Key Results

The interviews revealed that key results from the IBM Automation investment include:

› **Robotic automation of manual processes creates efficiencies for support teams and end users.** Interviewees deployed robotic automation to monitor business processes, proactively maintain applications, and alert the support team in the event of an incident requiring human intervention. Support teams also automated responses to user queries to provide a faster, self-service experience and reduce time spent on service desk tickets. Both support staff and end users gain efficiency through automation of repetitive tasks.

> "IBM Automation was one of the winners of our innovation event. Especially because of the potential, not only for cost revision, FTE revision, but also having one single place where we could store and easily access our documentation. That was really the main starting point."
>
> *Manager, application support, food and beverage company*

> "We've done several service improvement initiatives to automate about 1,100 hours of manual labor a month. That's 13,000 hours a year that we get back to use at our discretion. And for us, culturally, we gain momentum by not making it about a workforce reduction. It's really about having folks able to spend their time on more valuable activities and develop new project-based skills."
>
> *Senior manager application development, healthcare*

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> **Interviewees leverage automation to shift from reactive to proactive work.** By spending less time on manual monitoring, remediation, and service desk tickets, support teams can spend more time on proactive work, like skills development, new projects, or innovation initiatives, thereby delivering more value to the organization.

> **Robotic automation improves application availability, providing an improved user experience.** Interviewed organizations use application self-healing to automatically remediate incidents, and they use early alerting on high priority incidents to enable faster remediation. The result is improved system availability, reducing the impact of incidents on end users.

> **IBM Automation reduces overall labor costs in the IBM Services contract.** By automating manual tasks, interviewees can reduce labor costs in their existing IBM Services contract.

Composite Organization

Based on the interviews, Forrester constructed a TEI framework, a composite company, and an associated ROI analysis that illustrates the areas financially affected. The composite organization is representative of the four companies that Forrester interviewed and is used to present the aggregate financial analysis in the next section. The composite organization that Forrester synthesized from the customer interviews has the following characteristics:

Description of composite. The composite is a global organization with $19 billion in annual revenue and 16,000 employees across five regions. The organization uses IBM Services to primarily support a large SAP-driven enterprise resource planning system (ERP) environment with three instances globally.

Deployment characteristics. The composite organization added IBM Automation to its existing IBM Services contract to improve help desk efficiency, capital availability, and overall support contract costs. Following implementation, the organization identified and prioritized common user queries, repetitive manual monitoring, and maintenance tasks. The organization curated questions and answers, design artifacts, and incidents to power the cognitive learning capability that directs automated actions. The organization continued to curate new information and deploy new robotic automation use cases over the three-year period.

> "With IBM Automation, we've really focused on making the work for the global team more interesting and having more time for strategic work instead of all the questions that are being asked repeatedly."
>
> *Manager, application support, food and beverage company*

Key assumptions
$19 billion annual revenue

16,000 employees

Primary automation use cases for SAP

18 robots deployed in production and development environments

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Financial Analysis

QUANTIFIED BENEFIT AND COST DATA AS APPLIED TO THE COMPOSITE

Total Benefits

REF.	BENEFIT	YEAR 1	YEAR 2	YEAR 3	TOTAL	PRESENT VALUE
Atr	Service desk ticket reduction	$153,900	$256,500	$359,100	$769,500	$621,690
Btr	Improved capital efficiency	$121,838	$170,573	$243,675	$536,085	$434,807
Ctr	End user productivity	$205,200	$205,200	$205,200	$615,600	$510,302
Dtr	Improved system availability	$228,000	$456,000	$608,000	$1,292,000	$1,040,932
Etr	Service efficiency	$107,196	$160,794	$267,990	$535,979	$431,683
	Total benefits (risk-adjusted)	$816,133	$1,249,066	$1,683,965	$3,749,164	$3,039,413

Service Desk Ticket Reduction

Interviewees experienced benefits due to a reduction in service desk tickets, including:

› Interviewees had an internal group responsible for monitoring application infrastructure and resolving tickets placed by line-of-business users.

› Prior to IBM Automation, this group had low visibility into system health and often would not become aware of problems until alerted by an end user. The group spent significant time manually monitoring and resolving incidents. The group also continuously responded to common user queries, with one organization noting that turnover in line-of-business users kept these queries arriving at a standard pace. With limited staff the group could develop into a bottleneck situation.

