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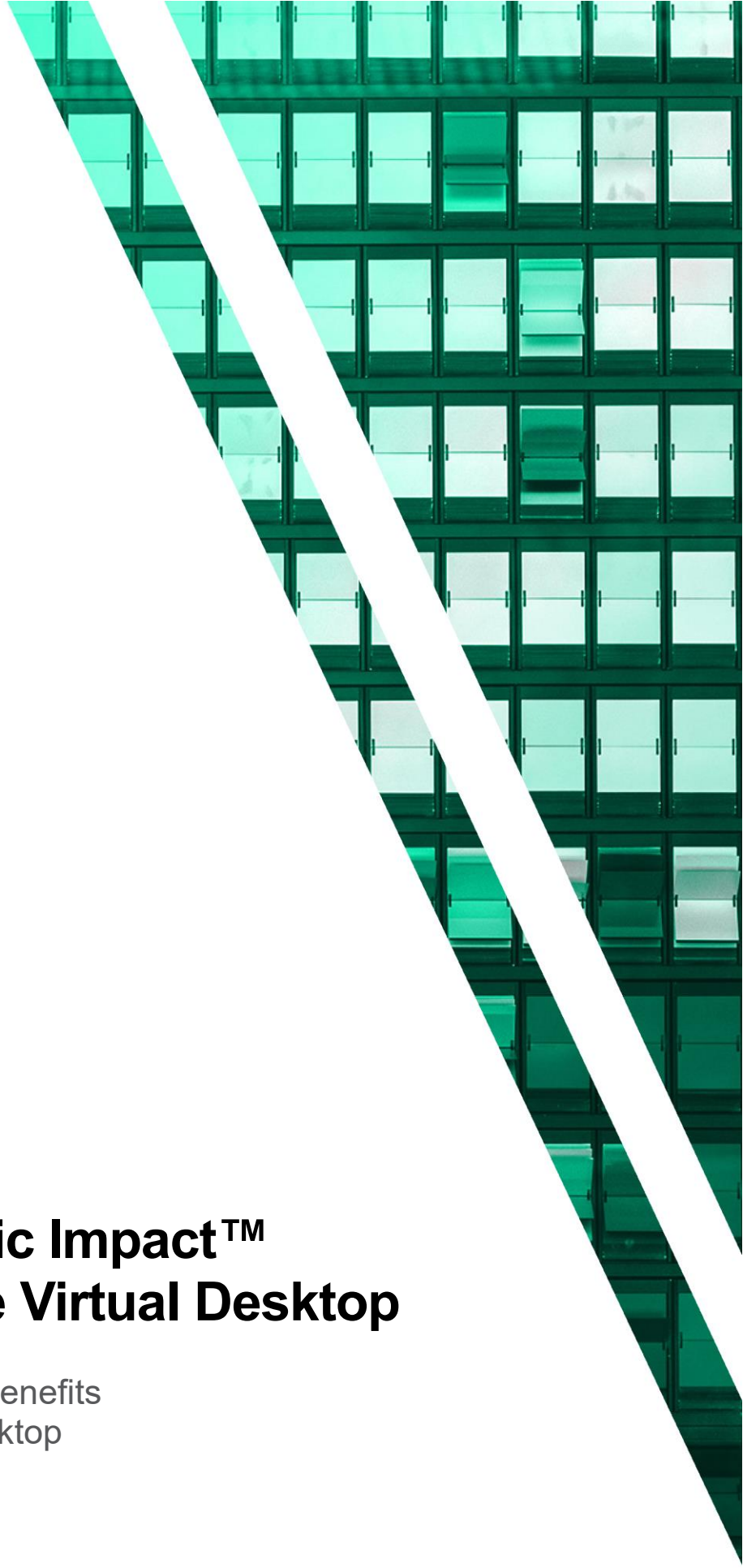

The Total Economic Impact™ Of Microsoft Azure Virtual Desktop

Cost Savings And Business Benefits Enabled By Azure Virtual Desktop

JANUARY 2021

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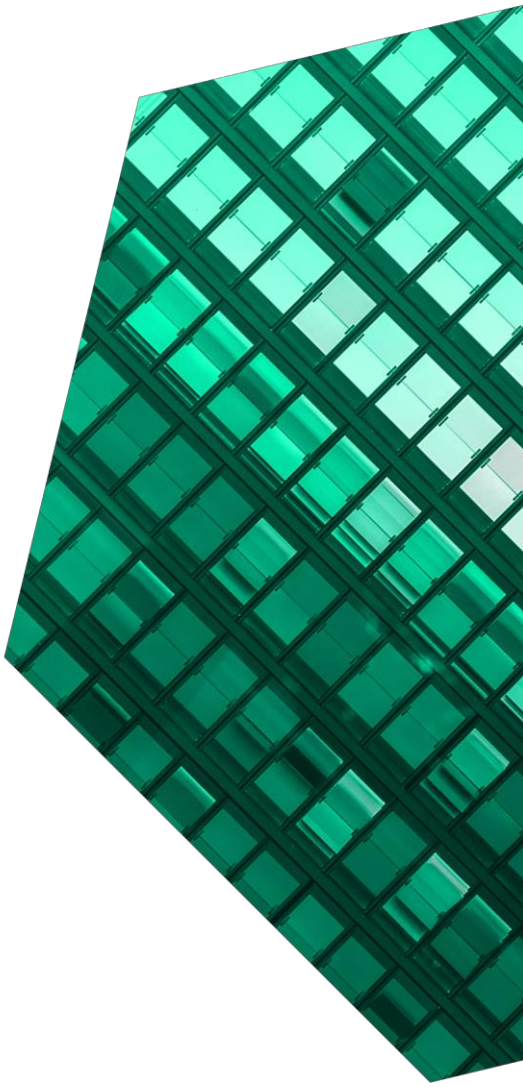


Executive Summary

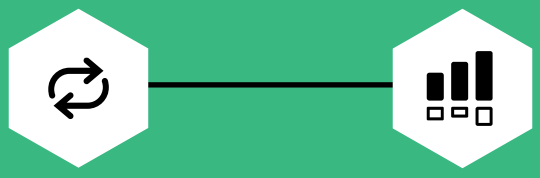
As work continues to move outside of traditional offices, firms are looking for infrastructure solutions that provide employees secure access to remote desktops, files, and applications from anywhere at lower cost than legacy solutions. Companies that migrated from Microsoft's on-premises Remote Desktop Services to cloud-based Azure Virtual Desktop have experienced time savings to IT, virtual desktop-related infrastructure cost savings, and improved productivity for both employee end users and IT professionals.

