

A Forrester Total Economic Impact™
Study Commissioned By Dell EMC
October 2017

The Total Economic Impact™ Of Dell EMC ScaleIO

Cost Efficiency And Improved
Performance Enabled By Software-
Defined Storage: ScaleIO

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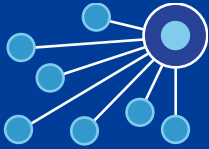
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Executive Summary

Benefits And Costs



A reduction of at least 40% in overall storage infrastructure costs over four years:

\$131 million



A 66% reduction in storage management and support costs over four years:

\$44 million



ScaleIO infrastructure investment over four years:

\$98.5 million

Dell EMC ScaleIO is a data center grade, scale-out software-defined storage (SDS) that applies the principles of virtualization — abstract, pool, and automate — to standard x86 server direct-attached storage (DAS). ScaleIO simplifies the storage lifecycle by removing complex forklift upgrades. It eliminates the requirement for SAN equipment or expertise, minimizes component variation in the data center and eliminates risky data migration. ScaleIO enables enterprises of all sizes to operate at web-scale efficiency. Dell EMC commissioned Forrester Consulting to conduct a Total Economic Impact™ (TEI) study and examine the potential return on investment (ROI) enterprises may realize by deploying ScaleIO. The purpose of this study is to provide readers with a framework to evaluate the potential financial impact of ScaleIO on their organizations.

To better understand the benefits, costs, and risks associated deploying software-defined storage, Forrester interviewed a current ScaleIO customer, a multinational financial services organization with several years of experience managing tens of petabytes of storage using ScaleIO.

Prior to using ScaleIO, the interviewed customer embarked on a strategy initiative to transform into a digital organization, shifting over \$1 billion from the IT infrastructure budget to application development areas to fuel client innovation. At the same time, the financial crisis forced the bank to invest more heavily in IT to increase collaboration and reduce costs. These drivers led to increased growth in storage and infrastructure requirements to support these projects. At a 30% annual growth rate of the organization's SAN storage environment, the pace of growth was offsetting the benefits from traditional storage as the cost of managing storage in silos got bigger each year. The organization realized that it needed a cost-efficient storage solution that could scale with the enterprise.

By implementing software-defined storage with ScaleIO, the organization could significantly reduce capital and operating costs when compared with traditional block storage. As one interviewed executive noted, "On a direct asset basis, we will leverage ScaleIO to double the amount of storage capacity installed and knock 30% of our storage asset TCO by 2019, and that's a fantastic story." These benefits were driven by the ScaleIO architecture, which removes the cost and complexity of a traditional SAN deployment. The organization improved its ability to scale and support its explosive data growth. The organization also gained increased agility, elasticity and provided better performance by deploying software-defined storage with ScaleIO.

Key Findings

Quantified benefits. The interviewed organization experienced the following risk-adjusted quantified benefits:

- › **Improved cost efficiency with storage hardware cost savings.** The organization stated that deploying ScaleIO saved per unit storage costs when compared with traditional block storage arrays. The financial analysis in this study is based on the internal rate cards provided by the interviewed organization. These rate cards are internal rates charged by the IT organization to its business units for use of its services.



ROI
89%



Benefits PV
\$186.7 million



NPV
\$88.2 million



Payback
10 months

After deployment, the organization's actual internal rate card for ScaleIO hardware was 61% less than the rate card for traditional storage hardware. Based on these internal rate cards, the organization will save \$74.2 million in traditional storage hardware costs over a four-year analysis. These hardware infrastructure cost savings cover storage racks, compute costs for the compute that are storage nodes, and apportionment of DC network switch costs, among others.

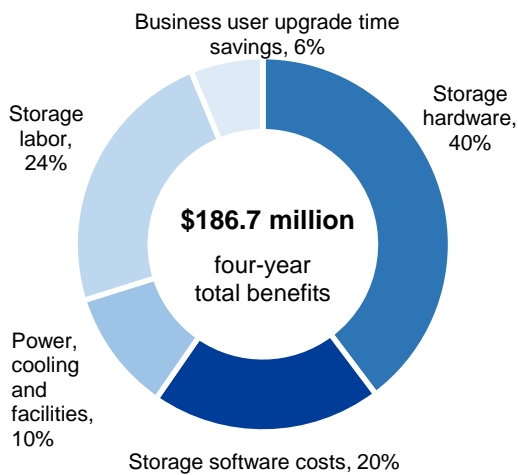
- › **Improved cost efficiency with storage software cost savings.** The organization's actual internal rate card for ScaleIO software was 3% less than the rate card for traditional storage software. Based on these internal rate cards, the organization will avoid the cost of \$37.2 million in traditional storage software by moving to ScaleIO over a four-year analysis. These storage software cost savings include all associated software costs for storage nodes, system management tools, and others.
- › **Reduction in data center costs by 70%.** When comparing costs across global locations, the organization noted that power, cooling and facilities costs for ScaleIO were lower than those for traditional block storage. In this analysis, rates for ScaleIO were 70% less than storage power, cooling, and facilities costs for traditional block storage. Over a four-year analysis based on these rates, the organization will gain data center facilities cost avoidance savings, which include power and cooling, of \$19.7 million for traditional storage.
- › **Reduction in ongoing storage management costs by 70%.** ScaleIO was also easier to manage when compared with the organization's traditional block storage environment. The increased flexibility, improved reliability with features such as self-healing, and ease of storage administration and automation contributed to a 70% reduction in deployment, management, and migration costs for the IT organization's storage administrators. With ScaleIO, the traditional SAN environment as we know it no longer exists, as ScaleIO uses Ethernet. This leads to lower management costs by eliminating expensive skills and simplifying the environment. These storage management cost savings are quantified at \$44 million over four years.
- › **Application development team migration cost savings.** Moving to ScaleIO also improved productivity for application developers, as the organization could add or replace servers without any data migrations or downtime. By eliminating forklift upgrades, the organization also eliminated the costs of this disruptive storage migration for these teams. Over the four-year analysis, as the number of applications supported by ScaleIO increased, and at an average 40 hours saved per person, these application development productivity gains are quantified at \$11.7 million.

Other benefits. The interviewed organization experienced the following benefits, which are not quantified for this study:

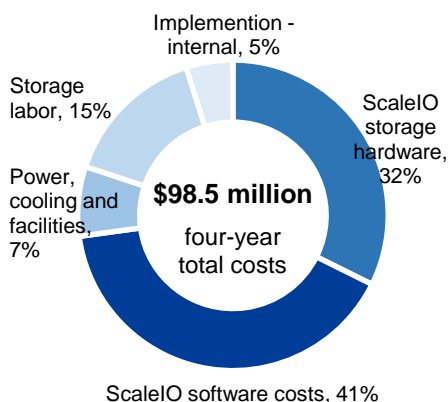
- › **Increased deployment agility and faster time-to-market.** The organization reduced deployment speed for a pod from six months in a traditional block storage environment to 31 days with ScaleIO. With quick turnaround from purchase order to "power on, faster deployment of storage resources also contributed to faster time-to-market for these projects.

