



Comparing IBM FlashSystem to Traditional Performance Disk Systems

An ESG Economic Value Analysis

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Introduction

Executive Summary

ESG was engaged by [IBM](#) to develop a detailed economic value model and analysis for its all-flash, enterprise-grade FlashSystem solution compared to traditional tier-1 performance disk arrays, which is the mode of storage this model of the FlashSystem line is intended to compete against; the model and accompanying analysis is intended to help organizations determine the relative costs and benefits of leveraging IBM FlashSystem for a variety of enterprise workloads compared to a likely traditional storage alternative. The economic value model builds upon in-depth interviews with IBM technical stakeholders, relevant product demos, additional ESG market research related to typical enterprise storage system requirements, and ESG's general familiarity with the myriad of storage solutions available in the market today. The goal of the Economic Value Validation (EVV) analysis is to provide potential customers with a comprehensive picture of the direct and indirect costs and benefits that they should consider when evaluating an investment to meet their storage needs.

As discussed in the following pages, the IBM FlashSystem enterprise storage offering represents a tipping point for many use cases where flash not only offers significant performance improvements, but also significantly drives down the total cost of ownership for storage based on a smaller, more cost-efficient footprint. In fact, ESG's analysis of a typical heterogeneous enterprise workload running on IBM FlashSystem yields an estimated 76% ROI over the baseline of traditional performance storage—lowering TCO by more than \$950,000 while adding performance benefits in the range of \$1.2M over a three-year time horizon. A closer examination of the TCO delta shows that IBM FlashSystem is expected to be the more cost effective solution along both CapEx (~\$912,000 versus ~\$1.5M) and OpEx (~\$291,000 versus ~\$662,000 annually) vectors. For organizations looking for an economically efficient way to deliver exceptional storage performance, IBM FlashSystem offers an extremely compelling value proposition. This report summarizes the rigorous research ESG conducted to quantify costs and benefits for the IBM FlashSystem and communicates the results of this analysis.

Market Overview

Flash storage has changed the industry permanently. However, sometimes watching the vendors compete is like watching a new reality show that might be called *Specmanship*, which is essentially what you get when you cross datasheets with leap-frog. Ever-escalating IOPS—more than most users could ever use—are designed to attract the unprepared customer. Of course, the modern, consolidated, virtualized, mobile, social, and cloud-embracing world demands higher and faster throughputs, and our expectations have risen accordingly. Higher throughput at lower latency can never be a bad thing; but—surprisingly—these are often not the parameters on which storage purchase decisions are made.

The choice to invest in any storage system is fundamentally a cost-benefit decision. Indeed—aside from a few storage acquisitions that are made based purely on emotions, and a few others made by that tiny number of customers with more money than logic—economics is the bedrock of all storage purchase decisions. Sometimes, the world of storage gets distracted by the inverse idea that we make decisions based on performance, capacity, or even functionality. What's really disguised in those debates is that we are making an economic decision about which data and workloads *deserve* a given capacity and level of performance. The question we are answering is, "How much are we willing to pay to receive a given level of benefit?" Consider this: If all storage cost the same, would we even have a storage hierarchy? Of course not; we would keep everything on silicon of some sort.

As fast as the price per TB of spinning drives has fallen over recent years, so too has the price per TB of flash tumbled. Both declines are important, but neither is able to keep pace with the growth in demand for both capacity

Analysis Highlights, Typical Enterprise Use Case:

- Modeled 76% ROI and 11-month payback period compared to traditional storage.
- Nearly \$600,000 in up-front CapEx savings and nearly \$400,000 in ongoing OpEx savings.

and performance to be served from flat or only marginally rising budgets. Flash is an interesting tool because it can not only address performance needs, but—well implemented—also help drive down the overall cost (per TB) of a storage infrastructure and help address capacity challenges by freeing up trapped, poorly utilized capacity. Because of this, the accelerating deployment of a growing volume of solid-state storage—mainly flash—over the last seven or eight years has been impressive, yet it has largely been implemented in two ways to date:

- The initial uptake was for very small amounts of persistent data with performance challenges where the high relative cost of flash was justified by the business outcomes (in other words, the benefits outweighed the costs). This “low-hanging fruit” model continues today and is a perfectly valid use of flash technology.
- Over the last few years, the industry has added increasing “smarts” to enable advanced caching and tiering that shares the benefits of flash over a larger capacity. This allows a given customer to clear her cost-benefit bar by reducing the effective cost of the flash since its premium is distributed across more of the overall capacity. Again, this “spread the wealth” model is a perfectly valid deployment model.