› With IBM Automation, organizations automate responses to common user queries and set up automatic monitoring and alerting on system health to reduce manual monitoring tasks. Further, IBM Automation is used to enable application self-healing to automate remediation and further reduce service desk tickets through improved preventative maintenance.

For the composite organization, Forrester assumes:

› The composite organization had an average of 2,250 tier 1 service desk tickets per month prior to the investment.

› Tier 1 tickets cost on average $20 to resolve.

› With IBM Automation, the organization reduces the number of tickets by 70% in year 3. Ticket reduction increases as more use cases are automated and the self-learning function of Watson identifies more questions and provides accurate responses.

Potential risks that can impact this benefit include:

The table above shows the total of all benefits across the areas listed below, as well as present values (PVs) discounted at 10%. Over three years, the composite organization expects risk-adjusted total benefits to be a PV of more than $3 million.

$621,690

three-year benefit PV
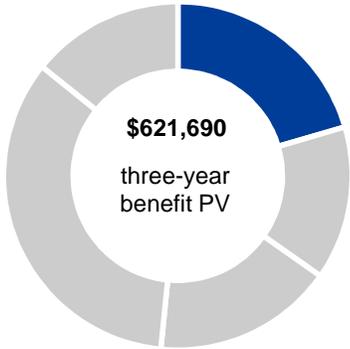
Service desk ticket reduction: **21%** of total benefits

Impact risk is the risk that the business or technology needs of the organization may not be met by the investment, resulting in lower overall total benefits. The greater the uncertainty, the wider the potential range of outcomes for benefit estimates.

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- The extent to which support teams identify common user queries, identify preventative maintenance tasks, and integrate systems to automate remediation will affect the ability to achieve service desk ticket reductions.
- User and support team adoption of automation will affect the pace and magnitude of savings.
- Costs to resolve tier 1 support tickets can vary by organization.

To account for these risks, Forrester adjusted this benefit downward by 5%, yielding a three-year risk-adjusted total PV of $622,000.

REF.	METRIC	CALC.	YEAR 1	YEAR 2	YEAR 3
Service Desk Ticket Reduction: Calculation Table					
A1	Total number of tier 1 tickets (monthly)		2,250	2,250	2,250
A2	Cost per ticket		$20	$20	$20
A3	Estimated reduction in tickets		30%	50%	70%
At	Service desk ticket reduction	A1*A2*A3*12	$162,000	$270,000	$378,000
	Risk adjustment	5%			
Atr	Service desk ticket reduction (risk-adjusted)		$153,900	$256,500	$359,100

Improved Capital Efficiency

Interviewees experienced benefits due to improved capital efficiency, including:

- Reduction in manual monitoring, recovery, and support ticket creation and response, frees up significant full-time equivalent (FTE) time for additional work.
- Several interviewees expressed a desire or ability to redirect saved FTE time to more complex, higher-value, and strategic activities, including skills development, innovation, and new project initiatives.
- The ability to shift resources to proactive, innovative work provides a higher return on resource spend and generates greater value for the organization.

For the composite organization, Forrester assumes:

- Prior to the investment, the composite spends on average $17.1 million annually on IT support.
- Fifteen percent of the IT support budget is spent on application maintenance and support.
- The composite shifts up to 10% of this spend from reactive support to proactive and strategic work by year 3.

Potential risks that can impact this benefit include:

- Support team adoption of automation for repetitive tasks and preventative maintenance will affect FTE savings on reactive work.
- The budget spend allocated to reactive versus proactive work will vary by organization and will determine the opportunity available to increase proactive spend.

$434,807

three-year benefit PV
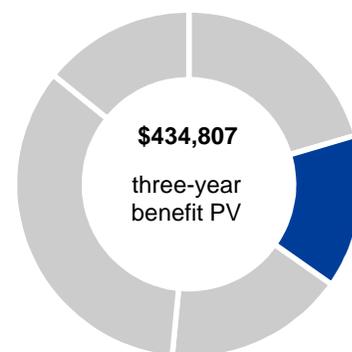
Improved capital efficiency: **14%** of total benefits

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> The success of initiatives to capture savings and reallocate FTEs to proactive or innovative work will determine the extent of capital efficiency improvements. Initiatives could include cross-training or skills development support.

To account for these risks, Forrester adjusted this benefit downward by 5%, yielding a three-year risk-adjusted total PV of $435,000.