- › **Better performance.** The organization also reported increased performance as it moved from a traditional SAN environment with hybrid or HDD's configuration to All-Flash storage using ScaleIO. The organization reported performance improvement of at least 40% on traditional workloads for applications such as Oracle-as-a-service, Mongo-as-a-service, among others.
- › **Improved ability to scale.** ScaleIO enabled the organization to easily increase and decrease storage capacity with minimal advanced planning. The organization can now scale and grow compute capacity or storage infrastructure as needed, without incurring restrictive costs.
- › **Better risk mitigation.** The organization also benefited from improved risk mitigation with a more robust storage infrastructure through ScaleIO. IT now has the ability to eliminate risky data migration and migrate data sets within data centers, giving the organization improved business continuity and increased efficiency. The organization avoids downtime and gains rapid self-healing.
- › **Improved inventory and asset management.** With ScaleIO, the organization could improve inventory asset management, as it was easier to track ScaleIO storage and assess storage assets more accurately. This led to better billing precision, with a potential 10% to 12% reduction in internal underbilling from IT to the business on a \$225 million annual storage portfolio.
- › **Support to accelerated pace of innovation that contributes to the firm's bottom line.** ScaleIO deployment brought the cultural benefit of driving engineering innovation while at the same time reducing infrastructure costs. Building a converged infrastructure, with a technology adoption strategy of which ScaleIO was a major component, contributed 10% on an earnings-per-share basis.

Block Siloed SAN



Block SDS/ScaleIO



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

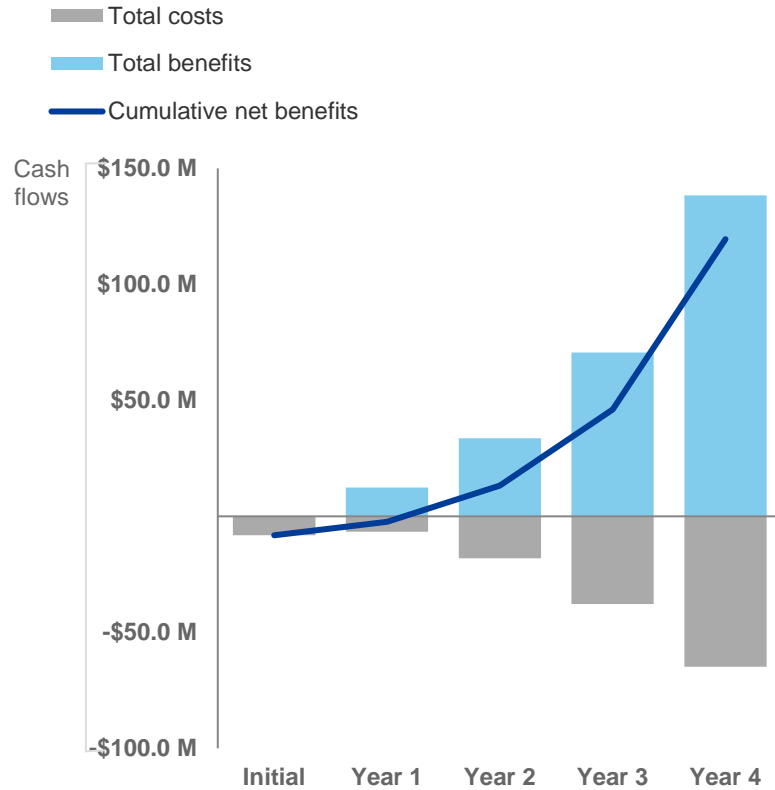
- › **ScaleIO hardware and software costs.** Based on internal rate cards, ScaleIO infrastructure costs. These costs include storage hardware and software, storage network (dedicated Arista IP fabric), compute endpoint connection, system management tools, and attributed services such as engineering, command center, and security.
- › **Power, cooling, and facilities costs.** Over the four-year analysis, the organization will also spend \$7.1 million on power, cooling, and facilities costs for ScaleIO. These costs are 70% less than that for legacy storage infrastructure.
- › **Labor and ongoing management costs.** Ongoing management and administration of ScaleIO will cost the organization \$14.8 million over four years. These costs are 70% less than that for legacy storage infrastructure.
- › **Project implementation costs.** Initial implementation costs include six IT engineers working for six months, as well as the cost of running a system in parallel for those six months on traditional storage. Total project implementation costs are \$4.8 million.

Forrester's interviews with the existing customer and subsequent financial analysis, using a discount rate of 10%, found that the interviewed organization will experience benefits of \$186,718,981 over four years versus costs of \$98,547,281, adding up to a **net present value (NPV) of \$88,171,701** and an **ROI of 89%**.

Financial Summary

CONSOLIDATED FOUR-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 interviewed organization's investment. Forrester assumes a yearly discount rate of 10% for this analysis.



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

Cash Flow Table (Risk-Adjusted)

	INITIAL	YEAR 1	YEAR 2	YEAR 3	YEAR 4	TOTAL	PRESENT VALUE
Total costs	(\$4,805,280)	(\$6,670,849)	(\$18,029,321)	(\$37,861,574)	(\$64,905,555)	(\$132,272,578)	(\$98,547,281)
Total benefits	\$0	\$12,455,143	\$33,662,548	\$70,691,352	\$138,305,295	\$255,114,338	\$186,718,981
Net benefits	(\$4,805,280)	\$5,784,294	\$15,633,228	\$32,829,778	\$73,399,740	\$122,841,760	\$88,171,701
ROI							89%
Payback period							10 months

TEI Framework And Methodology

From the information provided in the interview, Forrester has constructed a Total Economic Impact™ (TEI) framework for those organizations considering implementing Dell EMC ScaleIO.

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 Dell EMC ScaleIO can have on an organization:

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



DUE DILIGENCE

Interviewed Dell EMC stakeholders and Forrester analysts to gather data relative to ScaleIO.



CUSTOMER INTERVIEW

Interviewed one organization using ScaleIO to obtain data with respect to costs, benefits, and risks.



FINANCIAL MODEL FRAMEWORK

Constructed a financial model representative of the interview using the TEI methodology and risk-adjusted the financial model based on issues and concerns of the interviewed organization.



CASE STUDY

Employed four fundamental elements of TEI in modeling Dell EMC ScaleIO's impact: benefits, costs, flexibility, and risks. Given the increasing sophistication that enterprises have regarding ROI analyses related to IT investments, Forrester's TEI methodology serves to provide a complete picture of the total economic impact of purchase decisions. Please see Appendix A for additional information on the TEI methodology.

DISCLOSURES

Readers should be aware of the following:

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

Forrester makes no assumptions as to the potential ROI that other organizations will receive. Forrester strongly advises that readers use their own estimates within the framework provided in the report to determine the appropriateness of an investment in Dell EMC ScaleIO.

Dell EMC 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 EMC provided the customer name for the interview but did not participate in the interview.

The ScaleIO Customer Journey

BEFORE AND AFTER THE SCALEIO INVESTMENT

Interviewed Organization

For this study, Forrester conducted interviews with a current Dell EMC ScaleIO customer:

- › It is a leading global financial services organization.
- › It has locations in over 150 countries, with more than 200,000 employees worldwide.
- › It has over \$7 billion of IT spend per year. It also spends approximately \$225 million per year on its SAN storage environment. It is managing over 200 PBs of block storage.
- › Its infrastructure supports trillions of dollars in transactions per day.

