

FORRESTER®

The Total Economic Impact™ Of Dell Validated Designs For VDI

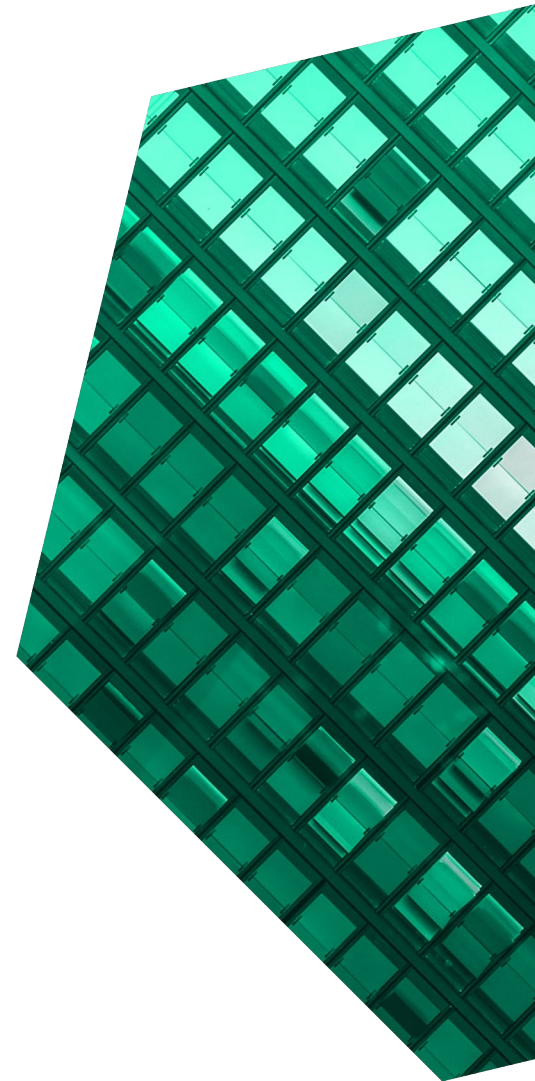
Cost Savings And Business Benefits
Enabled By Validated Designs for VDI

SEPTEMBER 2022

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ABOUT FORRESTER CONSULTING

Forrester provides independent and objective research-based consulting to help leaders deliver key transformation outcomes. Fueled by our customer-obsessed research, Forrester’s seasoned consultants partner with leaders to execute on their priorities using a unique engagement model that tailors to diverse needs and ensures lasting impact. For more information, visit forrester.com/consulting.

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Executive Summary

With the rise in remote work and hybrid workforces, virtual desktop infrastructure (VDI) can deliver the digital transformation an organization needs to empower its workforce from nearly anywhere. However, when looking to adopt a VDI environment, enterprises must take a use-case-specific approach to maximize their virtualization strategy.¹ Dell Validated Designs for VDI provides reliable, infrastructure benchmarked to an organization's needs to optimize its deployment and ongoing use of VDI while improving productivity for end users and IT teams.

Dell Validated Designs for VDI simplifies the design, configuration, and ordering of solutions optimized for VDI. Organizations can save time and effort with architected, tested, and validated solutions bringing together powerful and scalable compute, networking, and storage designed to reduce complexity, streamline operations, and enable employees to work from anywhere.

Additionally, Dell Validated Designs for VDI tested and validated with NVIDIA virtual graphic processing unit (vGPU) technology delivers a high-quality user experience for any VDI user — from knowledge workers using office productivity tools to designers and artists using professional visualization applications — with performance nearly indistinguishable from a physical desktop.

Dell Technologies and NVIDIA commissioned Forrester Consulting to conduct a Total Economic Impact™ (TEI) study and examine the potential

KEY STATISTICS



Return on investment (ROI)
124%



Net present value (NPV)
\$3.47M

return on investment (ROI) enterprises may realize by deploying Validated Designs for VDI.² The purpose of this study is to provide readers with a framework to evaluate the potential financial impact of Validated Designs for VDI on their organizations.

To better understand the benefits, costs, and risks associated with this investment, Forrester interviewed four representatives with experience using Validated Designs for VDI. For the purposes of this study, Forrester aggregated the interviewees' experiences and combined the results into a single composite organization.

Prior to using Validated Designs for VDI, interviewees' organizations operated in fully physical environments (i.e., using endpoints with local compute and local storage and not leveraging any VDI solutions). This environment hindered both IT and end user productivity, incurred high costs for the organizations, and lacked the level of security

Reduction in time spent on help desk tickets

80%



needed in an increasingly work-from-anywhere environment.

After the investment in Validated Designs for VDI, the organizations were able to modernize while decreasing costs and provide users with the flexible, safe, and efficient environments they needed to enhance performance. Additionally, by implementing NVIDIA vGPUs within the Dell-virtualized environments, the organizations could expand their VDI deployments to include compute-heavy, graphic-intensive users. The organizations were able to provide an optimal experience for both knowledge workers and high-compute users.

KEY FINDINGS

Quantified benefits. Three-year, risk-adjusted present value (PV) quantified benefits for the composite organization include:

- **A reduction in IT support requirements resulting in \$799,500 savings over three years.** Dell Validated Designs for VDI provides the composite organization with a VDI solution built for its performance needs. This, in turn, decreases the ongoing support needed for upkeep of the environment and reduces the time spent on both application and software deployment and maintenance and operating system (OS) deployment and maintenance by 96% and 90%, respectively. The organization also sees a 20% reduction in environment-related tickets and a 75% reduction in ticket resolution time, partially attributable to a better user experience with NVIDIA GPU-accelerated VDI.
- **Decreased infrastructure-related costs resulting in \$3.3 million savings over three years.** Virtual endpoints cost 77% less for high-performance devices and 43% less for average-performance devices when compared to their counterparts in a physical environment. Additionally, for the users now deployed in a VDI environment, the composite organization reduces its associated power and cooling spend by 50%.

Increased end user productivity resulting in \$2.2 million savings over three years. Using Validated Designs for VDI enables end users to be more productive in their day-to-day responsibilities. Additionally, with NVIDIA vGPUs, users can get support for multiple and high-resolution monitors, further improving efficiencies. The composite organization improves system uptime of up to 30 minutes per day with the joint solution in place.

Additionally, data is centrally managed, virtual desktops are not tied to specific hardware, and IT staff can benefit from support for GPU live migration — enabling them to live migrate virtual machines to do maintenance and patching. This enables the composite organization to reduce the time it takes to do an infrastructure refresh by 11 hours.