REF.	METRIC	CALC.	YEAR 1	YEAR 2	YEAR 3
Improved Capital Efficiency: Calculation Table					
B1	Current IT support budget		$17,100,000	$17,100,000	$17,100,000
B2	Percent of budget spent on administrative process		15%	15%	15%
B3	Amount repurposed from reactive to proactive spend		5%	7%	10%
Bt	Improved capital efficiency	B1*B2*B3	$128,250	$179,550	$256,500
	Risk adjustment	5%			
Btr	Improved capital efficiency (risk-adjusted)		$121,838	$170,573	$243,675

End User Productivity

Interviewees experienced benefits due to improved end user productivity, including:

> Support teams create a self-service experience for end users through automation of common queries with IBM Automation. This allows end users to submit requests and quickly receive support without having to submit a ticket or call the help desk.

> Improved system availability due to IBM Automation also improves end user productivity by further reducing the time spent submitting a support ticket and resolving system problems.

For the composite organization, Forrester assumes:

> The organization has approximately 4,500 line-of-business end users that spend, on average, 2% of their time on IT support requests related to their ERP environment.

> With IBM Automation, line-of-business users experience a 5% average reduction in time spent on support requests.

> Forrester conservatively assumes that 30% of this saved time is captured and converted into additional productivity.

> To capture the value of this additional productivity time, Forrester assumes an average annual fully-loaded compensation of $160,000 for end users.

Potential risks that can impact this benefit include:

> User adoption of automation will impact the magnitude of this benefit.

> Support team prioritization and automation of common user requests will determine the magnitude of this benefit.

$510,302

three-year benefit PV
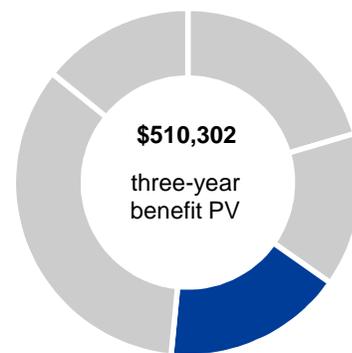
End user productivity: **17%** of total benefits

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> Time saved may not be fully captured for additional productivity work (this has been accounted for by the adjustment to 30% referred to above [or words to that effect…]).

To account for these risks, Forrester adjusted this benefit downward by 5%, yielding a three-year risk-adjusted total PV of $510,000.

REF.	METRIC	CALC.	YEAR 1	YEAR 2	YEAR 3
End User Productivity: Calculation Table					
C1	Number of line-of-business users		4,500	4,500	4,500
C2	Percent of time dealing with IT support requests		2%	2%	2%
C3	Improved efficiency with IBM Automation		5%	5%	5%
C4	Productivity recovered		30%	30%	30%
C5	Average annual cost per user		$160,000	$160,000	$160,000
Ct	End user productivity	C1*C2*C3*C4*C5	$216,000	$216,000	$216,000
	Risk adjustment	5%			
Ctr	End user productivity (risk-adjusted)		$205,200	$205,200	$205,200

Improved System Availability

Interviewees experienced benefits due to improved system availability, including:

> Prior to using IBM Automation, monitoring of system health was primarily manual and incidents often wouldn't be noticed until they impacted services. Late incident detection can result in more costly remediation.

> With IBM Automation organizations: automate preventative monitoring and maintenance tasks; enable application self-healing to resolve common problems before they escalate: and automate alerting to provide early detection of more critical issues for faster remediation.

For the composite organization, Forrester assumes:

> An average of four high priority incidents take place per year.

> High priority incidents take on average 2 hours and $200,000 to resolve.

> With IBM Automation, the organization sees an up to 80% reduction in the cost to resolve an incident by year 3.

Potential risks that can impact this benefit include:

> The length and cost of remediation is variable from organization to organization and for differing incidents.

> The extent of the use of automated preventative maintenance, application self-healing, and automated monitoring and alerting will impact the speed of response and amount of human involvement needed to remediate incidents.

To account for these risks, Forrester adjusted this benefit downward by 5%, yielding a three-year risk-adjusted total PV of $1 million.