Key Challenges

As the organization aggressively pursued a digital transformation strategy that required it to scale storage and infrastructure at a significant pace to support projects that drove innovation and new capabilities for financial services, its storage and systems team was faced with the challenge of managing costs with this growth, including:

- › **An accelerated growth of the storage environment.** The organization was seeing an average 31% growth rate year over year in its SAN block storage environment. The bank expected this growth to accelerate further as it progressed in its digital initiatives, especially with the emergence of Big Data, OpenStack architectures, and associated micro services.
- › **Rising costs to manage storage in silos.** The organization observed that these growth rates for storage were “offsetting the traditional benefits” the bank had derived from its block storage investments. Costs to manage storage in silos were rising. At a \$225 million a year cost for its current SAN storage environment, the organization had to find a more cost-efficient solution to scale its storage infrastructure.

Solution Requirements

The interviewed organization chose to implement software-defined storage to gain the flexibility and efficiency needed to scale. After an extensive request for proposal (RFP) and business case process evaluating multiple vendors, the interviewed organization chose ScaleIO and began deployment:

- › The organization chose a phased approach to deployment. Its first workload in production was in one pod in North America, and it rapidly scaled out to two other data centers for production workflows. Within 18 months, the organization had implemented ScaleIO from one data center to eight data centers and from one geography to three geographies.

“We’ve had a good number of large benefits from our ScaleIO investment. There’s the 40% to 80% savings, on a unit cost basis, when compared to traditional storage. We’re seeing far better performance. We’re seeing better flexibility at the scale of storage we’re deploying. There’s the cultural benefit of building something that’s innovative and cutting edge. And the economic impact at the macro level of seeing meaningful contributions back to earnings per share.”

EVP cloud portfolio, leading financial services organization



“It’s a pretty good testament to the ScaleIO platform that we are aggressive and have the confidence to move 40% of the firm’s database environment to ScaleIO. About 50% of our block storage data is consumed by our database environment, and it’s the lifeblood of how you move money across the bank.”

EVP cloud portfolio, leading financial services organization



- › The organization adopted a deployment model for its ScaleIO implementation that disaggregated compute capacity from the ScaleIO storage cluster. This was intentionally designed so the organization has the flexibility to grow compute or storage infrastructure as needed when workloads change.
- › The organization deploys x86 servers in rack-scale “pods” (in either compute or storage building blocks), using standard Ethernet networking. A typical storage pod consists of 90-110 servers.
- › By the end of 2019, the organization plans to have 40% of its database environment running on ScaleIO. The interviewed organization currently has approximately 1,600 cloud applications using ScaleIO, with approximately 3,500 users on the application development team supporting these applications.

“From an economics perspective, frankly, software-defined storage is too attractive to not do.”

EVP cloud portfolio, leading financial services organization



Key Results

The interviews revealed that key results from the ScaleIO investment include:

- › **Reduced costs, leading to better cost efficiency and improved ability to scale.** For the interviewed organization, the main benefit from its deployment of software-defined storage with ScaleIO was the cost savings on storage infrastructure, power, cooling, and facilities, as well as operating expenses in terms of labor and ongoing support, when compared with a traditional SAN investment. Moving to ScaleIO from traditional block storage also brought seamless data migration, which saves time and effort for the application development teams. Because of this improved cost efficiency, the organization can now scale and deliver digital innovation while managing storage expenses.
- › **Improved performance of storage infrastructure.** Improved performance was another key benefit of the ScaleIO deployment. Moving from traditional SAN to ScaleIO with All-Flash storage boosted performance of traditional workloads by least 40%. With the initial ScaleIO deployment, the storage and systems organization guaranteed 2,500 IOPS per terabyte for low-end capacity flash, and 5,000 IOPS per terabyte for high-end capacity flash. With the current 2017 ScaleIO fourth generation hardware design with improved density, the storage and systems organization can provide 20 million IOPS on All Flash ScaleIO configurations per POD. Performance with this fourth generation All Flash design represents a 260% improvement for traditional workloads. Users from the application development teams also reported improved batch load times and faster read and write times, and remarked on the “outstanding performance” from ScaleIO. As one interviewed executive noted, “The feature of ScaleIO that we found most valuable was that the solution was built to handle enterprise scale storage issues since it was high performance and robust at scale.”

“Anecdotes from the app teams usually end with an exclamation like, ‘Wow!’ when they do performance benchmarking for ScaleIO. Now you have the database guys calling their friends and other application owners, saying the [ScaleIO] platform is outstanding.”

Global engineering head, storage and systems, leading financial services organization



- › **Increased deployment agility and faster time-to-market.** With ScaleIO, the speed of deployment increased. A storage deployment was typically six months in a SAN environment. The organization considered the placement of the purchase order as the start of the deployment phase. The first ScaleIO pod the organization deployed took 31 days, which represents an 83% reduction in deployment time. “From purchase order to power on, we’ve taken months out of the deployment process,” one interviewee said. This translates to faster storage provisioning for applications and services, which brings increased agility to the business.
- › **Support of a culture of innovation.** The organization also noted that its ScaleIO implementation helped drive cultural change. The firm had an overarching tech strategy to modernize applications and transform computing products and capabilities as part of its private cloud initiative. From an engineering perspective, the organization noted that it was able to design, in deep partnership with the Dell EMC ScaleIO team, the next generation of storage infrastructure. Its storage and systems team was “energized” from the experience of working on this project that was “innovative and cutting edge.” At the same time, the improved performance and faster time-to-market benefits of ScaleIO also encouraged application development teams to improve collaboration and move their applications and projects toward this new cloud strategy. One executive observed, “Our app dev teams were going through behavior-changing acts to try to figure out how to get onto the software-defined storage platform.” This, in turn, drove the development of better internal capabilities to support these teams’ long-term digital initiatives.

While the software-defined storage strategy with ScaleIO has brought hard cost savings and more qualitative benefits to the firm, the team continues to work on constant engineering innovation to meet the organization’s overarching long-term goals. As the head of engineering of storage and systems noted: “What we’ve done so far, those are necessary achievements, but they’re not sufficient. We have to go further, we have to be more aggressive, because our costs are getting larger with the number of things we are trying to do [with our digital initiatives]. With the size and scope of our organization, we have to get in front of those cost levers to make our strategies for the future manifest.”