Unquantified benefits. Benefits that provide value for the composite organization but are not quantified in this study include:

- **Decreased security risks.** Dell's VDI environment offers the composite organization several security enhancements such as data loss prevention, patching simplification and secure remote access, reducing the risk of a breach and/or data loss.
- **Improved accessibility.** With Validated Designs for VDI, end users at the composite organization can confidently work from anywhere without concern for the underlying endpoint infrastructure.
- **The value of NVIDIA vGPUs.** NVIDIA vGPUs in the composite's Dell VDI environment elevates the experience and infrastructure performance for both knowledge workers and high-compute users. Additionally, the organization wouldn't have been able to deploy VDI to a more expansive user base with high-compute users without it.

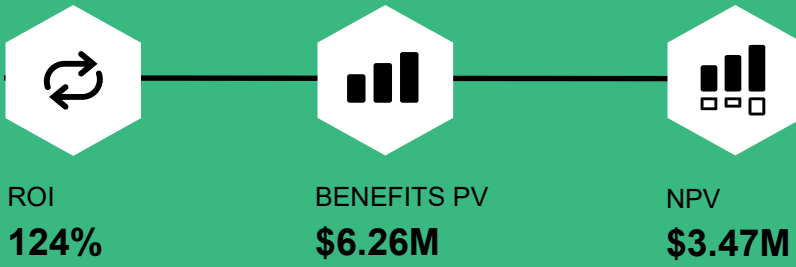
Costs. Three-year, risk-adjusted PV costs for the composite organization include:

- **Cost of VDI operation.** The composite pays fees to Dell Technologies for the VDI infrastructure itself. Based on the size and configuration of the composite organization's systems, this costs \$2.5 million over three years.
- **Implementation and ongoing management.** Engineers are involved in the deployment and ongoing management of the composite organization's Validated Designs for VDI solution.

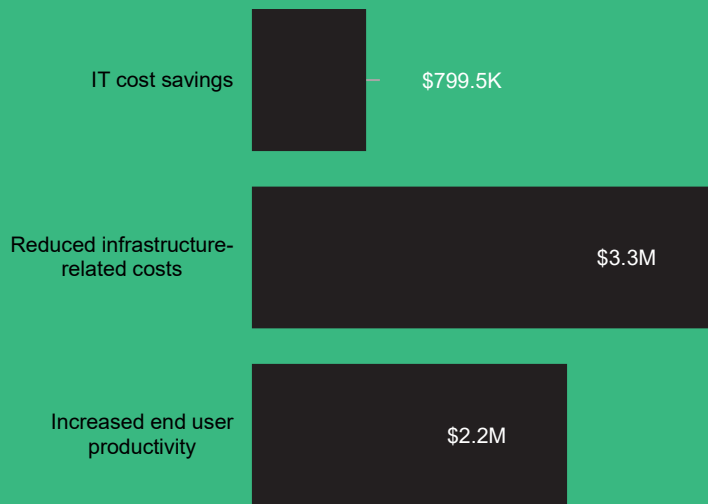
The representative interviews and financial analysis found that a composite organization experiences benefits of \$6.26 million over three years versus costs of \$2.79 million, adding up to a net present value (NPV) of \$3.47 million and an ROI of 124%.

“Anybody could sell you the parts. But to interface and get that support with one vendor while ensuring simple ongoing management for our small IT team like you could with Dell Validated Designs, there’s not a lot of companies that could do that.”

— DevOps manager, education



Benefits (Three-Year)



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 Validated Designs for VDI.

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 Validated Designs for VDI can have on an organization.

DISCLOSURES

Readers should be aware of the following:

This study is commissioned by Dell Technologies 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 study to determine the appropriateness of an investment in Validated Designs for VDI.

Dell Technologies 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.

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



DUE DILIGENCE

Interviewed Dell Technologies stakeholders and Forrester analysts to gather data relative to Validated Designs for VDI.



INTERVIEWS

Interviewed four representatives at organizations using Validated Designs for VDI to obtain data with respect to costs, benefits, and risks.



COMPOSITE ORGANIZATION

Designed a composite organization based on characteristics of the interviewees' 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 interviewees.



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 Dell Validated Designs for VDI Customer Journey

■ Drivers leading to the Validated Designs for VDI investment

Interviews			
Role	Industry	Region	VDI/vGPU usage
Associate CIO	Research university	North America	Total VDI users: 2,000 Total FTEs: 20,000 vGPU usage: Engineering and design workloads, standard office productivity workloads
DevOps manager	Education	North America	Total VDI users: 2,500 Total FTEs: 20,000 vGPU usage: Engineering, scientific research, mapping workloads, standard office productivity workloads
Deputy CIO	Insurance	EMEA	Total VDI users: 4,000 Total FTEs: 5,000 vGPU usage: N/A
EVP	Financial services	North America	Total VDI users: 400 Total FTEs: 1,000 vGPU usage: Trader, data analyst, graphics workloads, standard office productivity workloads

KEY CHALLENGES

Prior to investing in Validated Designs for VDI, the interviewees' organizations functioned in fully physical environments with endpoints containing local compute and local storage and no VDI solutions in place. They used aged IT infrastructure and devices that were complicated and costly to operate and created unnecessary inefficiencies for its users.

The interviewees' organizations struggled with several shared challenges, including:

- **IT inefficiencies.** In their previous environments, interviewees' organizations had designated IT personnel who would spend their whole day configuring, provisioning, and upkeeping physical desktops. The associate CIO at a research university said their institution employed six workers who spent 100% of their time on these low-value tasks. Additionally, with no central management, rolling out software updates to each physical endpoint could take weeks to

months, and OS updates would take even longer. The existing environment required continuous monitoring and expansion of capacity and capability to keep up with need, but scaling and ongoing maintenance seemed infeasible with the decentralized nature of the endpoint environment.

“Managing the physical machines and their software was not an easy thing to do. If there was a software update, the turnaround time would be more than two weeks. OS updates would take months. It was a huge burden on IT, but also created security holes.”

EVP, financial services

“There were a couple engineering courses for which we had one lab with 10 systems with the necessary software on it. If there were 20 kids who needed it, they would need to schedule a time, and it was possible that [their] allotted time [would be] from 3 a.m. to 5 a.m. on Tuesday. That sucks.”