Azure Virtual Desktop is a cloud-based virtual desktop solution offered free of licensing costs to businesses running Microsoft 365. It allows employees to access company desktops, files and applications securely through the cloud, without requiring customers to invest in an on-premises estate. It supports the latest compute offerings from Azure such as the second-generation Intel Xeon Scalable processors for improved latency and larger, high-speed local storage for multi-session deployments.

Microsoft and Intel commissioned Forrester Consulting to conduct a Total Economic Impact™ (TEI) study and examine the potential return on investment (ROI) enterprises may realize by deploying Azure Virtual Desktop. The purpose of this study is to provide readers with a framework to evaluate the potential financial impact of Azure Virtual Desktop on their organizations.

According to a Forrester survey conducted on behalf of Microsoft to identify the challenges and opportunities of desktop virtualization, business and IT decision-makers expect virtualized desktop use to grow 30% from 47% of employees working in a virtual desktop environment today to 61% five years from now. Forty-two percent of survey respondents shared that the COVID-19 pandemic catalyzed their interest or implementation of virtual desktop solutions. Cloud-based VDI was the most popular deployment model among respondents (60%), and the top benefits associated with VDI included better IT management, better security, and flexible remote access and remote work.[1]

KEY STATISTICS



Return on investment (ROI)
210%

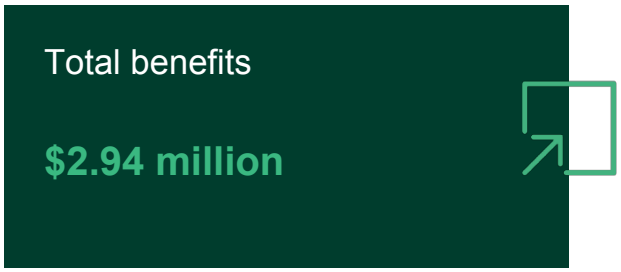
Net present value (NPV)
$1.89M

To better understand the benefits, costs, and risks associated with this investment, Forrester interviewed four customers with experience using Azure Virtual Desktop. For the purposes of this study, Forrester aggregated the experiences of the interviewed customers and combined the results into a single composite organization.

Prior to using Azure Virtual Desktop, the customers interviewed for this study all ran Microsoft Remote Desktop Services, mostly on-premises. This required investment into on-premises support infrastructure and inflated the workload of IT departments that needed to service this infrastructure. Additionally, regular IT workloads such as application and operating system (OS) maintenance or less frequent security response related to on-premises VDI proved time-consuming. End users of the VDI solution frequently experienced issues related to connectivity,

latency, and the VDI interface, impacting their productivity and overall user experience.

After the investment in Azure Virtual Desktop, the customers reduced their VDI-related infrastructure costs but also reduced other costs, such as spending on employer-owned PCs. IT department efficiency related to both regular workstreams and less frequent security responses improved. Additionally, customers reduced connectivity, latency, and interface issues for VDI end users with Azure Virtual Desktop, leading to improved employee productivity. This last benefit stands out as overall latency in the user experience was the second-most cited challenge of VDI for survey respondents and the most cited concern of end users.



KEY FINDINGS

Quantified benefits. Risk-adjusted present value (PV) quantified benefits include:

- **Reduced cost of VDI licensing and related IT infrastructure of 34%.** By migrating from VDI running on-premises to cloud-based Azure Virtual Desktop, customers reduced their prior VDI licensing and IT infrastructure costs by up to 34% annually. Customers eliminated RDS-associated costs, including licensing, on-premises servers and maintenance fees, and network and power costs. Additionally, customers could stop buying employer-owned PCs for 25% of Azure Virtual Desktop end users who instead used their own personal devices.
- **Cost savings of 59% on IT deployment and maintenance expenses.** The ease of working over a cloud-based VDI solution compared to on-premises solutions reduced IT workloads by a total of 59% annually. Savings resulted from reductions in:
    - Application and software deployment and maintenance and support (28% reduction).
    - Help desk management reduced (28% reduction).
    - Security access and patch management (78% reduction).
    - OS deployment and maintenance (78% reduction).
- **Increased productivity of 22 person-hours per Azure Virtual Desktop end user from improved connectivity, onboarding, and security response.** Because of the improvements to connectivity and security response achieved by migrating from RDS to Azure Virtual Desktop, customers improved the productivity of Azure Virtual Desktop end users by 22 person-hours per user annually. At a deployment with 1,200 monthly active users, companies would add back 26,512 person-hours of productivity annually. Of this additional productivity, security response occurred 96% faster with Azure Virtual Desktop, adding in 23 productive work hours per effected employee per incident.

Unquantified benefits. Benefits that are not quantified for this study include:

- **Improved user experience.** Azure Virtual Desktop matches more closely the local desktop experience than RDS. Because of this, customers reported improved user experience among Azure Virtual Desktop end users compared to their RDS environments.
- **Improved scalability and organizational resiliency.** Customers attributed to Azure Virtual Desktop the added benefit of scalability, which in

turn improved their productivity and response to crisis situations, such as the COVID-19 pandemic. Customers reported being more prepared for the shift to a work-from-home environment as well as the ability to scale and continue to provision services despite unexpected disruptions.

Costs. Risk-adjusted PV costs include:

- **Costs of Azure Virtual Desktop compute, storage, and networking.** Customers reported no licensing costs associated with Azure Virtual Desktop, as they were all already Microsoft 365 subscribers. Customers did incur Azure compute, storage, and networking costs associated with Azure Virtual Desktop.
- **Cost of migration.** For the modeled composite organization, representative of interviewees' experiences, migration requires a team of four FTEs to spend 50% of their time over a period of two months to deploy Azure Virtual Desktop.