Financial Analysis

QUANTIFIED BENEFIT AND COST DATA

Total Benefits

REF.	BENEFIT	YEAR 1	YEAR 2	YEAR 3	YEAR 4	TOTAL	PRESENT VALUE
Atr	Infrastructure cost savings - hardware	\$5,278,787	\$14,266,991	\$29,960,681	\$51,361,168	\$100,867,627	\$74,180,071
Btr	Infrastructure cost savings - software	\$2,643,717	\$7,145,181	\$15,004,880	\$25,722,652	\$50,516,431	\$37,150,794
Ctr	Power, cooling and facilities cost savings	\$1,400,670	\$3,785,594	\$7,949,748	\$13,628,139	\$26,764,151	\$19,682,892
Dtr	Management and support cost savings	\$3,131,969	\$8,464,782	\$17,776,042	\$30,473,215	\$59,846,009	\$44,011,952
Etr	Business user upgrade time savings	\$0	\$0	\$0	\$17,120,120	\$17,120,120	\$11,693,272
	Total benefits (risk-adjusted)	\$12,455,143	\$33,662,548	\$70,691,352	\$138,305,295	\$255,114,338	\$186,718,981

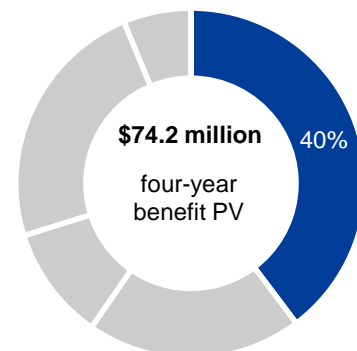
The benefits listed above are all cost avoidance savings. These benefits are the costs that the organization would have incurred for traditional storage infrastructure in the four benefit categories of (1) storage hardware, (2) storage software, (3) power, cooling and facilities, (4) management and labor support, and (5) application development migration time for the equivalent amount of software-defined storage with ScaleIO. For an in-depth discussion of the Forrester Total Economic Impact methodology, please refer to Appendix A.

The table above shows the total of all benefits across the areas listed below, as well as present values (PVs) discounted at 10%. Over four years, the interviewed organization expects risk-adjusted total benefits to be a PV of nearly \$187 million.

Hardware Cost Savings — Cost Avoidance Of Traditional Storage Infrastructure

By deploying ScaleIO, the organization improved the cost efficiency of its storage infrastructure. These cost efficiencies will continue to grow as the organization moves a larger percentage of its annual storage investment to SDS with ScaleIO instead of traditional proprietary storage array hardware.

- › When asked to evaluate the cost-benefit analysis of moving to ScaleIO from its traditional SAN environment, the organization reported that its internal rate card for traditional SAN storage was \$0.1506 per month per gigabyte versus a rate of \$0.0664 per month per gigabyte for ScaleIO. This represents a 56% reduction in overall storage costs based on internal chargeback rates.



Storage hardware cost avoidance savings: **40%** of total benefits

- › For the purposes of this analysis, quantification of cost and benefit categories is primarily based on internal rate cards reported by the organization. Internal rate cards are chargeback rates used by the IT organization to charge business units for IT services such as storage infrastructure.

The storage hardware infrastructure savings benefit is quantified in terms of cost avoidance of traditional storage hardware infrastructure expenses for the equivalent amount of ScaleIO storage. These expenses include storage hardware, racks, compute costs for the compute that are storage nodes, and apportionment of DC network switch costs, among others. For the interviewed organization, Forrester assumes that:

- › It deploys 7.4 petabytes (PB) of ScaleIO storage in the first year of implementation, and that this grows to 20 PB, 42 PB, and 72 PB in years 2, 3, and 4, respectively.
- › Chargeback rates for traditional storage hardware infrastructure are \$0.0626 per gigabyte (GB) per month, rounded to the nearest ten-thousandth. This figure is a portion of the \$0.1506 per GB figure cited earlier.

There are several potential risks that can affect this benefit. Refer to Appendix A for more details, but changes in assumptions that can affect this benefit are:

- › Variability in ScaleIO storage deployed and year-over-year growth of storage requirements
- › Variability in chargeback rates for traditional storage, as these rates may also change over time

To account for these risks, Forrester adjusted this benefit downward by 5%, yielding a four-year risk-adjusted total PV of \$74,180,071.



ScaleIO drove savings of at least 56% on a per-unit storage cost basis when compared with traditional storage arrays.

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

Avoided Costs For Traditional Storage Hardware Infrastructure: Calculation Table

REF.	METRIC	CALC.	YEAR 1	YEAR 2	YEAR 3	YEAR 4
A1	Storage amount (in PB)		7.4	20.0	42.0	72.0
A2	Traditional storage rate per month per gigabyte		\$0.0626	\$0.0626	\$0.0626	\$0.0626
A3	Conversion from GB to PB		1,000,000	1,000,000	1,000,000	1,000,000
A4	Number of months		12	12	12	12
At	Storage hardware infrastructure cost savings	$A1 * A2 * A3 * A4$	\$5,556,618	\$15,017,885	\$31,537,559	\$54,064,387
	Risk adjustment	↓5%				
Atr	Storage hardware cost savings (risk-adjusted)		\$5,278,787	\$14,266,991	\$29,960,681	\$51,361,168

Software Cost Savings — Cost Avoidance Of Traditional Storage Infrastructure

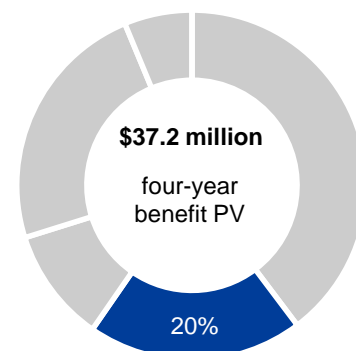
The storage software infrastructure savings benefit is quantified in terms of cost avoidance of traditional storage software expenses for the equivalent amount of ScaleIO storage software. These expenses include storage software costs such as associated software for storage nodes, system management tools, and attributed services. For the interviewed organization, Forrester assumes that:

- › Chargeback rates for traditional storage software infrastructure are \$0.03134 per gigabyte (GB) per month, rounded to the nearest ten-thousandth.
- › Platforms that run on storage, such as Oracle database software licensing, are not part of the scope of the rates as the analysis only compares storage to storage cost.

There are several potential risks that can affect this benefit. Refer to Appendix A for more details, but changes in assumptions that can affect this benefit are:

- › Variability in ScaleIO storage deployed and year-over-year growth of storage requirements
- › Variability in chargeback rates for traditional storage software, as these rates may also change over time

To account for these risks, Forrester adjusted this benefit downward by 5%, yielding a four-year risk-adjusted total PV of \$37,150,794.



Storage software cost avoidance savings: **20%** of total benefits

Avoided Costs For Traditional Storage Software Infrastructure: Calculation Table

REF.	METRIC	CALC.	YEAR 1	YEAR 2	YEAR 3	YEAR 4
B1	Storage amount (in PB)		7.4	20.0	42.0	72.0
B2	Traditional storage rate per month per gigabyte		\$0.03134	\$0.03134	\$0.03134	\$0.03134
B3	Conversion from GB to PB		1,000,000	1,000,000	1,000,000	1,000,000
B4	Number of months		12	12	12	12
Bt	Storage software infrastructure cost savings	$B1 * B2 * B3 * B4$	\$2,782,860	\$7,521,243	\$15,794,611	\$27,076,476
	Risk adjustment	↓5%				
Btr	Storage software cost savings (risk-adjusted)		\$2,643,717	\$7,145,181	\$15,004,880	\$25,722,652

Power, Cooling, And Facilities Cost Savings

By directing new growth and refreshes to ScaleIO from traditional vendor-sourced storage arrays and appliances, the organization was also able to reduce opex for data center facilities costs, which include power and cooling.