Associate CIO, research university

- **High costs.** Physical desktop infrastructure was expensive and inefficient for companies that were constantly scaling their businesses. Interviewees noted that average endpoints were up to 50% more expensive when compared to a laptop with limited internal resources, such as a thin client. Physical, high-power, graphic-intensive workstations with large drives could cost upward of \$8,000 based on the applications and compute needed. They also took up a lot of space and required substantial expenditures in power and cooling. Furthermore, the shelf life of existing devices was around three years, which exacerbated costs over time, especially with an expanding workforce.
- **Poor end user experience.** Users have high expectations around performance and availability regardless of where they are working. In the physical environments, it was hard for IT ensure resources matched the increasing demands for fast delivery, predictable scale, and high-performance users needed without manually examining each endpoint. Organizations' employees experienced numerous issues causing downtime because their workstations

were not continuously optimized for their needs and degraded over time.

For organizations with high-power workstations at their physical organizational locations, users couldn't work once they left the area. This was especially prevalent for organizations in the education/research industry. Overall, the physical environments created unexpected downtime and limited accessibility, which led to loss of productivity and end-user frustration.

- **Security issues.** Interviewees' organizations, especially those in the finance area, require the ability to control data, apply policies, comply with regulations, and monitor risk. In a physical environment, data is stored in the hardware. With the increase in remote work, more sensitive data is out of direct IT control, which increases the risk of data theft, viruses, and security breaches. The deputy CIO at an insurance organization said, "When we had a compliance check from a regulator, he pointed out that our data could be anywhere considering it was neither centrally stored nor centrally managed."

“Managing the physical machines and their software was not an easy thing to do. If there was a software update, the turnaround time would be more than two weeks. OS updates would take months. It was a huge burden on IT, but it also created security holes.”

EVP, financial services

Additionally, it was hard to ensure that physical desktops had access to the latest patches and upgrades because the process often required IT involvement, which took additional time. Delaying or avoiding these updates altogether could cause further security vulnerabilities.

“Dell had a holistic approach to a VDI environment, which made rollout much easier. The fact that you can get storage, networking, compute, endpoints — the whole stack — from one vendor has made the experience of working with them great, And the fact that it’s preconfigured and tested made rollout even easier.”

Deputy CIO, insurance

INVESTMENT OBJECTIVES

Some interviewees’ organizations tested out other VDI solutions in their environments on a small number of users. However, hurdles such as long and complicated planning and procurement cycles involving numerous vendors, difficulty delivering consistent user experiences, and issues upkeeping the environments hindered VDI adoption and caused their previous solutions to collapse.

The interviewees’ organizations searched for a solution that could:

- Come preconfigured and designed from one vendor with their specific use cases in mind.
- Provide optimized computing power alongside simplified management to attain improved performance, agility, and efficiency.

“Engineering applications require very substantial compute to run well. If you’re a student, how do you get that done? Well, you can either: A) go to the computer lab and use the workstation, or more likely, B) buy a \$4,000 workstation-caliber laptop and do that. We want to make education more accessible and affordable while keeping up high performance levels, and Dell Validated Designs for VDI allows us to do that while decreasing costs for students.”

Associate CIO, research university

- Enable scale without concern for the underlying IT infrastructure and costs.
- Help modernize their environments to empower users and improve user experiences while strengthening security.
- Cater to the compute needs of all types of users.

The interviewees’ organizations selected Dell Validated Designs for VDI due to the ability to have a fully preconfigured and engineering-certified VDI solution optimized for their needs. Additionally, Dell Technologies’ partnerships with other vendors such as NVIDIA was a huge selling point. Organizations could interface solely with one project manager from Dell who managed the collaboration with other vendors on the back end, reducing the burden on the interviewees’ organizations. By using a unified solution from one vendor, the organizations could speed up VDI deployment and time to value.

“Given our needs with the fact that we have so many high-performance users, we clearly had to go with Dell. They could easily configure an environment that works for everyone.”

EVP, financial services

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 interviewees, and it 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 organization functions in a high-performance environment that contains both laptops and workstations. Of its 10,000 employees, 2,500 work within the VDI environment. These employees consist of a mix of knowledge workers (i.e., those who access the internet, use email, and create spreadsheets and presentations on a daily basis) and power users (i.e., those who need graphic and compute-intensive applications). Approximately 50% of these users were experiencing downtime due to performance degradation stemming from the organization’s previous physical environment.

The VDI environment contains 2,500 endpoints that are a mix of average endpoints and high-end endpoints, both used with the NVIDIA vGPU solution consisting of NVIDIA virtual GPU software combined with NVIDIA GPUs and tested and validated as part of the Dell VDI Validated Design. The endpoints are all company-owned and are on a three-year

hardware refresh cycle. As part of its environment, the organization has average power and cooling costs of \$2.5 million per year.

Prior to investing in Dell Validated Designs for VDI, the organization housed a completely physical environment for all its employees. The composite organization was looking to transition to a VDI environment to improve accessibility, flexibility, and usability for its end users, to centralize IT management, and to reduce costs without inhibiting performance.

Deployment characteristics. The composite organization onboards 1,000 users/endpoints into the joint Dell VDI/NVIDIA vGPU environment configured using Validated Designs for VDI in Year 1. Of these endpoints, 70% are high-end devices containing graphic-intensive applications. The organization sees the benefits of implementing a VDI environment and continues to grow its usage. In both Year 2 and Year 3, the organization expands the VDI deployment to an additional 750 users/endpoints per year, 40% of whom use high-end devices. The VDI environment is deployed on-premises.

Key Assumptions

- **10,000 employees**
- **2,500 total VDI users and endpoints over three years**
- **52% of users are power users**
- **Three-year hardware refresh cycle**
- **High performance environment**

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	IT cost savings	\$307,570	\$322,452	\$337,334	\$967,356	\$799,542
Btr	Reduced infrastructure-related costs	\$1,642,500	\$1,074,375	\$1,158,750	\$3,875,625	\$3,251,681
Ctr	Increased end user productivity	\$520,538	\$910,941	\$1,301,344	\$2,732,822	\$2,203,778
	Total benefits (risk-adjusted)	\$2,470,607	\$2,307,768	\$2,797,428	\$7,575,803	\$6,255,001

IT COST SAVINGS

Evidence and data. Optimized VDI infrastructure with Validated Designs for VDI reduced the support requirements for IT teams at the interviewees' organizations.

VDI with Dell saved the organizations a lot of system administration time through centralization of management. IT employees can now maintain devices in the network from one central server, so deployments and upgrades can be centrally managed and done in groups, rather than being handled individually at each endpoint/workstation.

- The DevOps manager at an education organization said their institution rolls out new software applications or updates and one team member can deploy a single master image from a central console instead of needing a group of people to touch every physical device. They said: "Previously, validating and deploying software and trying to work out the kinks would take us two weeks. We can now deploy to the entire VDI environment within an hour."
- The EVP at a financial services organization explained, "Software updates take us inside of an hour, sometimes even 10 minutes, versus three weeks to a month full time for one person."