Both implementations will continue, but in both cases, there is an implicit acknowledgement of the simple assumption that flash costs more (at least on a per-capacity basis) than traditional spinning systems. Now we have a third potential justification entering the language of the storage market: ***the idea that flash can be less expensive than performance disk, period.*** Such claims most often emanate from the providers of all-flash arrays since their arrays are being deployed neither for the low-hanging fruit model nor for the spread-the-wealth model. With a much higher raw price, they must find ways to manage down their TCO or manage up their ROI in order to become a viable long-term element in the storage hierarchy.¹ This “less expensive than performance disk” claim is an easy semantic stake for marketers to use; but very often, the “proof” is nuanced at best, and partial at worst. The point of this study is to examine to what extent the claim holds true for the all-flash IBM FlashSystem enterprise storage system.

The assertion that it is the TCO and ROI that ultimately matter more than the nicety of the technology is well understood by users, even if vendors would like to pretend otherwise. The “latest shiny objects” neither impress senior management teams, nor do they justify IT investments: What matters is either saving (TCO) or making (ROI) money. ESG conducts extensive end-user research, and a couple of data points illustrate this point well:

- In ESG’s latest annual research of the overall IT market, when end-users were asked which considerations will be most important to justifying IT investments to senior management teams over the next 12 months, initiatives which improve security and mitigate risk were most cited.² This is an intuitive finding given the current world emphasis on security and risk management. What is noteworthy is that the next three most-mentioned considerations that will be most important in justifying IT investments to organizations’ business management teams over the next 12 months were return on investment, business process improvement, and reduction in OpEx.
- In qualitative research recently completed by ESG among senior IT decision makers, end-users’ attitude about solid-state storage can be easily summarized: “The debate is over...we want more...if we could afford more we would use more.”³ With very high levels of adoption (80% were either using, evaluating, or planning to use solid-state storage), the need for a more compelling cost-benefit proposition was clear. “The tipping point is price-driven: it needs to be close to spinning disk prices.”⁴ While there is clearly work for all-flash vendors, such as IBM, to do from a market conditioning perspective, it is equally clear that there is an enormous market opportunity for those vendors that can clear the economic bar.

¹ It is worth noting that most economic models delivered by vendors emphasize TCO savings rather than ROI improvements. The reason for this is simple: The former is a much easier calculation than the latter, and has been—understandably but unfortunately—the limited and blinkered approach to many storage decisions for decades. However, as IT increasingly must justify its value to the business, the need to look at ROI is going to increase for IT users and vendors alike.

² Source: ESG Research Report, *2015 IT Spending Intentions Survey*, to be published February 2015.

³ Source: ESG Research Report, *Next-generation Storage Architectures*, to be published February 2015.

⁴ Ibid.

- Turning to the actual likely use of flash storage, it will very often be deployed to help such I/O-intensive workloads as business intelligence and analytics, which increasingly require real-time integration operations involving many previously disparate data silos. Even in these arenas, ESG research found that users value the economic implications—both TCO and ROI—over other attributes that one might be forgiven for expecting to be more highly rated.⁵

Figure 1. Most Important Attributes When Considering Business Intelligence, Analytics, and Big Data Solutions



Source: Enterprise Strategy Group, 2015.

This market overview section has intentionally focused on why the economics of flash are so important, rather than simply recounting the product details of IBM’s. Suffice it to say that IBM FlashSystem combines excellent all-flash hardware with an integrated and extensive set of sophisticated data services. Its software component can also extend to be the nexus of a software-define storage implementation by managing different storage types, even from different vendors; that capability can also deliver—and should be evaluated on—economic benefits. But the remit of this research, paper, and economic model is simply to evaluate the veracity of the claim that IBM’s really can beat the cost-benefit profile of traditional performance disk.