- › When comparing power, cooling, and facilities costs across global locations, the organization noted that costs for ScaleIO were lower than those for traditional block storage. With better storage utilization and optimization, the organization deploys less equipment and avoids the cost of buying additional network hardware, thus reducing power, cooling and facilities costs.
- › The organization provided estimates from 30% to 98% reduction in power, cooling and facilities costs across the organization.
- › One interviewee noted that with the efficiency brought by its ScaleIO investment, the organization now had more space in the data center to run other hardware. This is a valuable benefit as the cost of building a new data center when an organization runs out of space can run into millions of dollars.

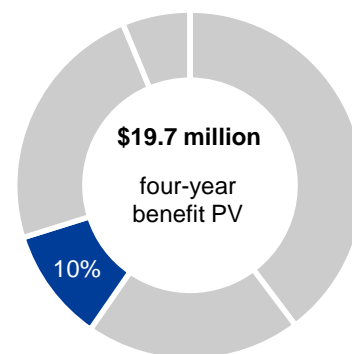
For the interviewed organization, Forrester assumes that:

- › Chargeback rates for power, cooling, and facilities costs for traditional storage infrastructure are \$0.1922 per gigabyte per year or \$0.0166 per gigabyte per month, rounded to the nearest ten-thousandth. At an internal annual chargeback rate of \$0.0598 for ScaleIO, this represents a 70% reduction in power, cooling and facilities costs.

There are several potential risks that can affect this power, cooling, and facilities cost avoidance savings benefit. Changes in assumptions that can affect this benefit are:

- › Power, cooling, and facilities rates will vary with each organization's pre-SDS environment, data center locations, and other configurations.

To account for these risks, Forrester adjusted this benefit downward by 5%, yielding a four-year risk-adjusted total PV of \$19,682,892.



Cost avoidance savings on power, cooling and facilities: **10%** of total benefits



Reduction in power, cooling, and facilities costs of **70%**

Power, Cooling And Facilities Cost Savings: Calculation Table

REF.	METRIC	CALC.	YEAR 1	YEAR 2	YEAR 3	YEAR 4
C1	Storage amount (in PB)		7.4	20.0	42.0	72.0
C2	Traditional storage power, cooling, and facilities rate per month per gigabyte		\$0.0166	\$0.0166	\$0.0166	\$0.0166
C3	Conversion from GB to PB		1,000,000	1,000,000	1,000,000	1,000,000
C4	Number of months		12	12	12	12
Ct	Power, cooling, and facilities cost savings	$C1 * C2 * C3 * C4$	\$1,474,389	\$3,984,836	\$8,368,156	\$14,345,409
	Risk adjustment	↓5%				
Ctr	Power, cooling, and facilities cost savings (risk-adjusted)		\$1,400,670	\$3,785,594	\$7,949,748	\$13,628,139

Management And Support Cost Savings

The organization also benefited from ease of management and automation with its ScaleIO deployment when compared with its previous traditional block storage environment. This management and support cost savings came from easier deployment activities such as bidding, capacity planning, and faster provisioning of storage. The IT infrastructure team was also able to reduce management effort with virtualization and consolidation. Using ScaleIO instead of traditional SAN also eliminated migration effort and corresponding IT infrastructure staff time spent on data migration for storage upgrades.

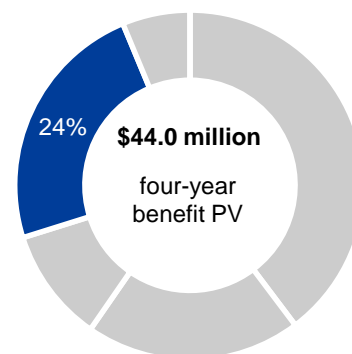
- › This organization reported that “from a labor support perspective, the operating costs of ScaleIO are one-tenth the operating costs of traditional storage.” Part of this cost reduction was due to the elimination of “big lift and shift” storage array upgrades. The organization also added that costs per terabyte per migration are coming down with each iteration of the ScaleIO platform.
- › The organization reported an internal chargeback rate of \$0.0113 per gigabyte per month for storage engineering and operations labor costs for the ScaleIO environment. This is equivalent to a 70% reduction in labor costs compared to a traditional block storage environment. This reduction may increase as the amount of storage implemented scales up, and storage engineering labor, which is part of the chargeback rate, is not variable with the amount of storage deployed.

With its ScaleIO deployment, the organization avoids the support costs for the equivalent traditional storage infrastructure. For the interviewed organization, Forrester assumes that:

- › The corresponding rate for management and support costs for the organization’s traditional block storage environment is \$0.0371 per gigabyte per month, rounded to the nearest ten-thousandth.

There are several potential risks that can affect this benefit, which include the variance in the size of the IT engineering storage team and the variability in management costs of the pre-SDS environment, as well as the variability in the implementation model for ScaleIO.

To account for these risks, Forrester adjusted this benefit downward by 5%, yielding a four-year risk-adjusted total PV of \$44,011,952.



Storage management and support cost avoidance savings: **24%** of total benefits



Labor and support costs for ScaleIO were 70% less than those for traditional storage.

Management And Support Cost Savings: Calculation Table

REF.	METRIC	CALC.	YEAR 1	YEAR 2	YEAR 3	YEAR 4
D1	Storage amount (in PB)		7.4	20.0	42.0	72.0
D2	Management and support costs for traditional storage per month per gigabyte		\$0.0371	\$0.0371	\$0.0371	\$0.0371
D3	Conversion from GB to PB		1,000,000	1,000,000	1,000,000	1,000,000
D4	Number of months		12	12	12	12
Dt	Management and support cost savings	$D1 * D2 * D3 * D4$	\$3,296,810	\$8,910,297	\$18,711,624	\$32,077,069
	Risk adjustment	↓5%				
Dtr	Management and support cost savings (risk-adjusted)		\$3,131,969	\$8,464,782	\$17,776,042	\$30,473,215

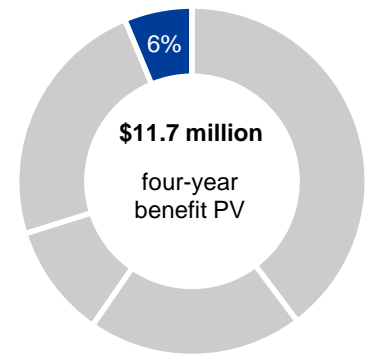
Migration Cost Savings For Application Development Team

Moving to ScaleIO from traditional SAN storage also eliminated migration costs for the application development team. These costs include the time spent on the migration effort, failover testing, and downtime from maintenance windows, among others. As the interviewed organization noted: "We'd upgrade storage every three to four years in the SAN environment, and considering all the change processes in an upgrade, and all the testing and software assurance teams involved, it's a significant cost. These migrations are generally disruptive from an app team perspective." The interviewed organization also added, "Whereas in a ScaleIO environment, we just switch out the storage and migrate the data, without any effect on app team opex." For the organization, the current applications running on ScaleIO are supported by approximately 3,500 developers.