"If I want to install or upgrade software, it takes a day or two. I just have to rebuild a central image and it's done. For 1,000 computers, this would take one month."

Deputy CIO, insurance

- The EVP also noted that OS updates now take one day, or about 5% of the time it previously took.
- The deputy CIO in the insurance industry said when their organization tried to deploy an OS update previously, it took two years to completely roll out. In the Dell VDI environment, it takes a week.

By using predesigned, tested, and configured VDI architecture with Validated Designs for VDI, the interviewees' organizations saw efficiencies within their IT ticketing systems as well.

“We’ve cut our tickets by 80% and see close to zero complaints on the hardware performance.”

EVP, financial services

Dell Technologies provided the organizations with a VDI solution benchmarked to their needs in terms of compute, networking, storage, and graphic acceleration. As a result, end users experienced fewer issues in their work environments, resulting in a reduction in architecture-related help desk tickets.

Additionally, if there are still issues, it is faster and easier to resolve them due to the centralized management of VDI endpoints. IT personnel can troubleshoot endpoints remotely instead of physically visiting each one. The remaining issues also tend to be easier fixes because those involving performance issues are preresolved by Dell.

- The DevOps manager at an education organization said their institution reduced its tickets by 80% once implementing a GPU-accelerated VDI environment with Dell. They said, “Users experience less issues related to downtime, and [IT] doesn’t spend nearly as much time troubleshooting issues.”
- The associate CIO at a research university said their institution was able to reduce the time to resolve tickets from hours or even days to hours or minutes. They explained: “When somebody would say they were having a problem, we would have to send a lab manager in to physically take a look at the computer. And sometimes it was difficult to find the problem, [so] you had to do a lot of digging. We don’t really have those complicated issues anymore because our environment is designed by us and our

needs, and the minor issues take 15 minutes to fix.”

- The deputy CIO in the insurance industry said his organization “has seen a reduction in issues being called out by multiple people” because if one person is having an issue that others might be experiencing, they could fix it proactively on the central image before others alerted IT. Overall, the organization now receives 20% less tickets in its VDI environment compared to the physical environment.

“Our IT team can now take on completely new tasks with the time they’re getting back — tasks that are more on the value-add scale, rather than: ‘Oh gosh, we have an emergency patch. Looks like that’s all I’ll be doing for the next week.’”

EVP, financial services

Having custom-built VDI solutions from a trusted provider decreased the ongoing configuration, management, and maintenance effort for interviewees’ organizations as they expanded deployment when compared to upkeeping a physical environment as well. Therefore, they were able to free up IT personnel and allow them to focus on higher-value tasks for the organization.

- A financial services organization was able to cut administration overhead by 50%, from six FTEs to three FTEs.

- The deputy CIO in the insurance industry said their organization has four times as many users in its VDI environment as in its physical environment. However, it takes the organization four times more effort to manage the physical environment than the VDI environment.
- The DevOps manager at the education organization and the associate CIO at the research university said their institutions were able to completely reallocate all their lab managers to other tasks throughout the organization. The associate CIO said: “Their job used to be just making sure the computers don’t break and are working properly. Now, they’re working on migrating data or other innovation initiatives. They’re involved in bigger and better things and are much happier in their jobs.”

Modeling and assumptions. For the composite organization, Forrester assumes:

- Four IT FTEs spend 100% of their time managing the physical environment for this subset of employees within the composite organization.
- There are 1,000 endpoints in the VDI environment in Year 1, 1,750 in Year 2, and 2,500 in Year 3.
- The composite organization previously spent 12 hours monthly on application and software deployment and maintenance per 100 endpoints in its legacy physical environment.
- With the Dell Technologies investment, application and software deployment and maintenance are reduced to 30 minutes monthly per 100 endpoints.
- The composite organization previously spent 16 hours biannually on OS deployment and maintenance per 100 endpoints in its legacy physical environment.

- With the Dell Technologies investment, application and OS deployment and maintenance are reduced to 1.5 hours biannually per 100 endpoints.
- In its prior environment, the composite organization received two tickets per month per 100 endpoints in its physical environment. On average, it took 2 hours for engineers to investigate and resolve a ticket.
- Once implementing Validated Designs as the backbone of its VDI environment, the composite organization reduces the number of tickets per 100 virtual endpoints by 20% over three years. Additionally, it takes an engineer 30 minutes to resolve the remaining tickets.
- The composite organization is able to reallocate additional IT time to other value-add activities by moving to a VDI environment with Dell. These savings are related to other activities, such as endpoint configuration and ongoing maintenance. In the organization’s VDI environment, three IT FTEs spend their time on ongoing management of the solution at the values listed in E4 of the calculation table for [Cost E](#). To prevent double-counting in the calculation table below, Forrester subtracted the time and resource reductions from A4, A7, and A13 from the four FTEs in the physical environment.
- The hourly rate of an IT FTE is \$53.

Risks. IT cost savings may vary depending on the following:

- The size and scope of deployment.
- The prior state benchmarks.
- The hourly rate of an IT FTE.
- The variation in skill sets of IT FTEs.

Results. To account for these risks, Forrester adjusted this benefit downward by 10%, yielding a

three-year, risk-adjusted total PV (discounted at 10%) of \$799,500.

IT Cost Savings					
Ref.	Metric	Source	Year 1	Year 2	Year 3
A1	Number of endpoints in VDI environment	Composite	1,000	1,750	2,500
A2	Hours spent on application and software deployments and maintenance per 100 endpoints in previous physical environment	Interviews	144	144	144
A3	Total hours spent on application and software deployments and maintenance per 100 endpoints in virtual environment with Dell Validated Designs for VDI	Interviews	6	6	6
A4	Subtotal: Hours saved on application and software deployments and maintenance in a virtual environment with Dell Validated Designs for VDI	$A1/100*(A2-A3)$	1,380	2,415	3,450
A5	Hours spent on OS deployment and maintenance per 100 endpoints in previous physical environment	Interviews	32	32	32
A6	Total hours spent on OS deployment and maintenance per 100 endpoints in virtual environment with Dell Validated Designs for VDI	Interviews	3	3	3
A7	Subtotal: Hours saved on OS deployments and maintenance with a virtual environment with Dell Validated Designs for VDI	$A1/100*(A5-A6)$	290	508	725
A8	Average number of tickets per year for 100 endpoints in previous physical environment	Interviews	24	24	24
A9	Total number of tickets per year in previous physical environment	$A1/100*A8$	240	420	600
A10	Average time to resolve a ticket in previous physical environment (hours)	Interviews	2.0	2.0	2.0
A11	Reduction in number of tickets with Dell VDI environment	Interviews	15%	20%	20%
A12	Average time to resolve a ticket with Dell VDI environment (hours)	Interviews	0.5	0.5	0.5
A13	Subtotal: Hours saved on help desk support with a virtual environment with Dell Validated Designs for VDI	$(A9*A10)-(A9*(1-A11)*A12)$	378	672	960
A14	Additional IT time savings on admin overhead/infrastructure management (hours)	Composite	4,400	3,165	1,937
A15	IT FTE hourly rate (fully burdened)	TEI standard	\$53	\$53	\$53
At	IT cost savings	$(A4+A7+A13+A14)*A15$	\$341,744	\$358,280	\$374,816
	Risk adjustment	↓10%			
Atr	IT cost savings (risk-adjusted)		\$307,570	\$322,452	\$337,334
Three-year total: \$967,356			Three-year present value: \$799,542		