⁵ Source: ESG Research Report, [Enterprise Big Data, Business Intelligence, and Analytics Trends](#), January 2015.

IBM FlashSystem: Economic Value Analysis Overview

Methodology

For this project, ESG adhered to the following research and modeling methodology:

- ESG conducted initial market research across IBM and other relevant IT vendors to assess current market trends, vendor value claims, and the purchase considerations that are most important and relevant to enterprise storage customers.
- Based on the results of this initial research, ESG subsequently identified a “present mode of operation” (PMO)—effectively, a traditional approach that customers may take to meet their storage requirements—against which the costs and benefits of utilizing IBM FlashSystem was to be compared. For this analysis, the PMO is a blended average of traditional performance disk-based systems from leading enterprise vendors.
- ESG then conducted a series of in-depth interviews with systems engineering, service and support, and technical marketing representatives from IBM. The data collected in these interviews was used to refine assumptions built into the model related to current customer environments and the direct and indirect costs and benefits attributable to both IBM FlashSystem and traditional storage systems. Product marketing collateral, configuration guides, and case studies of IBM FlashSystem use cases were also used to identify specific IT and user workflows and the labor burden (in both time and cost) associated with those workflows. These findings were then compared against the results of ESG’s qualitative and quantitative market research with organizations currently using traditional storage systems. This research helped to inform ESG’s understanding and analysis of flash storage adoption drivers, usage trends, and the operational and financial benefits that customers can realize.
- Once the economic model was finalized and all validation was complete, ESG modeled a default scenario that is designed to demonstrate the relative costs and benefits of IBM FlashSystem in a hypothetical enterprise environment. Those results were then compared with model outcomes for a similar-scale traditional storage solution based on best-of-breed enterprise solution offerings from leading vendors. The results for this default scenario are described in the remainder of this paper.

Please note that the data and conclusions presented in this report regarding the costs and benefits associated with implementing and utilizing IBM FlashSystem compared with traditional storage infrastructure reflect the output of ESG’s economic value analysis based on the specific use case and default scenario assumptions modeled for this report. ESG acknowledges that changes to these assumptions will lead to a different set of results and, as such, advises IT professionals to use this report as one validation point in a comprehensive financial analysis process prior to making a purchase decision. IBM provided current standard pricing and product information for IBM FlashSystem to ESG. Other IT equipment and labor cost assumptions were obtained from publicly available sources such as IT vendor and channel partner websites and published price lists.

Economic Value Model Overview

As previously noted, ESG’s EVV methodology compares two scenarios: The first is an organization that elects to support its application workloads with an IBM FlashSystem array. The second scenario represents an organization that defaults to a more traditional performance disk-based storage system leveraging spinning media. The TCO of the storage environment was modeled and compared for both these scenarios based on the workload parameters supplied in the model. Additionally, to give an accurate picture of both costs and benefits, the operational improvements offered by IBM FlashSystem over and above the traditional storage baseline are estimated. The basic profiles for each acceleration scenario are:

- **IBM FlashSystem scenario:** In this scenario, the customer is leveraging an appropriately configured IBM FlashSystem as the primary storage supporting its application workloads. The model takes into account all storage environment components including hardware, software, data center infrastructure, and support

and maintenance costs associated with IBM FlashSystem. Related IT and user labor costs and efficiencies for planning, implementation, ongoing administration, and training are also within the scope of the model.

- **Traditional storage present mode of operation:** In this scenario, the customer is using an alternative performance disk-based storage system, which is underpinned by 15K RPM drives. Costs, configurations, and specifications for controller nodes, HDDs, other hardware and infrastructure, and OS and management software are based on blended averages of offerings from leading enterprise storage vendors.

The tasks and processes used as the basis of comparison between both scenarios include:

- Storage system management over time, including RAID group setup, system tuning, tiering, and adjustments.
- IT time and effort allocated to responding to break-fix events and drive failures.
- The impact of storage performance on helpdesk requirements—both from a user perspective and an IT staff perspective.
- The impact of storage performance on end-user workflows, including reductions in VDI service interruptions resulting from boot storms, scan storms, and other virtual workload latency spikes.
- The impact of storage performance on database-driven application user workflows, including query and reporting lag.
- The impact of storage performance on ecommerce and web application users, including abandoned transactions.