To quantify the benefit of eliminating the storage migration effort on application development teams, Forrester assumes that for the interviewed organization:

- › The number of users on the application development team whose applications run on ScaleIO will grow from 648 initially to 6,048 by Year 4.
- › The average fully loaded compensation for these developers is \$65,000 per year. This figure is a global blended rate, as these developers are in multiple locations worldwide.
- › The average time saved for these application developers by eliminating storage migration effort is five days, or 40 hours.
- › Migration time saved for ScaleIO storage deployed in the initial implementation period will be realized in Year 4. Migration time saved for ScaleIO storage implemented in Year 1 will be realized in Year 5. Migration time saved for ScaleIO storage implemented in years 2, 3, and 4 will be realized in years 6, 7, and 8, respectively.

The table below shows the calculations for application development team time savings from eliminating storage migration effort for ScaleIO storage deployed in the first four years of the analysis. The total present value in year 4 of these productivity savings is \$19,022,356.



ScaleIO eliminated migration cost for app dev team: 6% of total benefits



40 hours migration effort saved per developer

Productivity Savings, Years 4 Through 8: Calculation Table

REF.	METRIC	CALC.	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8
X1	Number of users		648	3,500	4,200	5,040	6,048
X2	Average fully loaded compensation per hour (developer)	\$65,000/2,080 hours	\$31.25	\$31.25	\$31.25	\$31.25	\$31.25
X3	Average number of hours saved for storage migration		40	40	40	40	40
Xt	Productivity savings	X1*X2*X3	\$809,375	\$4,375,000	\$5,250,000	\$6,300,000	\$7,560,000
Xpv	Present value (Initial = Year 4)	Xt for years 4 to 8	\$19,022,356				

There are several potential risks that can affect this benefit, mainly stemming from some assumptions that are highly variable. Refer to Appendix A for more details, but changes in assumptions that can affect this benefit are:

- › There may be variability in the number of applications supported by ScaleIO and the number of application developers affected by storage migration projects
- › The timeframe for storage refresh in a traditional SAN environment may vary depending on the vendor and the way the initial purchase and support contracts were structured.
- › Compensation levels may change depending on the location of the application developers affected.
- › Migration effort may also vary depending on an organization's pre-ScaleIO environment.

To account for these risks, Forrester adjusted this benefit downward by 10%, yielding a four-year risk-adjusted total PV of \$11,693,272.

Migration Cost Savings — Application Development: Calculation Table

REF.	METRIC	CALC.	YEAR 1	YEAR 2	YEAR 3	YEAR 4
E1	Value of application development hours saved by avoiding traditional migration cost with ScaleIO deployment	Xpv	\$0	\$0	\$0	\$19,022,356
Et	Application development team — migration cost savings	E1	\$0	\$0	\$0	\$19,022,356
	Risk adjustment	↓10%				
Etr	Application development team — migration cost savings (risk-adjusted)		\$0	\$0	\$0	\$17,120,120

Unquantified Benefits

The organization was not able to quantify all benefits enabled by ScaleIO. Some benefits that the organization has identified but not quantified are:

- › **Faster speed of deployment** and more seamless data migration processes would also affect business users and not just the application development teams. This could potentially result in productivity savings for these business users as well as improved revenue from the projects that benefited from faster time-to-market with ScaleIO.
- › **Cost avoidance of new data centers.** Organizations who are running out of space in their data center may save additional millions of dollars with their move to ScaleIO. The increased efficiency of ScaleIO may result in deferral of new data center requirements.
- › **Improved risk mitigation** was another cited benefit, as the organization noted that it moved to a more robust software-defined ecosystem with ScaleIO. The systems and storage team could now migrate data sets within data centers, giving the organization improved business continuity and increased efficiency.
- › The organization saw **improved inventory asset management** with ScaleIO, as it was easier to track ScaleIO storage and assess storage assets more accurately when compared with its traditional storage infrastructure. ScaleIO gives the organization better billing precision. Currently, the organization estimates that it has a 10% to 12% billing inaccuracy on its traditional SAN investment. This risk of underbilling means that current storage rates are higher to manage this risk. With the more accurate billing precision due to improved asset management through ScaleIO, the organization has the potential benefit of reducing storage rates further in the future.

Flexibility

The value of flexibility is clearly unique to each customer, and the measure of its value varies from organization to organization. There are multiple scenarios in which a customer might choose to implement ScaleIO and later realize additional uses and business opportunities. For the organization, this includes:

- › Productivity savings for business users and additional revenue from faster time-to-market for ScaleIO-supported projects could potentially bring more financial benefits to the firm in the future.
- › The organization cited the long-term impact of moving to software-defined storage infrastructure with ScaleIO as potentially bringing in more cost savings beyond the four-year horizon that it evaluated. The global engineering head of systems and storage noted that with a product like ScaleIO and a rotating hardware stack underneath it, the organization could effectively build a storage array that would last 25-plus years. A storage array with a 25-year lifespan would have far-reaching effects on mitigating data transfer effort and mitigating costs for the infrastructure associated with managing that ecosystem.

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

Flexibility, as defined by TEI, represents an investment in additional capacity or capability that could be turned into business benefit for a future additional investment. This provides an organization with the "right" or the ability to engage in future initiatives but not the obligation to do so.

Total Costs

REF	COST	INITIAL	YEAR 1	YEAR 2	YEAR 3	YEAR 4	TOTAL	PRESENT VALUE
Ftr	ScaleIO hardware costs	\$0	\$2.27M	\$6.13M	\$12.87M	\$22.06M	\$43.33M	\$31.87M
Gtr	ScaleIO software costs	\$0	\$2.84M	\$7.68M	\$16.12M	\$27.63M	\$54.27M	\$39.91M
Htr	Power, cooling, and facilities costs	\$0	\$0.51M	\$1.37M	\$2.89M	\$4.95M	\$9.72M	\$7.15M
Itr	Labor and ongoing management costs	\$0	\$1.05M	\$2.85M	\$5.98M	\$10.26M	\$20.14M	\$14.81M
Jtr	Implementation costs — internal	\$4.81M	\$0	\$0	\$0	\$0	\$4.81M	\$4.81M
	Total costs (risk-adjusted)	\$4.81M	\$6.67M	\$18.03M	\$37.86M	\$64.90M	\$132.27M	\$98.55M

For full details on costs, please refer to Appendix C.

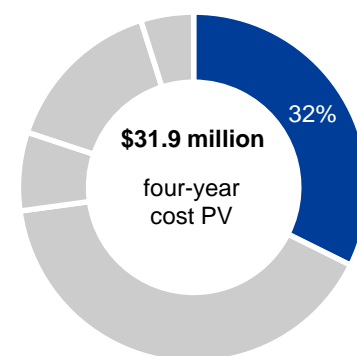
ScaleIO Hardware Infrastructure Costs

The organization's internal rate card for ScaleIO storage hardware is \$0.2919 per gigabyte per year or \$0.0243 per gigabyte per month, rounded to the nearest ten-thousandth. These costs include storage hardware, storage network (dedicated Arista IP fabric), compute endpoint connection, among others.

Given that these storage hardware infrastructure costs might vary over time, Forrester adjusted this benefit by 5%. Refer to Appendix A for more information about Forrester's approach to risk adjustment.