REDUCED INFRASTRUCTURE-RELATED COSTS

Evidence and data. Interviewees shared that their organizations could reduce the cost of endpoints as

well as costs associated with power and cooling consumption once transitioning to a VDI environment with Dell Validated Designs.

VDI endpoints tend to be thin clients (i.e., computers with limited internal resources and optimized for a server-based environment). These are overall less expensive than desktops or laptops that require large hard drives and computing power. Additionally, VDI hardware lasts longer than a typical, physical endpoint because computing is reduced on the local machine. This can further reduce long-term costs.

For organizations using a GPU-accelerated VDI environment, compute resources such as GPUs could be shared across multiple users. When certain users were not working, others who were could utilize these resources. Through Validated Designs, organizations could work with Dell Technologies and NVIDIA to design this environment to provide a great user experience while not overbuying resources.

- The EVP in the financial services industry said their organization saw an 80% reduction in costs associated with higher-end workstations once moving into a Dell VDI environment with NVIDIA GPU acceleration and a 50% reduction in costs associated with average workstations. Its VDI endpoints also have a longer shelf life than the old physical workstations. The EVP said: “We’re probably not going to replace our virtual workstations for six to seven years because all they’re doing is serving an image. They don’t need any processing power, so it gives me a lot more flexibility in terms of elongating how long I have a device in my environment.”
- The associate CIO at a research university said their institution was able to purchase 300 new virtual endpoints instead of 300 new physical endpoints, which cut its spend by more than 50%.
- The DevOps manager at an education organization said their institution previously refreshed hardware every three years for more than \$1 million. Now, the Dell VDI endpoints last for more than five years.

Traditional endpoints also consume a lot of power, and it can be expensive to cool the environment to keep endpoints functioning. Interviewees’ organizations found virtual endpoints to be much more efficient, reducing power and cooling energy consumption.

- The EVP at a financial services organization stated, “From going from a nonvirtualized [environment] to a Dell virtualized environment, we saw a 50% reduction in spend on power and cooling.”
- The deputy CIO at an insurance organization seconded this statement, explaining: “We tested our energy usage, and it was 50% less for our virtualized environment with Dell. Our Dell thin clients use much less power because they don’t have an energy-consuming disk inside. We could also use less air conditioning to keep them functioning.”
- The associate CIO at a research university said: “A full desktop machine is probably running a 500-watt power supply. A virtual terminal probably runs on 10 watts. There’s 100% energy savings — no question there.”

“Instead of having to buy a \$4,000 laptop to run engineering applications, we can buy a \$250 thin client and get the exact same experience for a fraction of the cost”

Associate CIO, research university

“We can use our virtual workstations for five to 10 years because it’s a very basic piece of hardware compared to our physical endpoints. And refreshes end up being significantly cheaper.”

Deputy CIO, insurance

Modeling and assumptions. For the composite organization, Forrester assumes:

- The composite organization adds 1,000 endpoints to its Dell VDI environment in Year 1 and an additional 750 endpoints in Years 2 and 3. The composite organization uses a three-year refresh cycle, and the replaced endpoints were reaching the end of their shelf life.
- Of these endpoints, 70% are high-end endpoints in Year 1 and 50% are high-end endpoints in Years 2 and 3. These are used by power users within the organization.
- High-end endpoints in the physical environment costed \$3,000 each for the composite organization.
- Endpoints with the same capabilities providing similar or increased levels of performance in the VDI environment with Dell Validated Designs cost \$700.
- The remaining endpoints are used by knowledge workers.

- Previously, an average endpoint in the physical environment costed \$700 each for the composite organization.
- Endpoints with the same capabilities providing similar or increased levels of performance in the VDI environment with Dell Validated Designs cost \$400.
- In its legacy environment, the composite organization had an average annual power and cooling spend of \$2.5 million.
- By deploying its Dell VDI environment, the composite organization reduces its power and cooling spend by 12.5% over three years. The organization spends 50% of what it did on power and cooling for the affected endpoints in its VDI environment versus its physical environment.
- 1,000 endpoints equate to 10% of the total endpoints within the composite organization in Year 1, so a 5% decrease in costs equates to half of the previous spend on the same endpoints.

Risks. The reduction in infrastructure-related costs may vary depending on the following:

- The number of endpoints and percent of high-end endpoints in the VDI environment.
- Prior state benchmarks.
- The annual spend for power and cooling in legacy environment.

Results. To account for these risks, Forrester adjusted this benefit downward by 10%, yielding a three-year, risk-adjusted total PV of \$3.3 million.

Reduced Infrastructure-Related Costs					
Ref.	Metric	Source	Year 1	Year 2	Year 3
B1	Number of new endpoints in VDI environment	Composite	1,000	750	750
B2	Percent of high-end endpoints	Interviews	70%	50%	50%
B3	Cost of a high-end endpoint in physical environment	Composite	\$3,000	\$3,000	\$3,000
B4	Cost of a high-end endpoint in virtual environment	Composite	\$700	\$700	\$700
B5	Cost of an average endpoint in physical environment	Composite	\$700	\$700	\$700
B6	Cost of an average endpoint in virtual environment	Composite	\$400	\$400	\$400
B7	Subtotal: Cost savings on virtual endpoints with Validated Designs for VDI	$(B1*B2*(B3-B4))+(B1*(1-B2)*(B5-B6))$	\$1,700,000	\$975,000	\$975,000
B8	Average annual power and cooling spend in legacy environment	Composite	\$2,500,000	\$2,500,000	\$2,500,000
B9	Reduction in power and cooling spend due to a virtual environment with Validated Designs for AI	Interviews	5.00%	8.75%	12.50%
Bt	Reduced infrastructure-related costs	$B7+(B8*B9)$	\$1,825,000	\$1,193,750	\$1,287,500
	Risk adjustment	↓10%			
Btr	Reduced infrastructure-related costs (risk-adjusted)		\$1,642,500	\$1,074,375	\$1,158,750
Three-year total: \$3,875,625			Three-year present value: \$3,251,681		

INCREASED END USER PRODUCTIVITY

Evidence and data. Besides increasing efficiencies within the IT teams, using a VDI solution designed and benchmarked for specific use cases built with Validated Designs resulted in productivity improvements for end users.