  Cost of ongoing management. Ongoing management of Azure Virtual Desktop at the composite organization requires two FTEs at 20% of their time annually, with five FTEs spending 2% of their time annually supporting and troubleshooting the solution.

The customer interviews and financial analysis found that a composite organization experiences benefits of $2.78M over three years versus costs of $896,876, adding up to a net present value (NPV) of $1.89M and an ROI of 210%.

> **"It changed the way we deliver IT services by offering greater flexibility. We expanded remote users from 200 to 5,000 overnight during COVID-19."**
>
> — CIO, government

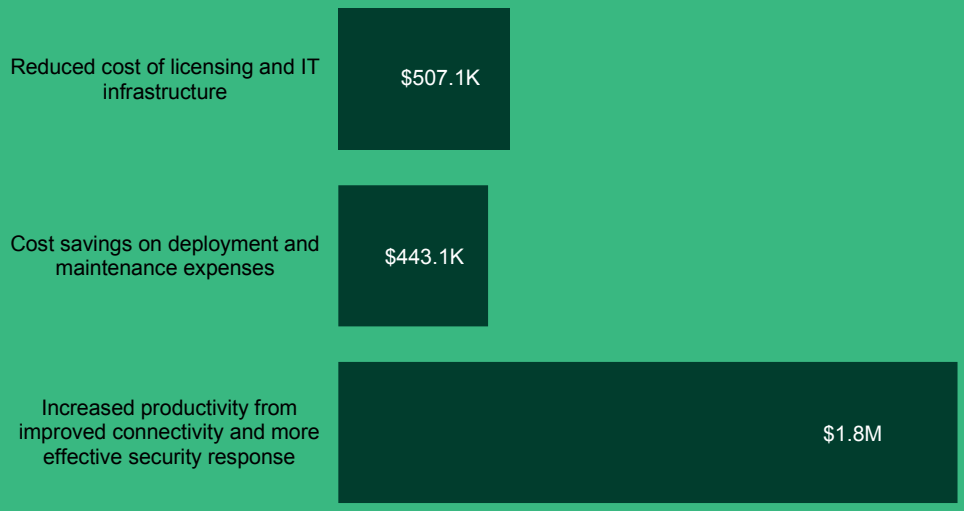
ROI
210%

BENEFITS PV
$2.78M

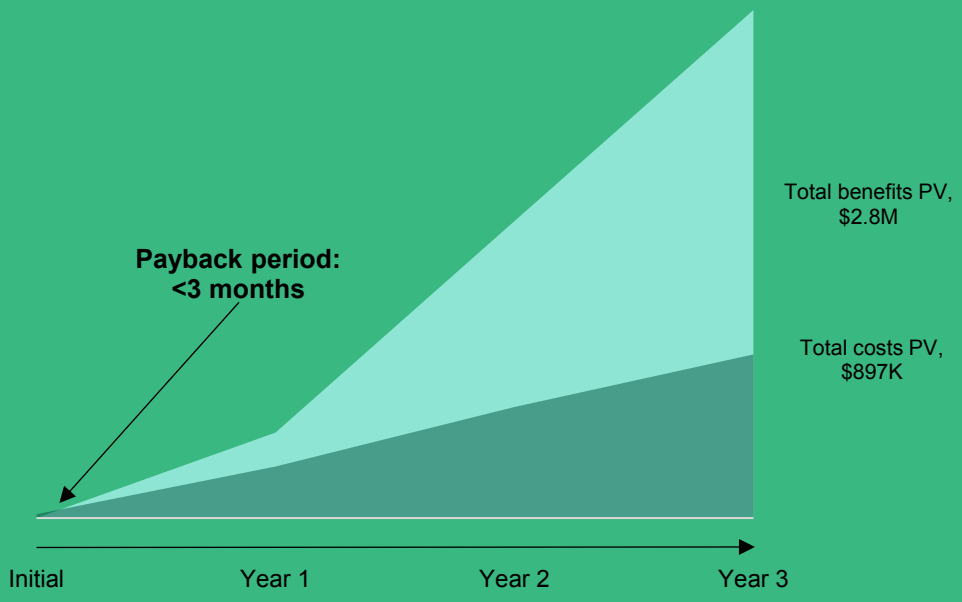
NPV
$1.89M

PAYBACK
< 3 months

Benefits (Three-Year)



Financial Summary



TEI FRAMEWORK AND METHODOLOGY

From the information provided in the interviews, Forrester constructed a Total Economic Impact™ framework for those organizations considering an investment in Azure Virtual Desktop.

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 Azure Virtual Desktop can have on an organization.

DUE DILIGENCE

Interviewed Microsoft stakeholders and Forrester analysts to gather data relative to Azure Virtual Desktop.

CUSTOMER INTERVIEWS

Interviewed four decision-makers at organizations using Azure Virtual Desktop 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 the investment impact: benefits, costs, flexibility, and risks. Given the increasing sophistication of ROI analyses related to IT investments, Forrester's TEI methodology provides a complete picture of the total economic impact of purchase decisions. Please see Appendix A for additional information on the TEI methodology.

The Microsoft Azure Virtual Desktop Customer Journey

Drivers leading to the Azure Virtual Desktop investment

Interviewed Organizations

Industry	Region	Interviewees	Total users; Total FTEs
Food and agriculture	North America	Director of IT Cloud architect	170 users; 400 FTEs
Food and agriculture	EMEA	IT architect	600 users; 3,500 FTEs
Consumer products	EMEA	Global service owner, modern client technologies	1,500 users; 20,000 FTEs
Government	EMEA	CIO IT infrastructure manager	4,000 users; 20,000 FTEs

KEY CHALLENGES

Before investing in Azure Virtual Desktop, customers ran Remote Desktop Services (RDS), with three customers running RDS on-premises and one customer running RDS in the cloud.