Based on these internal chargeback rates, the storage infrastructure costs for the organization's investment in software-defined-storage with ScaleIO is quantified at a risk-adjusted total PV of \$31,867,159 over a four-year analysis.

The table above shows the total of all costs across the areas listed below, as well as present values (PVs) discounted at 10%. Over three years, the interviewed organization expects risk-adjusted total costs to be a PV of approximately \$98.55 million.



Implementation risk is the risk that a proposed investment may deviate from the original or expected requirements, resulting in higher costs than anticipated. The greater the uncertainty, the wider the potential range of outcomes for cost estimates.

ScaleIO Hardware Infrastructure Costs: Calculation Table

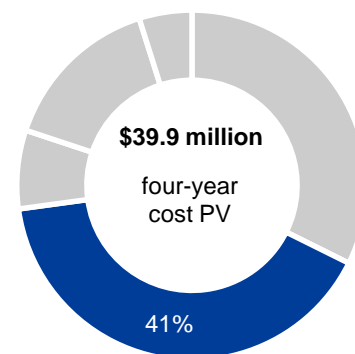
REF.	METRIC	CALC.	INITIAL	YEAR 1	YEAR 2	YEAR 3	YEAR 4
F1	Number of PB			7.4	20.0	42.0	72.0
F2	ScaleIO hardware rate cost per month per gigabyte			0.0243	0.0243	0.0243	0.0243
F3	Conversion			1,000,000	1,000,000	1,000,000	1,000,000
F4	Number of months			12	12	12	12
Ft	ScaleIO hardware infrastructure costs	$F1 \cdot F2 \cdot F3 \cdot F4$		\$2,159,737	\$5,837,128	\$12,257,968	\$21,013,660
	Risk adjustment	↑5%					
Ftr	ScaleIO hardware infrastructure costs (risk-adjusted)			\$2,267,724	\$6,128,984	\$12,870,866	\$22,064,342

ScaleIO Software Infrastructure Costs

The organization's internal rate card for ScaleIO software storage is \$0.3655 per gigabyte per year or \$0.0305 per month, rounded to the nearest ten-thousandth. These costs include storage software, system management tools, and attributed services such as engineering, command center, and security.

Given that these ScaleIO storage software infrastructure costs might vary over time, Forrester adjusted this benefit by 5%. Refer to Appendix A for more information about Forrester's approach to risk adjustment.

Based on these internal chargeback rates, the storage software infrastructure costs for the organization's investment in software-defined-storage with ScaleIO is quantified at a risk-adjusted total PV of \$39,912,463 over a four-year analysis.



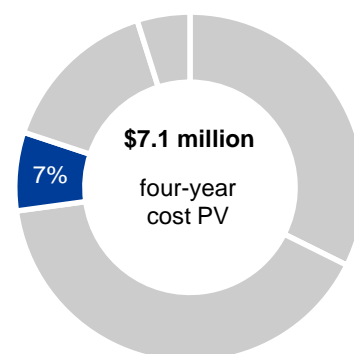
ScaleIO Software Infrastructure Costs: Calculation Table

REF.	METRIC	CALC.	INITIAL	YEAR 1	YEAR 2	YEAR 3	YEAR 4
G1	Number of PB			7.4	20.0	42.0	72.0
G2	ScaleIO software rate cost per month per PB gigabyte			\$0.0305	\$0.0305	\$0.0305	\$0.0305
G3	Conversion			1,000,000	1,000,000	1,000,000	1,000,000
G4	Number of months			12	12	12	12
Gt	ScaleIO software infrastructure costs	$G1 \cdot G2 \cdot G3 \cdot G4$	\$0	\$2,704,993	\$7,310,791	\$15,352,661	\$26,318,848
	Risk adjustment	↑5%					
Gtr	ScaleIO software infrastructure costs (risk-adjusted)		\$0	\$2,840,242	\$7,676,331	\$16,120,294	\$27,634,790

Power, Cooling, And Facilities Costs

Power, cooling, and facilities costs for the organization's deployment of ScaleIO were significantly lower than that of traditional block storage. As these rates vary across global locations, the interviewees gave estimates of cost reductions between 30% to 98% on a per usable terabyte basis. To be conservative, this analysis assumes a cost reduction of 70% of traditional block storage power, cooling and facilities costs. This is equivalent to an internal rate card of \$0.0598 per gigabyte per year or \$0.0050 per month, rounded to the nearest ten-thousandth. For the 7.4 PB of ScaleIO storage in Year 1, the power, cooling and facilities costs are \$442,317, rising to \$4.3 million in Year 4.

Risks that may affect these costs include variability in the amount of ScaleIO storage deployed, and variability in data center costs for different organizations in different locations. To account for these risks and wide range of variability estimated by the interviewees, Forrester adjusted this cost upward by 15%, yielding a four-year risk-adjusted total PV of \$7,147,998.



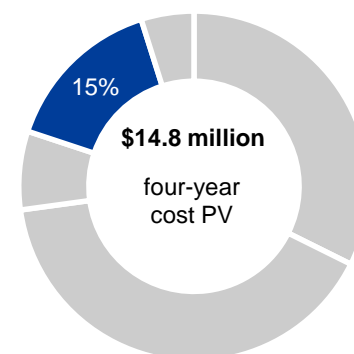
Power, Cooling, And Facilities Costs: Calculation Table

REF.	METRIC	CALC.	INITIAL	YEAR 1	YEAR 2	YEAR 3	YEAR 4
H1	Number of PB			7.4	40.0	72.0	87.4
H2	ScaleIO monthly rate cost per gigabyte			\$0.0050	\$0.0050	\$0.0050	\$0.0050
H3	Conversion			1,000,000	1,000,000	1,000,000	1,000,000
H4	Number of months			12	12	12	12
Ht	Power and cooling costs	$H1 * H2 * H3 * H4$	\$0	\$442,317	\$1,195,451	\$2,510,447	\$4,303,623
	Risk adjustment	↑15%					
Htr	Power and cooling costs (risk-adjusted)		\$0	\$508,664	\$1,374,768	\$2,887,014	\$4,949,166

Labor And Ongoing Management Costs

In the TEI analysis, the cost of labor and ongoing management of ScaleIO is based on an internal rate card of \$0.0113 per gigabyte per month (rounded to the nearest ten-thousandth), as reported by the interviewed organization. In Year 1, ScaleIO support costs are quantified at approximately \$1 million, while in Year 4, ScaleIO storage operations and engineering support costs are quantified at approximately \$9.78 million.

Storage support and ongoing management costs might vary over time. Storage engineering resources might stay constant while storage operations resources might increase as the ScaleIO storage deployed increases. As the internal rate cards for storage labor are composed of both storage engineering and support costs, there is a risk that labor and ongoing management costs for ScaleIO in the later years might be overstated. The amount of storage deployed might also change from previous plans. To account for these risks, Forrester risk-adjusted the cost of labor and ongoing management of ScaleIO up by 5%. This yields a four-year risk-adjusted total PV of \$14,814,381.