Moving to a VDI environment with Validated Designs for VDI decreased downtime that users previously experienced in the physical environment due to endpoint performance degradation. This was especially prevalent for power users.

- According to the EVP at a financial services organization, roles at their organization such as power traders and financial analysts rely on compute- and graphics-intensive and network-

heavy applications. Providing GPU-powered performance that can scale as needed for these power users was critical, as users can experience less problems related to latency, dropped frames, and downtime compared to CPU-only VDI. With the joint and optimized NVIDIA and Dell Technologies VDI solution in place, VDI users at the organization achieved a 10 times improvement in performance and response capabilities.

- The EVP in the financial services industry said that in their organization’s previous state, power users saw upwards of 45 minutes of their day wasted due to lags in their workstation performance. With a VDI solution benchmarked to their needs through Validated Designs, users

experienced desktop-like performance in a reliable environment with compute optimized for their needs. Support from NVIDIA virtual GPUs enabled the organization to provide beyond workstation-level performance of these power users wherever they were, and it decreased downtime dramatically.

- Similarly, the DevOps manager at an education organization and the associate CIO at a research university said their institutions turned to Dell Validated Designs to configure their VDI environments with NVIDIA virtual GPUs to run their computer-aided engineering (CAE) workloads. VDI access to simulation and 3D-modeling solutions with NVIDIA virtual GPU-powered performance enabled greater design freedom and flexibility. Additionally, with solutions tested and validated by Dell, the organizations could ensure their environments could scale as needed. The associate CIO said their organization was able to reduce downtime by 75%.

Interviewees' organizations were also able to cut the time lost due to infrastructure refreshes, further increasing user productivity.

- All interviewees mentioned that since virtual desktops are not tied to specific hardware, it's easy to get new desktops up and running, and users do not lose work or waste time by setting up an entirely new machine.
- The DevOps manager at an education organization said: "If there's a hardware failure, there's no redundancy on a physical desktop. If a desktop goes down, it has to be repaired, and there's no other desktop laying around to slide in. It could take days for it to be fixed. In today's VDI environment, I have redundancy within the data center and within the VDI environment itself, so if I lose a host, it's easy to fix and there's no impact

to students. I can fix stuff without people knowing."

"If somebody's laptop is starting to die and it needs to be replaced, we would have to put in the order, and wait about a week for somebody to configure it. With VDI, if your laptop is dying, we can overnight a new one, and all [the user has] got to do is hook it up to your Wi-Fi login and, boom, you've got what you need. We can definitely respond much faster."

EVP, financial services

Modeling and assumptions. For the composite organization, Forrester assumes:

- The composite organization has a total of 1,000 endpoints in Year 1, 1,750 by Year 2, and 2,500 by Year 3 within the VDI environment.
- Fifty percent of these endpoints previously experienced downtime due to performance-degradation issues.
- With a personalized VDI solution through Validated Designs for VDI, end users are able to reduce the downtime they experience by 30 minutes.
- Fifty percent of end users experience no additional, external factors that continue to negatively influence downtime.

- In the VDI environment at the composite organization, 5% of endpoints need an infrastructure refresh per year.
- In the physical environment, infrastructure refreshes took 16 hours.
- With the Dell VDI environment, infrastructure refreshes take 5 hours.
- The hourly rate of a business user FTE is \$35.
- Forrester conservatively estimates that 50% of the total time saved per FTE is applied directly back to value-generating tasks, and it is therefore included in the benefit calculation. Individual employees may apply additional time savings toward professional development, training, and work-life activities that are not included in the benefit analysis.

Risks. End user productivity improvements may vary depending on the following:

- The size, scope, and complexity of VDI usage within the organization.
- Prior state benchmarks.
- The existence of external factors affecting latency and connectivity after the Dell VDI implementation with Validated Designs.
- The hourly rate of a business user FTE.
- The percent of productivity captured by the affected users.

Results. To account for these risks, Forrester adjusted this benefit downward by 10%, yielding a three-year, risk-adjusted total PV of \$2.2 million.

“With NVIDIA vGPUs, we can have a faster response capability in our environment, especially around those really graphics-rich virtual workstations for data analytics. We’re able to provide a much better graphic capability than a normal desktop or a laptop without having to use a high-end \$10,000 workstation.”

EVP, financial services

Increased End User Productivity					
Ref.	Metric	Source	Year 1	Year 2	Year 3
C1	Total number of endpoints in VDI environment	Composite	1,000	1,750	2,500
C2	Percent of endpoints previously experiencing downtime issues	Composite	50%	50%	50%
C3	Hours productivity improvement to daily workstreams per user	Interviews	0.50	0.50	0.50
C4	Percent of endpoints where no external factors continue to affect downtime issues	Composite	50%	50%	50%
C5	Subtotal: Hours saved from improved performance in virtual environment with Validated Designs for VDI	$C1 * C2 * C3 * 260 \text{ days} * C4$	32,500	56,875	81,250
C6	Percent of endpoints needing an infrastructure refresh	Composite	5%	5%	5%
C7	Hours lost by end user due to infrastructure refresh in the physical environment	Interviews	16	16	16
C8	Hours lost by end user due to infrastructure refresh in the virtual environment	Interviews	5	5	5
C9	Subtotal: Hours saved on infrastructure refreshes with Validated Designs for VDI	$C1 * C6 * (C7 - C8)$	550	963	1,375
C10	Business user FTE hourly rate (fully burdened)	TEI standard	\$35	\$35	\$35
C11	Productivity recapture	TEI standard	50%	50%	50%
Ct	Increased end user productivity	$(C5 + C9) * C10 * C11$	\$578,375	\$1,012,156	\$1,445,938
	Risk adjustment	↓10%			
Ctr	Increased end user productivity (risk-adjusted)		\$520,538	\$910,941	\$1,301,344
Three-year total: \$2,732,822			Three-year present value: \$2,203,778		

UNQUANTIFIED BENEFITS

Interviewees mentioned the following additional benefits that their organizations experienced but were not able to quantify:

- **Decreased security risks.** Transitioning to a VDI environment through Dell Validated Designs offered numerous security enhancements for the interviewees' organizations, reducing the risk of data breaches, data loss, sharing viruses, and cyberattacks.