The interviewed organizations struggled with common challenges, including:

- **Limitations and expense of running RDS on-premises.** Relative to running Azure Virtual Desktop in the cloud, customers reported experiencing limited functionality and high expenses associated with running RDS on their on-premises infrastructures. With RDS, the onus is on the customer to maintain and update the on-premises VDI. This created certain limitations: Because the operating systems and hardware running RDS were outdated and at their "end of life," interviewees described not being able to offer the breadth of applications their organizations would have liked. Instead, decision-makers like the IT infrastructure manager from the government sector were restricted to running "traditional, legacy, thick-client applications."

  Additionally, running RDS on-premises proved difficult to scale as customers needed to invest in additional servers to expand RDS use. This in turn led to customers overinvesting in servers when the required scale of RDS proved difficult to predict. Lastly, running RDS on-premises incurred additional costs associated with disaster recovery, with the government customer running an entire second infrastructure estate for VDI recovery.

> **"The single biggest challenge for us was protecting against a disaster. Running RDS on-premises required us to duplicate infrastructure for DR [disaster recovery], so we had to buy everything twice, inflating the price of running the solution."**
>
> *IT infrastructure manager, government*

- **Workstream inefficiencies stemming from poor user experience.** Employees connecting remotely to work applications through RDS experienced latency and connectivity issues that led to loss of productivity, especially when these employees were outside of the region of the central data center. Likewise, service desk team

members working to troubleshoot employee IT issues consistently experienced echo and feedback through Microsoft Teams, as it was unsupported on RDS, creating roadblocks to the successful completion of their work.

"We had employees in Brazil and Australia connecting to RDS through our European infrastructure, which created high latency and in a number of cases delayed payments to vendors."

Global service owner, modern client technologies, consumer products

SOLUTION REQUIREMENTS AND INVESTMENT OBJECTIVES

The interviewed decision-makers searched for a solution that could:

- Allow end users to adapt easily to remote work by providing the same look and feel of working on a device on-premises.
- Allow end users to access business applications and files from anywhere, without regard to device owner or type.
- Provide scalability without the need to further invest in expensive on-premises infrastructure.
- Facilitate the long-term strategy of moving more IT and employee workstreams to the cloud.

COMPOSITE ORGANIZATION

Based on the interviews, Forrester constructed a TEI framework, a composite company, and an 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 has the following characteristics:

Description of composite. The global, multibillion-dollar business-to-business organization employs a total of 11,000 employees, with 1,700 of these needing to access work remotely either part- or full-time. Of these 1,700 total end users, 1,200 are monthly active users. Approximately 50% of these remote workers experience latency and connectivity issues stemming from the current on-premises RDS environment. The organization also uses remote services to connect workers in its production facilities, which each has approximately 100 employees.

Deployment characteristics. The organization has global operations and begins by rolling out Azure Virtual Desktop to 50% of its remote workforce in Year 1. All 1,700 remote workers are equipped with Azure Virtual Desktop by Year 2, when the organization begins realizing the full benefits of Azure Virtual Desktop deployment. Also in Year 2, the organization experiences a security incident in one of its production facilities, risking substantial productivity costs from employee downtime.

Key assumptions

- **11,000 FTEs**
- **1,700 total Azure Virtual Desktop users**
- **1,200 monthly active users**
- **Azure Virtual Desktop is deployed to 50% of end users in Year 1**

Analysis Of Benefits

Quantified benefit data as applied to the composite

Total Benefits						
Ref.	**Benefit**	**Year 1**	**Year 2**	**Year 3**	**Total**	**Present Value**
Atr	Reduced cost of licensing and IT infrastructure	$36,720	$190,944	$420,444	$648,108	$507,073
Btr	Cost savings on deployment and maintenance expenses	$43,956	$255,528	$255,528	$555,012	$443,122
Ctr	Increased productivity from improved connectivity and more effective security response	$435,060	$954,828	$864,000	$2,253,888	$1,833,759
	Total benefits (risk-adjusted)	$515,736	$1,401,300	$1,539,972	$3,457,008	$2,783,954

REDUCED COST OF LICENSING AND IT INFRASTRUCTURE

Evidence and data. Interviewed organizations shared that they could reduce their ongoing cost of infrastructure when transitioning from on-premises RDS to Azure Virtual Desktop-native. Infrastructure savings included:

- The complete decommissioning of their on-premises RDS environments, resulting in the elimination of per-user RDS licensing costs; any compute, storage, and networking costs associated with RDS; and any IT infrastructure costs like power and utilities directly associated with their RDS environments.
- Foregone costs otherwise required to reinvest in new servers to continue running on-premises RDS, such as the direct server costs and maintenance fees.
- A reduction in costs on employer-provisioned PCs. Customers reported that a subset of Azure Virtual Desktop end users preferred to use their own devices for work and that Azure Virtual Desktop enabled these customers to allow bring-your-own-device (BYOD) in this environment without security tradeoffs.

Reduced cost of prior VDI-related expenses:

34%

Modeling and assumptions. Based on the customer interviews, Forrester estimates for the composite organization:

- A total of 1,700 Azure Virtual Desktop end users and 1,200 monthly active users, with 50% deployed in Year 1.
- An eliminated licensing cost for RDS of $3.50 per monthly active user per month.
- A prior monthly cost of $1,400 related to RDS compute, storage, and networking costs.
- A prior monthly cost of $1,200 related to RDS network and power supply.
- An on-premises server and maintenance cost of $255,000 avoided in Year 3.
- BYOD users comprising 25.6% of total Azure Virtual Desktop users, saving the organization a

$600 average expense on PCs for these users. Half of these users begin to use their own devices in Year 2, with the other half doing so in Year 3.

Risks. The reduced cost of IT infrastructure will vary with:

- The total number of Azure Virtual Desktop end users and the rate of deployment.
- The number of these users previously on RDS.
- The ability to reduce server and maintenance expenses.
- The percentage of end users who utilize their own devices for Azure Virtual Desktop workloads.

To account for these risks, Forrester adjusted this benefit downward by 10%, yielding a three-year, risk-adjusted total PV of $507,073.