$1.0 million

three-year benefit PV
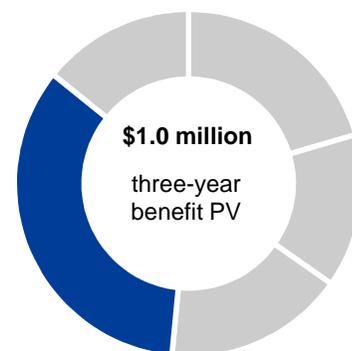
Improved system availability: **34%** of total benefits

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Improved System Availability: Calculation Table					
REF.	METRIC	CALC.	YEAR 1	YEAR 2	YEAR 3
D1	Number of high priority incidents		4	4	4
D2	Cost of recovery per incident		$200,000	$200,000	$200,000
D3	Reduction in cost of recovery		30%	60%	80%
Dt	Improved system availability	D1*D2*D3	$240,000	$480,000	$640,000
	Risk adjustment	5%			
Dtr	Improved system availability (risk-adjusted)		$228,000	$456,000	$608,000

Service Efficiency

Interviewees experienced benefits due to service efficiency, including:

› Reducing labor costs with automation of repetitive tasks decreases overall IBM Services contract costs.

For the composite organization, Forrester assumes:

› The table below shows the IBM Services contract costs before and after the IBM Automation investment.

› With IBM Automation, the composite reduces total costs by almost 5% through reduced labor requirements.

Potential risks that can impact this benefit include:

› Contract costs are variable from organization to organization based on the scope of services, vendor discounts, and other factors.

› The ability to deploy additional automation use cases will affect the reduction in labor costs as part of the contract.

To account for these risks, Forrester adjusted this benefit downward by 5%, yielding a three-year risk-adjusted total PV of $432,000.

$431,683

three-year benefit PV
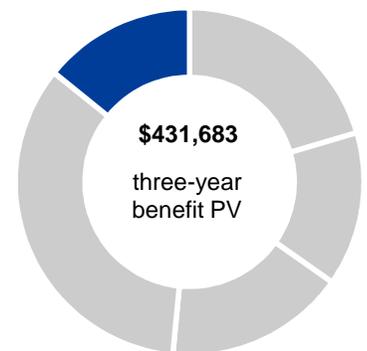
Service efficiency: **14%** of total benefits

Service Efficiency: Calculation Table					
REF.	METRIC	CALC.	YEAR 1	YEAR 2	YEAR 3
E1	TCV without automation		$2,496,878	$3,745,316	$6,242,194
E2	TCV with automation		$2,384,040	$3,576,060	$5,960,100
Et	Service efficiency	E1-E2	$112,838	$169,257	$282,094
	Risk adjustment	5%			
Etr	Service efficiency (risk-adjusted)		$107,196	$160,794	$267,990

Flexibility

The value of flexibility is clearly unique to each customer, and the measure of its value varies from organization to organization. There are multiple scenarios in which a customer might choose to implement IBM

Automation and later realize additional uses and business opportunities, including:

› **Extending the use of IBM Automation to additional domains.** One interviewee described an environment of several document or knowledge repositories, and a desire to not let IBM Automation become an additional silo. The interviewee wants to extend IBM Automation into all domains to create one access point for end users and to enhance the benefits of automation for the organization.

Flexibility would also be quantified when evaluated as part of a specific project (described in more detail in Appendix A).

> Flexibility, as defined by TEI, represents an investment in additional capacity or capability that could be turned into business benefit for a 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.

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Total Costs

| REF.	COST	YEAR 1	YEAR 2	YEAR 3	TOTAL	PRESENT VALUE
Ftr	Software, production cost	$138,600	$207,900	$249,480	$595,980	$485,256
Gtr	Software, development/user acceptance testing	$98,280	$147,420	$176,904	$422,604	$344,091
Htr	Professional services	$367,500	$110,250	$110,250	$588,000	$508,039
Itr	Training	$105,000	$26,250	$26,250	$157,500	$136,871
Jtr	Hardware	$210,000	$42,000	$42,000	$294,000	$257,175
Ktr	Administration	$56,700	$50,400	$40,320	$147,420	$123,491
	Total costs (risk-adjusted)	$976,080	$584,220	$645,204	$2,205,504	$1,854,923

Total Investment Cost

Total costs of the automation solution were bundled into the overall IBM Services contract. These costs included the costs of software, professional services and training, and the necessary hardware, as well as administration of the automation solution.