With the Dell VDI solution, data is completely centralized instead of being stored on a hard drive of a machine. According to the DevOps manager at an education organization, this prevents sensitive information from leaving the network, and it "ensures that you don't lose your data if your desktop crashes, as it's stored in the networks and can therefore be restored easily."

Additionally, Dell's VDI solutions helped interviewees' organizations maintain security without sacrificing the notion of "anywhere work," because all data, communications, and applications stay safely behind the corporate firewall.

The centralized management of endpoints also simplifies the patching process. Virtual desktops do not require users to manually restart their machines or remotes users to connect to the network. Therefore, patching can be done fast, and vulnerabilities can be addressed quickly, leaving less opportunities for breaches. According to the deputy CIO at an insurance organization: "If we get an alert about a vulnerability in some software, we can have it fixed in a half hour. It could take more than a month to ensure it's deployed to every physical endpoint."

"Validated Design for VDI allowed us to democratize the data and programs our users need and provide equitable access across all our students regardless of their background or economic condition way faster than we could have done ourselves."

Associate CIO, research university

"It's way easier to keep up with passing security issues when you can do it en masse because the increase in speed to modify in the virtual environment rather than pushing out updates to all the physical devices that are out there is 100 to one."

EVP, financial services

- **Improved accessibility.** Due to the COVID-19 pandemic, institutions are navigating the changing landscape of remote, in-office, and hybrid workforces. As workforces become more mobile, VDI enables organizations to work from anywhere without adding to IT complexity. With Validated Designs, organizations can get their VDI environments up and running faster, and VDI users can be confident that their environment is optimized for their needs. And with NVIDIA virtual GPU technology, they can expect a consistent user experience regardless of their location.

The deputy CIO at an insurance organization explained: “Our Dell VDI setup has changed our reality. Our employees can work from home, they can work from their workstation, [and] they can work from their neighbor’s workstation. They can work from wherever they want, and it always works.”

In a similar vein, the DevOps manager at an education organization said: “We can give our students 24/7 access to the applications they need wherever they are [and] on any form of device. And because of our VDI solution, we could continue to teach our engineering classes throughout the pandemic, and we can do so at just the cost of a thin client compared to having pay-per-minute costs for a specific software. For teachers, students, and our school overall, our Dell VDI solution has been invaluable.”

- **The value of NVIDIA vGPUs.** While also mentioned throughout the quantified benefits, interviewees highlighted the importance of Dell Technologies’ partnership with NVIDIA. The DevOps manager at an education organization stated: “NVIDIA vGPUs are a requirement if we want our applications to run. And when you factor in the ease of management, the Dell Technologies and NVIDIA joint VDI solution provides a far better return on investment than other options we could pursue, such as refreshing our physical workstations. And getting the comprehensive solution preconfigured through Dell makes the experience even better.”

FLEXIBILITY

The value of flexibility is unique to each customer. Scenarios in which a customer might implement Validated Designs for VDI and later realize additional uses and business opportunities, include:

- **Expanding deployment.** Interviewees expressed interested in extending their organizations' VDI deployments to more users

over time with Validated Designed for VDI. They noted that the ease of scale of the solution, along with the fact that they could rely on Dell Technologies as a trusted partner to ensure their VDI environments remain optimized as usage scales, which makes this goal attainable.

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

“We started with a VDI environment without NVIDIA vGPUs. But now that we have them, there’s a 0% chance I would ever go back to a VDI environment without GPU acceleration. At the end of the day, adding vGPUs makes your end users’ experiences better and allows them to be productive from wherever they are.”

Associate CIO, research university

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	Cost of VDI operation	\$110,000	\$1,100,000	\$880,000	\$880,000	\$2,970,000	\$2,498,430
Etr	Implementation and ongoing management	\$72,188	\$103,950	\$86,625	\$69,300	\$332,063	\$290,345
	Total costs (risk-adjusted)	\$182,188	\$1,203,950	\$966,625	\$949,300	\$3,302,063	\$2,788,775

COST OF VDI OPERATION

Evidence and data. While having their compute, networking, and storage solutions architected, tested, and validated for VDI through Dell Technologies was free, the interviewees' organizations paid fees for the infrastructure itself. Dell Technologies offers a variety of pricing models that vary widely based on the scope, usage, and design of specific VDI systems.

Beyond VDI hardware, interviewees' organizations also used Dell professional services to help with planning and minor training in the initial implementation period.

Modeling and assumptions. For the composite organization, Forrester assumes:

- The composite organization pays \$100,000 for Dell professional services during the initial five-month initial implementation period.
- The organization spends \$1 million in Year 1 for onboarding 1,000 endpoints into the VDI environment.
- The organization spends \$800,000 in Years 2 and 3 for onboarding an additional 750 endpoints per year and ongoing associated fees with the VDI environment.

Risks. The cost of VDI operation may vary depending on the following:

- The total number of endpoints to which the Dell VDI environment is deployed.
- The varying compute, storage, or networking requirements of these endpoints.

Results. To account for these risks, Forrester adjusted this cost upward by 10%, yielding a three-year, risk-adjusted total PV (discounted at 10%) of \$2.5 million.

Cost Of VDI Operation						
Ref.	Metric	Source	Initial	Year 1	Year 2	Year 3
D1	Professional services	Composite	\$100,000			
D2	Ongoing costs associated with VDI compute, storage, networking, and infrastructure	Composite		\$1,000,000	\$800,000	\$800,000
Dt	Cost of VDI operation	D1+D2	\$100,000	\$1,000,000	\$800,000	\$800,000
	Risk adjustment	↑10%				
Dtr	Cost of VDI operation (risk-adjusted)		\$110,000	\$1,100,000	\$880,000	\$880,000
Three-year total: \$2,970,000			Three-year present value: \$2,498,430			

IMPLEMENTATION AND ONGOING MANAGEMENT

Evidence and data. Interviewees described how much easier implementation, deployment, and ongoing management was with Validated Designs for VDI compared to previous attempts at deploying VDI environments and/or having to do it themselves. Validated Designs streamlined infrastructure procurement and sped up deployment so IT teams could achieve working solutions quicker than with build-your-own environments.