Reduced Cost Of Licensing And IT Infrastructure

Ref.	Metric	Calculation	Year 1	Year 2	Year 3
A1	Azure Virtual Desktop Monthly Active Users	Composite	600	1,200	1,200
A2	Azure Virtual Desktop Total Users	Composite	850	1,700	1,700
A3	Reduced cost of RDS licensing	$3.50*A1*12	$25,200	$50,400	$50,400
A4	Reduced cost of RDS compute, storage, and networking	Interviews; $1400 monthly (50% benefit in Year 1)	$8,400	$16,800	$16,800
A5	Reduced cost of RDS network and power supply	Interviews; $1200 monthly (50% benefit in Year 1)	$7,200	$14,400	$14,400
A6	Reduced cost of servers and maintenance fees related to RDS	Interviews	$0	$0	$255,000
A7	Subtotal - Reduced cost of RDS	A3+A4+A5+A6	$40,800	$81,600	$336,600
A8	Reduced cost of end-user PCs	Forrester Research Survey	$0	$130,560	$130,560
At	Reduced cost of licensing and IT infrastructure	A6+A7	$40,800	$212,160	$467,160
	Risk adjustment	↓10%			
Atr	Reduced cost of licensing and IT infrastructure (risk-adjusted)		$36,720	$190,944	$420,444
	Three-year total: $648,108			**Three-year present value: $507,073**	

COST SAVINGS ON DEPLOYMENT AND MAINTENANCE EXPENSES

Evidence and data. Customers reported cost reductions from diminished time spent on IT workloads after implementing Azure Virtual Desktop. Impacted IT workloads include:

- Application and software deployment and maintenance (28% time reduction for 1 FTE).
- Support and help desk management (28% time reduction for 1 FTE).
- Security management (57% time reduction; reduced requires IT resources from 4 FTEs to 2).

- Operating system deployment and maintenance (57% time reduction; reduced requires IT resources from 4 FTEs to 2).

> **"Azure Virtual Desktop saves our IT team a lot of time. Anytime we needed to make a change related to our VDI environment, it could take days or weeks. We're saving 50% of this time on some processes."**
>
> *IT architect, food and agriculture*

For application and software deployment and maintenance, Azure Virtual Desktop enabled the customers to integrate their applications into a golden image, eliminating work previously spent deploying software to each user and virtual machine (VM).

For support and help desk management, Azure Virtual Desktop brought end users better connectivity to virtual workplace software and systems than prior environments, resulting in a reduction of support tickets.

For security management, Azure Virtual Desktop enabled customers to rely more heavily on Microsoft's security capabilities to secure the Azure-based VDI and its associated workloads. Azure Virtual Desktop also eased the patching, isolation, and remediation of compromised machines. Additionally, with Azure Virtual Desktop, customers could more easily implement controlled access and multifactor authentication, improving their overall security environment.

Finally, Azure Virtual Desktop saved IT time deploying and maintaining operating systems as customers were enabled to deploy a single OS, Windows 10, companywide on Azure. Similarly, customers' IT teams saved time testing OS compatibility and testing and pushing out OS patches.

Additionally, customers noted saving enough time on these processes that they were also able to free two IT FTEs from these workloads, allowing them to focus on other non-VDI technology work.

Cost savings on deployment and maintenance expenses:

59%

Modeling and assumptions. Based on the customer interviews, Forrester estimates:

- One FTE saves 28% of the previous two days monthly spent on application and software deployment and maintenance, based on a total end-user base of 1,700.
- One FTE saves 28% of the previous 1 hour per 50 requests monthly spent on support and help desk management, based on a monthly active user base of 1,200.
- Four FTEs previously spent three days monthly on security-related access and patch management. With Azure Virtual Desktop, two FTEs spend 57% of that time on the same tasks, based on 1,700 total users.
- Four FTEs previously spent five days quarterly on operating system deployment and maintenance. With Azure Virtual Desktop, two FTEs spend 57% of that time on the same tasks, based on 1,700 total users.
- Beginning in Year 2, two FTEs from the IT department are freed from deployment and maintenance work to lead other, more strategic IT workstreams. To prevent double-counting, Forrester has subtracted the time and resource

reductions from the previous two bullets from these full-time reductions.

Risks. The improvement to IT workload efficiency will vary with:

- The number of deployed Azure Virtual Desktop end users.
- The amount of time previously spent on application and software deployment and maintenance, support and help desk management, security management, and operating system deployment and maintenance.
- The fully burdened hourly rate of IT employees.

To account for these risks, Forrester adjusted this benefit downward by 10%, yielding a three-year, risk-adjusted total PV (discounted at 10%) of $443,122.

Cost Savings On Deployment And Maintenance Expenses

Ref.	Metric	Calculation	Year 1	Year 2	Year 3
B1	Person-hours saved on application and software deployment and maintenance	Interviews; 28% of 2 days monthly for 1 FTE (50% benefit in Year 1)	27	54	54
B2	Person-hours saved on support and help desk management	Interviews; 28% of 1 hour per 50 requests monthly for 1 FTE (50% benefit in Year 1)	84	168	168
B3	Person-hours saved on security management	Interviews; 57% of 3 days monthly; 4 FTEs to 2 FTEs (50% benefit in Year 1)	452	904	904
B4	Person-hours saved on OS deployment and maintenance	Interviews; 57% of 5 days quarterly; 4 FTEs to 2 FTEs	251	502	502
B5	Additional IT time savings	Interviews; 2 FTEs reallocated to more strategic work post-migration	0	3,104	3,104
B6	Fully burdened hourly rate per IT employee	Forrester Research	$60	$60	$60
Bt	Cost savings on deployment and maintenance expenses	(B1+B2+B3+B4+B5)*B6	$48,840	$283,920	$283,920
	Risk adjustment	↓10%			
Btr	Cost savings on deployment and maintenance expenses (risk-adjusted)		$43,956	$255,528	$255,528
	Three-year total: $555,012			**Three-year present value: $443,122**	

INCREASED PRODUCTIVITY FROM IMPROVED CONNECTIVITY AND MORE EFFECTIVE SECURITY RESPONSE

Evidence and data. Azure Virtual Desktop improved latency and connectivity issues previously experienced by employee end users in the on-premises RDS environment while also making security response more effective at remote sites.