Simply put, ESG's model estimates the likely cost and potential benefits—according to the tasks outlined—of supporting a variety of applications by deploying either an IBM FlashSystem array or an alternative storage system.

Default Scenario

To illustrate the relative costs and benefits of leveraging IBM FlashSystem against the traditional storage PMO, ESG developed a set of model inputs representative of a possible heterogeneous enterprise storage use case, including three distinct application workloads all supported by the storage system.

The first application workload is a database-driven employee-facing application, which could represent a business intelligence (BI), enterprise resource planning (ERP), or analytics application. This workload is assumed to require 30TB of capacity and grow at an annual rate of 20%. Moreover, there are assumed to be an average of 100 concurrent users completing five transactions per hour in the application. Finally, the organization is assumed to be spending \$25,000 in application licensing annually, while running the application on five servers and achieving 50% server CPU utilization.

The second application workload is a database-driven customer-utilized application, which could represent an ecommerce or order processing application. This workload is assumed to require 20TB of capacity and grow at an annual rate of 20%. It is assumed that while this application is supported by the PMO, three transactions per day are abandoned due to application storage performance and the unit transaction value is \$50—in summary, poor application storage performance is costing the organization \$150 per day in customer value. Additionally, the number of customers transacting with the organization via this application is assumed to grow at an annual rate of 15% over time.

The final workload modeled in ESG's default scenario is a VDI implementation. This workload is assumed to require 10TB of capacity and grow at an annual rate of 20%. The VDI user community is assumed to be made up of 500 employees and grow at an annual rate of 25%. It is assumed that while this implementation is supported by the PMO, three major boot storm events occur each week and two major scan storm events occur each week, each impacting the majority of users and hindering their productivity. These and other key assumptions can be reviewed in tabular format in Table 1.

Table 1. Key Default Storage Use Case and Workload Assumptions for a Heterogeneous Enterprise

Parameter	Workload 1	Workload 2	Workload 3
What type of application describes this workload?	Database-driven app used by employees	Database-driven app used by customers	Virtual desktop infrastructure
What is the capacity required and growth rate for this workload's data?	30TB / 20%	20TB / 20%	10TB / 20%
What is the minimum IOPS needed for this workload today and at what rate is that requirement growing?	10,000 / 10%	20,000 / 15%	15,000 / 25%
What is the average number of concurrent application users and at what rate is the user base growing?	100 / 10%	N/A	N/A
How many transactions/hour does a typical user complete?	5	N/A	N/A
How much does your organization spend/year on server software licensing and what is the average CPU utilization?	\$25,000 / 50%	N/A	N/A
At what rate is the number of customers transacting via the app growing?	N/A	15%	N/A
Approximately how many transactions/day are abandoned due to poor application storage performance?	N/A	3	N/A
What is the average value of a customer transaction?	N/A	\$50	N/A
What is the average number of concurrent VDI users and at what rate is the user base growing?	N/A	N/A	500 / 25%
What is the average weekly frequency/duration/reach of VDI boot storms?	N/A	N/A	3 / 60 seconds / 80%
What is the average weekly frequency/duration/reach of VDI scan storms?	N/A	N/A	2 / 45 seconds / 65%
What is the time horizon of the analysis?	3 years		
What is the average annual salary for an IT administrator?	\$80,000		
What is the average annual salary for a typical non-IT employee?	\$70,000		

Source: Enterprise Strategy Group, 2015.

Economic Value Validation Results

Summary of Results

With the model parameters tuned to the default assumptions in Table 1, ESG’s economic value analysis concludes that the net benefits of implementing IBM FlashSystem greatly outweigh the associated costs. Table 2 shows the annual return on investment (ROI), payback period, average annual total cost of ownership (TCO), and average annual incremental benefit for IBM FlashSystem compared against the PMO. The following sections detail the most compelling findings from this analysis as they relate to both the costs and benefits associated with these solutions.