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Financial Summary

CONSOLIDATED THREE-YEAR RISK-ADJUSTED METRICS

Cash Flow Chart (Risk-Adjusted)

- Total costs
- Total benefits
- Cumulative net benefits
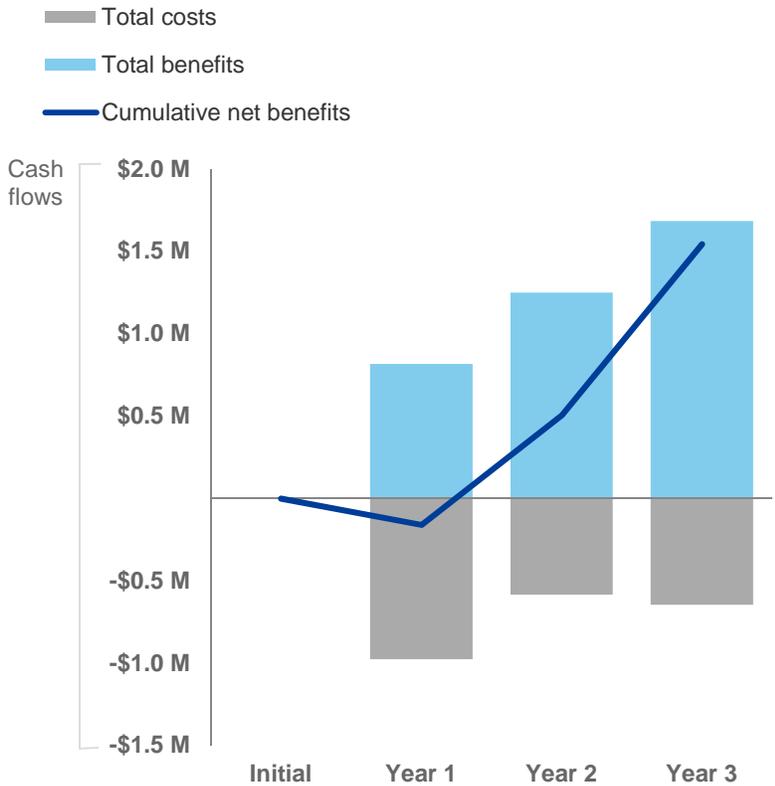
The financial results calculated in the Benefits and Costs sections can be used to determine the ROI, NPV, and payback period for the composite organization's investment. Forrester assumes a yearly discount rate of 10% for this analysis.

These risk-adjusted ROI, NPV, and payback period values are determined by applying risk-adjustment factors to the unadjusted results in each Benefit and Cost section.

Cash Flow Table (Risk-Adjusted)

	YEAR 1	YEAR 2	YEAR 3	TOTAL	PRESENT VALUE
Total costs	($976,080)	($584,220)	($645,204)	($2,205,504)	($1,854,923)
Total benefits	$816,133	$1,249,066	$1,683,965	$3,749,164	$3,039,413
Net benefits	($159,947)	$664,846	$1,038,761	$1,543,660	$1,184,490
ROI					64%
Payback period					15 months

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IBM Automation: Overview

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

Automation, monitoring and cognitive decision making come together within IBM Automation for Application Management to lift the burden of repetitive tasks from skilled IT staff. It enables organizations to identify and fix problems before they affect users, and it also provides meaningful, context-rich insights to help organizations spend more time on innovation. IBM automation services result in lower cost, higher quality, better consistency, and improved process performance.

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Appendix A: Total Economic Impact

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.

Total Economic Impact Approach

Benefits represent the value delivered to the business by the product. The TEI methodology places 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.

Costs consider all expenses necessary to deliver the proposed value, or benefits, of the product. The cost category within TEI captures incremental costs over the existing environment for ongoing costs associated with the solution.

Flexibility represents the strategic value that can be obtained for some future additional investment building on top of the initial investment already made. Having the ability to capture that benefit has a PV that can be estimated.

Risks measure the uncertainty of benefit and cost estimates given: 1) the likelihood that estimates will meet original projections and 2) the likelihood that estimates will be tracked over time. TEI risk factors are based on "triangular distribution."

The initial investment column contains costs incurred at "time 0" or at the beginning of Year 1 that are not discounted. All other cash flows are discounted using the discount rate at the end of the year. PV calculations are calculated for each total cost and benefit estimate. NPV calculations in 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.

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.

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.

RETURN ON INVESTMENT (ROI)

A project's expected return in percentage terms. ROI is calculated by dividing net benefits (benefits less costs) by costs.

DISCOUNT RATE

The interest rate used in cash flow analysis to take into account the time value of money. Organizations typically use discount rates between 8% and 16%.

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.

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