Improved latency and connectivity not only saved costs to the organizations in terms of reduced reliance on support and help desks, but they also added to the productivity of end users who experienced less latency and connectivity issues after Azure Virtual Desktop implementation.

The IT architect from the food and agriculture industry shared: “The application starts up a bit faster, but overall latency is far less, and the connection to the application is much better. Some employees are now saving as much as 10% of their day due to reduced latency and disconnects.”

Additionally, customers could reduce the time spent onboarding users to Azure Virtual Desktop because of its interface improvements and ease of use. Customers reported saving 50% of time previously spent onboarding each user, allowing these users to become productive on Azure Virtual Desktop that much faster.

Added annual productivity per end user

22 hours

Furthermore, interviewees reported improving their security response effectiveness with Azure Virtual Desktop, resulting in both a quantified benefit to the productivity of a subset of employees and a broader, unquantified benefit.

The interviewee from the consumer products industry shared that his firm experienced a cybersecurity event while running RDS that shut down “everything” at a production facility, including servers, clients, payroll, and telephone lines. Because they had not yet implemented Azure Virtual Desktop, the IT department had to scramble to quickly refresh all servers and clients, totaling 20,000 machines by the customer’s tally. The attack kept a subset of employees unproductive for between three and four days while IT addressed the issue. The customer shared that with Azure Virtual Desktop, it would have only taken 1 hour to refresh everything using the centralized portal.

> **“When a cybersecurity event like this happens, everything goes down, so everything stops. With Azure Virtual Desktop, this downtime risk is reduced by 96% simply because I can get the VMs back up and running with a click.”**
>
> *Global service owner, modern client technologies, consumer products*

The interviewed customers also expressed an unquantifiable improvement to their security environments after Azure Virtual Desktop implementation thanks to the enablement of multifactor authentication and conditional access. Their prior on-premises RDS environments lacked these security features, which constituted one of the main reasons for investing in Azure Virtual Desktop for at least one customer.

> **“Identity and access were top of mind in our decision to go with Azure Virtual Desktop. The ability to control who’s connecting, from where, and from what is so important..”**
>
> *IT cloud specialist, food and agriculture*

Modeling and assumptions. Based on the customer interviews, Forrester estimates:

- Fifty percent of Azure Virtual Desktop end users previously experienced latency and connectivity issues.
- Azure Virtual Desktop contributes 0.8 hours daily to the productivity of these end users.
- Onboarding each user previously took 1 hour, and Azure Virtual Desktop reduces this time by 50%.
- The fully burdened hourly rate per end user is $40.
- Fifty percent of end users experience no additional, external factors that continue to negatively influence latency and connectivity.
- There is a productivity recapture rate of 40% for daily workstreams and onboarding activities.
- Additionally, the organization experiences a single security event causing mass downtime at a single location in Year 2.
- Prior security incidents caused a single location per event to lose three and a half days of productivity.
- Time to refresh reduces to 1 hour after Azure Virtual Desktop implementation.
- Four IT professionals respond to the incident at a fully burdened hourly cost of $60 each.
- One hundred employees are affected by this downtime at a fully burdened cost of $40 each.
- There is a productivity recapture rate of 100% (not shown) for the affected employees.

Risks. The improvement to end-user productivity may vary with:

- The number of RDS users in the prior environment experiencing latency and connectivity issues.
- The amount of downtime caused by latency and connectivity issues per end user in the prior environment.
- The number of users onboarding per year.
- The prior time spent onboarding users.
- The average fully burdened hourly rate of Azure Virtual Desktop end users.
- The existence of external factors affecting latency and connectivity after Azure Virtual Desktop implementation.
- The amount of productivity recaptured per end user.
- The number of security incidents causing downtime in the previous environment.
- The number of sites affected by this downtime.
- The number of IT professionals needed to respond.
- The fully burdened hourly rate of these IT professionals.
- The number of employees experiencing downtime from these events.
- The fully burdened hourly rate of these employees.
- The amount of productivity able to be recaptured by these employees.

To account for these risks, Forrester adjusted this benefit downward by 10%, yielding a three-year, risk-adjusted total PV of $1,833,759.

Increased Productivity From Improved Connectivity And More Effective Security Response					
Ref.	**Metric**	**Calculation**	**Year 1**	**Year 2**	**Year 3**
C1	Percent of end users previously experiencing latency and connectivity issues	Composite	50%	50%	50%
C2	Hours productivity improvement to daily workstreams per user	Interviews	0.8	0.8	0.8
C3	Person-hours saved from daily workstreams	A1*C1*C2*250	60,000	120,000	120,000
C4	Net new Azure Virtual Desktop end users		850	850	0
C5	Prior on-boarding hours with RDS	Interviews	1	1	
C6	Productivity improvement to onboarding process	Interviews	50%	50%	
C7	Person-hours saved from onboarding	C2*C3*C4	425	425	0
C8	Fully burdened hourly rate of average employee	Forrester Research	$40	$40	$40
C9	Percent of end users where no external factors continue latency and connectivity issues	Composite	50%	50%	50%
C10	Productivity recapture rate	Forrester Research	40%	40%	40%
C11	Subtotal increased productivity from improved on-boarding, connectivity, and latency for remote work	(C5+C7)*C8*C9*C10	$483,400	$963,400	$960,000
C12	Hours to refresh infrastructure and hours lost by employees with RDS	Interviews; 3 days * 8 working hours	0	24	0
C13	Hours to refresh infrastructure and hours lost by employees with Azure Virtual Desktop	Interviews	0	1	0
C14	Number of IT professionals required to refresh	Interviews	0	4	0
C15	Number of employees at affected site	Composite	0	100	0
C16	Subtotal increased productivity from improved effectiveness of security response	(C12-C13)*C14*B6 +(C12-C13)*C15*C8	$0	$97,520	$0
Ct	Increased productivity from improved connectivity and more effective security response	C11+C16	$483,400	$1,060,920	$960,000
	Risk adjustment	↓10%			
Ctr	Increased productivity from improved connectivity and more effective security response (risk-adjusted)		$435,060	$954,828	$864,000
	Three-year total: $2,253,888			**Three-year present value: $1,833,759**	

UNQUANTIFIED BENEFITS

Additional benefits that customers experienced but were not able to quantify include:

- **Improved user experience.** Customers noted a better user experience stemming from interface enhancements moving from RDS to Azure Virtual Desktop. The IT architect from the food and agriculture space said: "A big benefit from the user's perspective is that if they run an application, it looks like it's running on their own machine. There was sometimes friction from RDS's user interface for our less IT-savvy employees, but I have heard of no difficulties after switching to Azure Virtual Desktop."