Table 2. Economic Value Summary, Tier-1 IBM FlashSystem

Solution	ROI	Payback Period (months)	Average Annual TCO	Average Annual TCO Avoided Versus PMO	Average Annual Incremental Benefit
IBM FlashSystem	76%	11	\$400,814	\$317,025	\$390,403

Source: Enterprise Strategy Group, 2015.

Annual Benefit

This ESG analysis considers two primary benefit categories: IT efficiency, and user improvements delivered over and above what is expected to be achieved with the traditional storage PMO.

- Increases in IT efficiency include savings in areas like reduced storage administration labor requirements, fewer drive failures over time, freed up server resources due to higher CPU utilization rates, avoided application licensing costs tied to the need for fewer server licenses, fewer helpdesk issues tied to application performance, and conservative estimates for the return earned on reinvested TCO savings.
- User improvements include value delivered to the user community in terms of saved time to enterprise application users and VDI users. Additionally, the value of fewer abandoned customer transactions due to increased customer-facing application performance is included in this category.

The sum of these two macro-categories equals the total benefit delivered by IBM FlashSystem compared to the PMO. The annual benefit is the sum of all the benefit categories included in this analysis averaged over the time horizon of three years.

Annual TCO

This ESG analysis considers four cost categories: hardware, software, maintenance and support, and data center infrastructure:

- To calculate hardware costs, the model considers all three application workloads and how they are expected to scale over time. The model then configures an appropriately sized IBM FlashSystem array to support the environment and utilizes IBM list pricing to derive hardware costs. Similarly, the model configures a generic performance disk-based system (i.e., controller nodes, disks, disk shelves, and other infrastructure) based on the workload requirements and a blended average of likely IBM alternatives and publicly available pricing.
- Software costs in the IBM scenario make up a very small portion of the TCO because much of the storage administration features and functionality of the solution is bundled into the system cost. That said, ESG’s model does classify costs specific to encryption and compression as incurred software costs by default. By contrast, the PMO is calculated to require operating system and management licensing costs in addition to encryption and compression costs. This software cost is estimated on a capacity basis.

- For both solutions, IBM FlashSystem and the PMO, maintenance and support costs are estimated formulaically based on industry norms. Hardware maintenance and support is estimated as an annual cost equal to 10% of cumulative hardware CapEx (i.e., upfront storage system costs). Similarly, software maintenance and support is estimated as an annual cost equal to 18% of cumulative software CapEx. Together, these two charges make up the total annual maintenance and support costs expected for each solution.
- Three data center infrastructure costs are within the scope of ESG's model for both IBM and the PMO: power, cooling, and data center space. The model estimates wattage consumption for each system hardware configuration and assumes 24x365 system operation, along with utility rate of \$.13/KWH to generate power consumption costs. Similarly, the model estimates the BTUs dissipated by each system configuration and the wattage needed to counteract that amount of heat being introduced into the data center. Finally, ESG's model assigns a value of \$12,000/rack for data center real estate. This cost can be viewed as either an opportunity cost (every rack used for storage cannot be used for another purpose) or as a hard cost (for organizations renting space from a hosting or colocation facility).

By aggregating all of the cost categories, the total cost of ownership (TCO) of each solution is estimated. Annual TCO is the sum of all the cost categories included in the analysis averaged over the time horizon of three years. As displayed in Table 2, a transition from the PMO to IBM FlashSystem is expected to result in a 44% decrease in the annual TCO of the solution.

ROI

ROI is a financial ratio that compares net benefits (including avoided costs) against TCO and helps make sense of the cost and benefit numbers estimated by the model. As displayed in Table 2, the ROI for IBM FlashSystem in ESG's default scenario is 76%.

Payback Period

ROI is not the "be-all and end-all" of financial metrics for determining the viability of a project or investment. Another important metric is the payback period, which is an estimate of when customers will start to see a positive return from their investment. As displayed in Table 2, the payback period for IBM FlashSystem, as modeled in our default scenario, is 11 months—a compelling breakeven point for a three-year time horizon.