Labor And Ongoing Management Costs: Calculation Table

REF.	METRIC	CALC.	INITIAL	YEAR 1	YEAR 2	YEAR 3	YEAR 4
I1	Number of PB			7.4	20.0	42.0	72.0
I2	ScaleIO rate cost per month per gigabyte			0.0113	0.0113	0.0113	0.0113
I3	Conversion			1,000,000	1,000,000	1,000,000	1,000,000
I4	Number of months			12	12	12	12
It	Labor and ongoing management costs	I1*I2*I3*I4	\$0	\$1,004,017	\$2,713,560	\$5,698,475	\$9,768,815
	Risk adjustment	↑5%					
Itr	Labor and ongoing management costs (risk-adjusted)		\$0	\$1,054,218	\$2,849,238	\$5,983,399	\$10,257,255

Implementation Costs — Internal

For the financial analysis, implementation costs for the organization's initial ScaleIO deployment include:

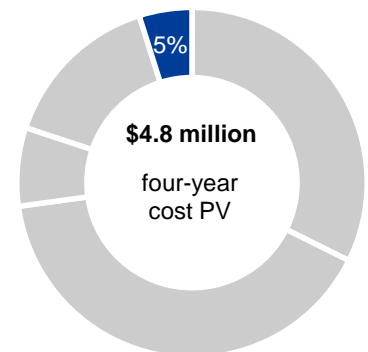
- › Three storage and system engineers worked on the implementation for six months. An additional three IT personnel from the operations and project management teams supported this implementation.
- › At an average annual fully loaded cost of \$130,000 per FTE for these implementation resources, the total cost of internal labor for the ScaleIO project implementation is \$390,000.
- › Forrester also considers the cost of running parallel storage systems as part of the implementation cost of ScaleIO. In the analysis, Forrester assumes that during the ScaleIO implementation, the organization ran a traditional storage system in parallel for 4 PB of storage for six months.

The internal rate card for traditional block storage which includes storage hardware, software, facilities and labor is \$0.1506 per gigabyte per month, rounded to the nearest ten-thousandth. The total cost of running a parallel system in traditional block storage for six months is \$3,614,400.

There are several potential risks that can affect these costs:

- › The scope of deployment might increase, and the level of effort required during implementation might vary.
- › The length of time that parallel storage systems co-exist might vary, depending on internal requirements and strategy.
- › Some organizations may choose not to run parallel storage systems with their ScaleIO deployment or may choose not to consider this cost in their analysis.

To account for these risks, Forrester adjusted this cost upward by 20%, yielding a four-year risk-adjusted total PV of \$4,805,280.



Six months
Total implementation and deployment time

Internal Implementation Costs: Calculation Table

REF.	METRIC	CALC.	INITIAL
J1	Number of PB of traditional storage run parallel to ScaleIO		4.0
J2	Monthly rate for traditional storage per gigabyte		\$0.1506
J3	Cost of running parallel traditional storage during implementation	$J1 * J2 * 6 \text{ months} * 1,000,000$	\$3,614,400
J4	Total internal labor costs spent on implementation	6 months for 6 people at \$130,000 per year	\$390,000
Jt	Implementation costs — internal	$J3 + J4$	\$4,004,400
	Risk adjustment	↑20%	
Jtr	Implementation costs — internal (risk-adjusted)		\$4,805,280

Dell EMC ScaleIO: Overview

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

Dell EMC ScaleIO is a data center grade software-defined storage solution that uses standard x86 hardware and Ethernet to deliver scale-out block storage, simplifying storage lifecycle management and empowering IT organizations to operate with ruthless efficiency. ScaleIO abstracts, pools and automates storage locked in servers, including high performance All-Flash or hybrid media, and provides scalable shared storage with enterprise class reliability.

As a leading data-center scale software-defined storage, ScaleIO delivers massive scale and flexible options including:

- › Freedom of Deployment – Traditional, Modern, or Cloud with HCI and software-defined data center options.
- › Choice of Media: All-Flash, NVMe, Hybrid, HDDs-only
- › Flexible Consumption Options: ScaleIO SW only, ScaleIO Ready Node, VxRack System FLEX

ScaleIO customers of any size are able to:

- › Deploy storage in minutes using standard x86 and Ethernet
- › Operate at web-scale efficiency by abstracting, pooling and automating resources previously locked within servers and deliver enterprise storage at data center scale using software automation.
- › Add, remove or refresh nodes when desired with automated, in-place, data balancing and redistribution – without impacting applications.
- › Simplify the storage lifecycle and avoid risky data migrations.
- › Support any application, at any desired scale, on any media or operating system.

The management of large-scale, rapidly growing traditional infrastructure is a constant challenge for many data center operation teams and data storage is at the heart of these challenges. Data is growing by leaps and bounds while at the same time IT organizations are looking for ways to reduce capex and opex costs; improve automation and provisioning times; and simplify management.

- › ScaleIO addresses the challenges customers are experiencing in managing multiple storage silos by creating a more efficient operating model - removing complexity, waste and inefficiency.
- › ScaleIO reduces the complexity of data center infrastructures by enabling IT to standardize on x86 server hardware and Ethernet, minimizing component variation and eliminating the need for SAN equipment and expertise.
- › ScaleIO is designed to support enterprises of any size and enable them to deliver massive scale, performance, elasticity and operational efficiency by using software automation to deploy, provision and manage storage.
- › ScaleIO simplifies the storage lifecycle, removing complex forklift upgrades and eliminate risky and expensive data migration. Customers can perform non-disruptive rolling server upgrades without ever impacting applications.
- › ScaleIO removes the limitations on how data centers can consume or deploy block storage, by providing customer the ability to consume ScaleIO as software only, an appliance or an engineered rack system. Customers have the freedom to deploy ScaleIO in a co-resident, two-layer or mixed configuration.

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.

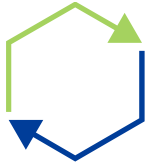
Total Economic Impact Approach



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: Supplemental Material

Related Forrester Research

“Infrastructure As Code, The Missing Element In The I&O Agenda,” Forrester Research, Inc., January 27, 2016

“Vendor Landscape: Software-Defined Data Centers,” Forrester Research, Inc., September 1, 2016

Appendix C: Endnotes

Total Costs								
	COST	INITIAL	YEAR 1	YEAR 2	YEAR 3	YEAR 4	TOTAL	PRESENT VALUE
Ftr	Storage hardware	\$0	\$2,267,724	\$6,128,984	\$12,870,866	\$22,064,342	\$43,331,917	\$31,867,159
Gtr	Storage software	\$0	\$2,840,242	\$7,676,331	\$16,120,294	\$27,634,790	\$54,271,658	\$39,912,463
Htr	Power, cooling, and facilities	\$0	\$508,664	\$1,374,768	\$2,887,014	\$4,949,166	\$9,719,613	\$7,147,998
Itr	Storage mgmt.	\$0	\$1,054,218	\$2,849,238	\$5,983,399	\$10,257,255	\$20,144,110	\$14,814,381
Jtr	Implementation Internal	\$4,805,280	\$0	\$0	\$0	\$0	\$4,805,280	\$4,805,280
	Total costs	\$4,805,280	\$6,670,849	\$18,029,321	\$37,861,574	\$64,905,555	\$132,272,578	\$98,547,281