FLEXIBILITY

The value of flexibility is unique to each customer. There are multiple scenarios in which a customer might implement Azure Virtual Desktop and later realize additional uses and business opportunities, including:

- **Improved organizational resiliency.** Azure Virtual Desktop provided productivity protection and flexible response in crisis situations. For example, one customer was able to maintain employee productivity and continue to provision services throughout the global COVID-19 pandemic because of Azure Virtual Desktop. The customer from the government sector described: "We originally made the investment because we lost weeks of employee productivity during an unforeseen weather event several years back. But when COVID-19 hit, we didn't skip a beat."

  Potential avoided costs from this improved resiliency include:

  - Loss of employee productivity.
  - Negative impact to customers and other stakeholders.
  - Cost of third parties to shore up employee productivity and avert customer impact.
  - Delayed hiring with inability to onboard new employees.

> **"When COVID-19 came along, management was surprised by how quickly we responded. We scaled to thousands of people working from home relatively quickly. Without Azure Virtual Desktop, we would have lost months of service delivery."**
>
> *CIO, government*

- **Scaling of cost savings.** Customers noted that the cost savings of Azure Virtual Desktop grow as the use of Azure Virtual Desktop scales. As Azure Virtual Desktop is a cloud-based service offered through Microsoft Azure, it allows for dynamic scaling. Customer organizations can grow and shrink their virtual desktop userbase as it grows or shrinks. Without it, customers would either need to invest in on-premises infrastructure before scaling, incurring additional costs, or wait to scale as they invest in on-premises infrastructure, delaying the offering of virtual desktop services to their users. As the Azure Virtual Desktop user base grows, these associated cost savings grow with it.

> **"As we add more users, we get more cost savings. Even for those instances where we haven't seen net cost savings, we are getting more for the same money."**
>
> *IT architect, food and agriculture*

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

Analysis Of Costs

Quantified cost data as applied to the composite

Total Costs							
Ref.	**Cost**	**Initial**	**Year 1**	**Year 2**	**Year 3**	**Total**	**Present Value**
Dtr	Costs of Azure Virtual Desktop compute, storage, and networking	$0	$158,400	$316,800	$316,800	$792,000	$643,835
Etr	Cost of migration	$22,000	$22,000	$0	$0	$44,000	$42,000
Ftr	Cost of ongoing management	$0	$105,600	$79,200	$66,000	$250,800	$211,041
	Total costs (risk-adjusted)	$22,000	$286,000	$396,000	$382,800	$1,086,800	$896,876

COSTS OF AZURE VIRTUAL DESKTOP COMPUTE, STORAGE, AND NETWORKING

Evidence and data. Customers reported only experiencing costs from compute, storage, and networking related to their Azure Virtual Desktop investment. The interviewed companies were all already Microsoft 365 subscribers. As such, they did not incur any licensing costs during or after transitioning to Azure Virtual Desktop.

> **"Azure Virtual Desktop is a part of our Microsoft 365 license. So, we already bought it as part of consuming Microsoft 365. It was almost, dare I say, a freebie."**
>
> *IT infrastructure manager, government*

Modeling and assumptions. Forrester estimates for the composite organization:

- Compute, storage, and networking costs are calculated at an average monthly rate equivalent to supporting the same usage as in the prior on-premises environment. Actual compute, storage, and networking costs will vary monthly based on the number of Azure Virtual Desktop end users connecting and their total usage.
- Average monthly compute costs of $6,000.
- Average monthly storage costs of $1,700.
- Average monthly networking costs of $900.
- Fifty percent of costs experienced in Year 1, as Azure Virtual Desktop is only deployed to half the monthly active users (600) in this year.

Average cost of compute, storage, and networking per active user

$20

Risks. The total cost of compute, storage, and networking from Azure Virtual Desktop will vary with:

- The total number of users to which Azure Virtual Desktop is deployed.

- Varying compute, storage, or networking requirements of these users.

To account for these risks, Forrester adjusted this cost upward by 10%, yielding a three-year, risk-adjusted total PV of $643,835.

Costs Of Azure Virtual Desktop Compute, Storage, And Networking

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
D1	Total cost of compute			$100,800	$201,600	$201,600
D2	Total cost of storage			$28,800	$57,600	$57,600
D3	Total cost of networking			$14,400	$28,800	$28,800
Dt	Costs of Azure Virtual Desktop compute, storage, and networking	E1+E2+E3	$0	$144,000	$288,000	$288,000
	Risk adjustment	↑10%				
Dtr	Costs of Azure Virtual Desktop compute, storage, and networking (risk-adjusted)		$0	$158,400	$316,800	$316,800
	Three-year total: $792,000			**Three-year present value: $643,835**		

COST OF MIGRATION

Evidence and data. Customers shared that they experienced costs migrating from their RDS estates to their Azure Virtual Desktop deployments. Customers noted following Microsoft guidelines for migration and testing Azure Virtual Desktop with small groups of users before expanding deployment to larger teams.

Modeling and assumptions. Forrester estimates for the composite organization:

- A two-month migration process, with one month of migration initially to deploy Azure Virtual Desktop to the first half of total end users (850) and one month of migration in Year 2 to deploy to the remaining total end users.
- Four FTEs needed at 50% of their time for each migration process.
- A $60 per hour fully burdened hourly rate for these FTEs.

Risks. The total cost of migration will vary with:

- The breadth of Azure Virtual Desktop deployment.