Quantifying Relevant Cost and Benefit Differences

Economic models are, by definition, abstractions from reality. In any model, numerous estimates and assumptions must be made. ESG's methodology leverages rigorous market research and in-depth interviews to estimate material differences between two fundamentally different approaches to enterprise storage, both in terms of how the storage systems would be configured and how they would impact organizational efficiencies from an IT and end-user perspective. This section discusses important estimates incorporated into ESG's economic value model.

Comparative Cost Analysis

For the default customer scenario described, the subcategorized TCO for IBM FlashSystem and the PMO are displayed in Table 3.

Table 3. Subcategorized, Three-year TCO, Tier-1 IBM FlashSystem versus the PMO

Cost Type	Cost Category	IBM FlashSystem	PMO
CapEx	Hardware	\$888,500	\$1,212,413
	Software	\$23,330	\$278,901
OpEx	Maintenance and Support	\$279,148	\$514,330
	Data Center Infrastructure	\$11,464	\$147,872
Total		\$1,202,442	\$2,153,516

Source: Enterprise Strategy Group, 2015.

Key TCO estimates and assumptions, which drive economic differences between IBM FlashSystem and the PMO in ESG's model, follow:

- Hardware:** For both storage solutions, the hardware needed to support the default scenario makes up the lion's share of the TCO according to ESG's EVV model. In the scenario ESG modeled for this report, one 6u IBM FlashSystem node is able to support all three workloads. The node includes a storage enclosure that is configured with 12 4TB flash modules (with compression enabled—supplying a 3x capacity boost) arranged in RAID 5 configuration. ESG utilized list pricing to arrive at the estimated cost of \$888,500 with the two redundant control enclosures and the storage enclosure included in the system node, carrying with them a cost of \$89,120. The unit cost used by the model for the flash modules is \$64,200. The balance of hardware costs configured by the model include redundant AC power, a UPS, and host interface cards.

In contrast to IBM's small system footprint, the PMO configuration, underpinned by 600GB 15k HDDs, is much more sprawling. To begin, ESG's model assumes that to support >100TB of data in the environment at the end of the three-year time horizon, two to three nodes, each containing redundant controllers, would likely be deployed—carrying with them a hardware CapEx charge in excess of \$300,000. Additionally, to support the IOPS requirement of the environment—73K IOPS at the end of the time horizon—some 406 HDDs must be incorporated into the system, assuming that each drive adds 180 IOPS to the aggregate system. The resulting drive and drive array enclosure costs estimated by the model are in the range of \$750,000. Additional ancillary hardware costs for things like host connectivity, power supplies, and other non-core infrastructure make up the balance of the PMO's hardware costs.

Software: As noted, software costs in the IBM FlashSystem use case make up a marginal portion of the overall system TCO. This is because the bulk of the system features are bundled into overall system costs. The result is that for the IBM FlashSystem configuration, software costs make up less than 2% of the solution's TCO. According to ESG's analysis, the low software cost, coupled with a robust bundled feature set, is a differentiator for IBM FlashSystem.

In contrast to IBM FlashSystem, most enterprise-grade performance disk systems charge customers for administration features and the operating system. ESG's model assumes that, in the PMO, there is a capacity-based software cost incurred for these software components and that to cover the environment described by the workloads in ESG's default scenario, the PMO software costs would be in the range of \$220,000. Additionally, encryption is considered a separately charged for item and is estimated at ~\$15,000 per controller node.

- Maintenance and support:** As noted previously, ESG's model estimates annual hardware and software maintenance costs as a percentage of cumulative CapEx costs—10% for hardware and 18% for software. For the IBM FlashSystem scenario, the result is an annual hardware maintenance charge of \$88,850 and an annual software maintenance charge of \$4,199. Over three years, the total maintenance and support costs are estimated as \$279,148. Due to the fact that the PMO solution is estimated to be significantly more expensive from a capitalized hardware and software perspective, maintenance for the PMO is commensurately more costly. On an annual basis, hardware maintenance is estimated as a charge of \$121,241 and software maintenance is estimated as a charge of \$50,202. In total over three years, maintenance and support costs for the PMO system are estimated at \$514,330.