- The EVP at a financial services organization said their organization was able to save a couple months around initial deployment with Dell compared to with another vendor. Furthermore, Dell offered more granularity within the VDI solution in terms of ensuring different types of users had access to VDI infrastructure optimized for their specific needs through automating the process of VDI configuration based on job title. This reduced ongoing management related to onboarding new users. The EVP said: “With Dell, we were able to automate the process of designating high-end and low-end workstations with the necessary software, memory, processing power, and GPUs based on job title, such as a

data analyst or trader versus a loan processor. With Validated Designs, Dell worked with us to preconfigure this in the back end, so it takes 50% less time to onboard new users than it did with our previous vendor.”

“We were able to get [our Dell VDI environment] up and running pretty quickly and can sustain it long-term. Dell has done the configuration of this, the testing has been done, this has been verified. It’s not something we are just patching together. Its’ nice to know we don’t have to worry about it, and we can move onto phase two.”

DevOps manager, education

- The Deputy CIO at an insurance organization highlighted the value of working through one point of contact with Dell versus multiple points of contact for setting up their organization's previous VDI environment. The interviewee stated: "Previously, when there was a problem, the server guy would blame the software guy, the software guy would blame the networking guy, and we would have to run between them all. Nothing ever got resolved. It was a huge stressor for our team and a time sink, so we stopped the project. It was easy with Dell because we just interfaced with one person, and they took care of all the vendors themselves. Within months, we had something. Whereas, before, we were getting nowhere in that same amount of time."
- The DevOps manager at an education organization said their institution was able to implement its VDI environment in four months with Validated Designs for VDI, compared to requiring a year if it had had to deploy it on its own. The interviewee said: "We did not have to worry about the hardware installation. If we oversaw that, it would've taken months to ensure the setup, compute, and storage was optimized."
- The associate CIO of a research university said their institution's deployment took two months compared to six months if it had configured an environment itself. Additionally, it reduced ongoing management headaches. The interviewee said: "Setting up with Validated Designs for VDI is astronomically fast. It really short-circuits your time in development. By using Validated Designs, we were able to focus on making our applications usable for everyone, instead of [saying]: 'We have a bug in the storage since the system is not working. What do we do to fix this?'" Dell resolved problems like this in their testing stage, so we can focus on generating value from the solution instead of the solution itself."

"We've had bugs in the past that could take up to two months to fix, and this could happen over and over. Dell takes care of these issues ahead of time and ensures your environment is built for success."

Associate CIO, research university

Modeling and assumptions. For the composite organization, Forrester assumes:

- Three engineers dedicate 50% of their time during the initial five-month implementation period.
- Three engineers dedicate 30% of their time in Year 1, 25% of their time in Year 2, and 20% of their time in Year 3 for ongoing management and maintenance of the VDI environment. Time spent managing the environment decreases as the FTEs become more familiar with the solution.
- The average fully burdened annual salary of an engineer is \$110,000.

Risks. Implementation and ongoing management may vary depending on the following:

- The size, scope, and complexity of operations.
- The available capacity and skill sets of teams.
- The salaries of FTEs.

Results. To account for these risks, Forrester adjusted this cost upward by 5%, yielding a three-year, risk-adjusted total PV of \$290,300.

Implementation And Ongoing Management						
Ref.	Metric	Source	Initial	Year 1	Year 2	Year 3
E1	Engineer FTE involved in implementation and ongoing management	Composite	3	3	3	3
E2	Time dedicated by engineering FTEs (months)	Interviews	5	12	12	12
E3	Percent of engineering FTEs' time dedicated to implementation	Interviews	50%			
E4	Percent of engineering FTEs' time dedicated to ongoing management	Interviews		30%	25%	20%
E5	Engineering FTE annual salary (fully burdened)	TEI standard	110,000	\$110,000	\$110,000	\$110,000
E _t	Implementation and ongoing management	$E1 \cdot E2 \cdot E3 \cdot (E5/12 \text{ months}) + E1 \cdot E2 \cdot E4 \cdot (E5/12 \text{ months})$	\$68,750	\$99,000	\$82,500	\$66,000
	Risk adjustment	↑5%				
E _{tr}	Implementation and ongoing management (risk-adjusted)		\$72,188	\$103,950	\$86,625	\$69,300
Three-year total: \$332,063			Three-year present value: \$290,345			

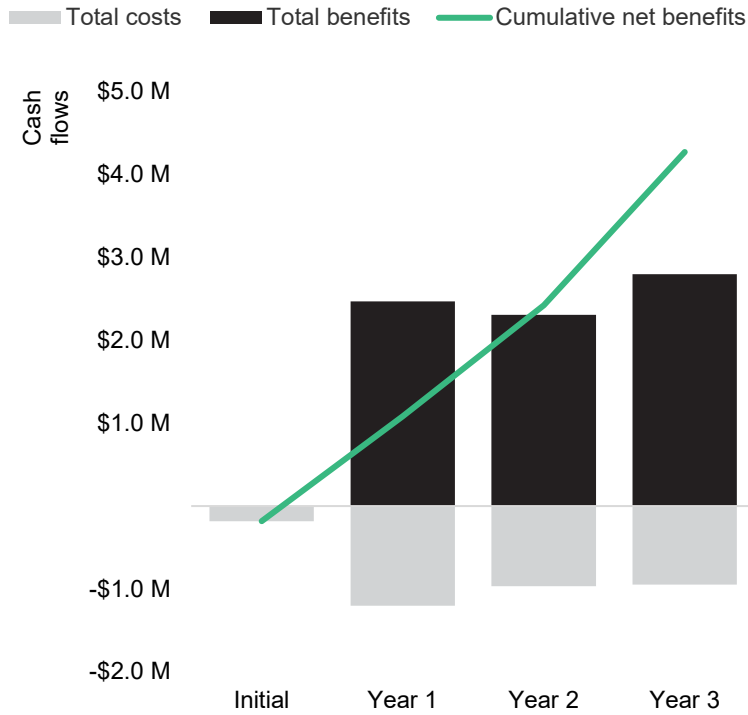
“By using something already validated by Dell, you reduce the risk around whether your solution is going to work and can short-circuit your time to market. It’s already been tested; you’re guaranteed that it’s going to work.”

— Associate CIO, research university

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 and NPV for the composite organization's investment. Forrester assumes a yearly discount rate of 10% for this analysis.

These risk-adjusted ROI and NPV 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	(\$182,188)	(\$1,203,950)	(\$966,625)	(\$949,300)	(\$3,302,063)	(\$2,788,775)
Total benefits	\$0	\$2,470,607	\$2,307,768	\$2,797,428	\$7,575,803	\$6,255,001
Net benefits	(\$182,188)	\$1,266,657	\$1,341,143	\$1,848,128	\$4,273,740	\$3,466,226
ROI						124%

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 Source: “The State of VDI, 2021,” Forrester Research, Inc., October 20, 2021.

² 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.

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