> **"We stood up some Azure Virtual Desktop services in Azure as per Microsoft's guidelines and used the Microsoft calculator. We made sure the infrastructure was there so there was access to applications, set it all up, and then ported it. We then asked for volunteers basically, so we got some users testing it. That probably took the best part of two months, and then we just opened it up to everybody else post-testing."**
>
> *IT infrastructure manager, government*

- The decision to test Azure Virtual Desktop with a small group of users and the time length of this testing.
- The number and cost of FTEs needed to complete migration.

To account for these risks, Forrester adjusted this cost upward by 10%, yielding a three-year, risk-adjusted total PV of $42,000.

Cost Of Migration

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
E1	Length of migration in months	Interviews	1	1		
E2	Number of FTEs needed for migration	Interviews	4	4		
E3	Percent time spent on migration	Interviews	50%	50%		
E4	Fully burdened hourly rate per IT employee	A6	$60	$60		
Et	Cost of migration	2000/12*F2*F3*F4	$20,000	$20,000	$0	$0
	Risk adjustment	↑10%				
Etr	Cost of migration (risk-adjusted)		$22,000	$22,000	$0	$0
	Three-year total: $44,000			**Three-year present value: $42,000**		

COST OF ONGOING MANAGEMENT

Evidence and data. The interviewed customers reported costs associated with the ongoing management of Azure Virtual Desktop. Customers required a small group of FTEs to spend about one-fifth of their time managing profiles, monitoring logs, optimizing use of Azure Virtual Desktop, watching for capacity constraints, and innovating with Azure Virtual Desktop. They required a slightly larger team spending a small percentage of their time annually to support and troubleshoot Azure Virtual Desktop use.

Modeling and assumptions. Forrester estimates for the composite organization:

- Two FTEs managing Azure Virtual Desktop for 35% of their time in Year 1, 25% of time in Year 2, and 20% of time in Year 3. Time spent managing Azure Virtual Desktop decreases as the FTEs become more familiar with the solution.
- Five FTEs supporting and troubleshooting issues with Azure Virtual Desktop for 2% of their time.
- A fully burdened hourly rate of $60 for these FTEs.

Risks. The total cost of ongoing management will vary with:

- The number of FTEs needed to manage Azure Virtual Desktop.
- The number of FTEs needed to support and troubleshoot Azure Virtual Desktop.
- The fully burdened hourly rate of these FTEs.

To account for these risks, Forrester adjusted this cost upward by 10%, yielding a three-year, risk-adjusted total PV of $211,041.

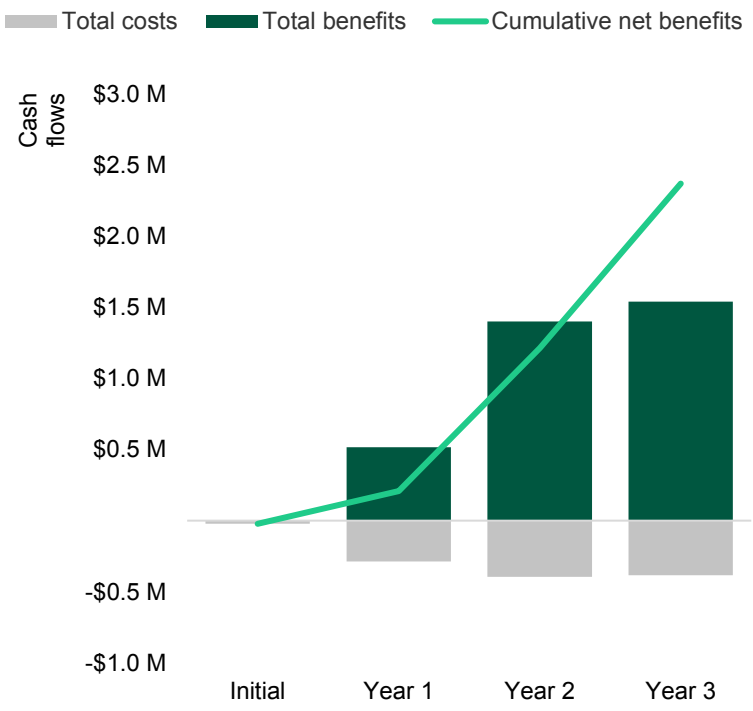
Cost Of Ongoing Management

Ref.	Metric	Calculation	Initial	Year 1	Year 2	Year 3
F1	Number of FTEs managing Azure Virtual Desktop	Interviews		2	2	2
F2	Percent of time spent managing Azure Virtual Desktop	Interviews		35%	25%	20%
F3	Number of FTEs supporting Azure Virtual Desktop-related requests	Interviews		5	5	5
F4	Percent time spent supporting Azure Virtual Desktop	Interviews		2%	2%	2%
F5	Fully burdened hourly rate per IT employee	A6		$60	$60	$60
Ft	Cost of ongoing management	G1*G2*G5*2000+G3*G4*G5*2000	$0	$96,000	$72,000	$60,000
	Risk adjustment	↑10%				
Ftr	Cost of ongoing management (risk-adjusted)		$0	$105,600	$79,200	$66,000
	Three-year total: $250,800			**Three-year present value: $211,041**		

Financial Summary

CONSOLIDATED THREE-YEAR RISK-ADJUSTED METRICS

Cash Flow Chart (Risk-Adjusted)



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 Analysis (Risk-Adjusted Estimates)

	Initial	Year 1	Year 2	Year 3	Total	Present Value
Total costs	($22,000)	($286,000)	($396,000)	($382,800)	($1,086,800)	($896,876)
Total benefits	$0	$515,736	$1,401,300	$1,539,972	$3,457,008	$2,783,954
Net benefits	($22,000)	$229,736	$1,005,300	$1,157,172	$2,370,208	$1,887,078
ROI						210%
Payback period						< 3 months

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.

Appendix B: Endnotes

[1] Base: 1,800 business and IT decision-makers in the US, Germany, Australia, Japan, and China with traditional and virtualized PC environments. Source: A commissioned survey conducted by Forrester Consulting on behalf of Microsoft, September 2020.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