- Data center infrastructure:** As noted previously, to serve the environment described by the workloads in ESG’s default scenario, IBM FlashSystem requires a significantly smaller footprint than the traditional storage system PMO. This fact has major implications on the modeled data center costs estimated by ESG’s model.

First, the IBM FlashSystem configuration is estimated to be significantly less expensive to power. While the 6U IBM FlashSystem node requires only 925W to run, the PMO configuration consisting of multiple controller nodes, 406 HDDs, and a number of storage enclosures is estimated to require on the order of 11,500W to run. Taking into account ESG’s assumption that the system requires 24x365 availability and that utility costs are equal to \$.13/KWH, while the IBM FlashSystem configuration will cost ~\$1,000 to power for a full year, the PMO will cost ~\$13,200.

Next, based on publically available specifications, the IBM FlashSystem configuration is expected to dissipate significantly less heat over time compared to the PMO. The IBM FlashSystem configuration is expected to dissipate 3,158 BTU/hr while the much larger PMO configuration is expected to dissipate in excess of 37,000 BTU/hr. By converting BTU/hr to wattage, ESG’s model estimates the additional electricity expense to eliminate the heat dissipated by each configuration. The resulting cost estimate to cool the IBM configuration is ~\$1,000, while cooling the PMO is modeled to cost ~\$12,400 annually.

Finally, there is the cost of the physical data center space occupied by each configuration. As articulated, this cost can be viewed as either an opportunity cost (every rack used for storage cannot be used for another purpose) or as a hard cost (for organizations renting space from a hosting or colocation facility). ESG’s model quantifies this cost as \$12,000 per year, per rack. Thus, the annual charge for the 6U IBM configuration is \$1,714. In contrast, the PMO is modeled to occupy 83 rack units, which equates to an annual cost of \$23,714.

Comparative Benefit Analysis

For the default customer scenario described, the subcategorized incremental benefits estimated to be delivered by IBM FlashSystem beyond what is expected in the PMO scenario are displayed in Table 4.

Table 4. Subcategorized, Three-year Incremental Benefits Delivered by Tier-1 IBM FlashSystem

Benefit Category	IBM FlashSystem
IT Efficiency Savings	\$426,553
<i>Avoided Drive Failures - Replacement Cost</i>	\$110,644
<i>Avoided Drive Failures - Staff Time</i>	\$1,604
<i>Reduced General Storage Management Labor</i>	\$66,044
<i>Freed-up Server Resources</i>	\$17,566
<i>Avoided Application Licensing Costs</i>	\$25,000
<i>Database User Helpdesk Ticket Reduction</i>	\$6,372
<i>VDI User Helpdesk Ticket Reduction</i>	\$55,543
<i>Return Earned on Avoided Costs</i>	\$150,746
User Improvements	\$744,655
<i>Fewer Users Abandoning Transactions</i>	\$163,978
<i>VDI User Productivity Increases</i>	\$154,816
<i>VDI User Helpdesk Ticket Reduction</i>	\$48,600
<i>Database User Productivity Increases</i>	\$371,685
<i>Database User Helpdesk Ticket Reduction</i>	\$5,575
Total	\$1,248,173

Source: Enterprise Strategy Group, 2015.

Many benefits included in ESG’s model are characterized as time saved for either the IT administrators or application end-users. However, it is critical to note that ESG does not assume every saved staff-hour is productive.

Rather, ESG uses the assumption that only 50% of saved staff time to either constituency will be productive. A detailed breakdown IT efficiency benefits follows:

- **Avoided Drive Failures – Replacement Cost and Staff Time:** One key assumption in ESG’s model is that the failure rate for the flash modules in the IBM FlashSystem is significantly lower than traditional HDDs—.1% versus 5.5% respectively. Additionally, since there are only 12 flash modules configured in the IBM scenario, no failures are expected to be experienced. However, 406 drives are configured in the PMO scenario, which means that in excess of 20 drive failures are expected annually. The result is that significant drive procurement costs in the PMO scenario are eliminated in the IBM scenario (>20 per year at a unit cost of \$1,676) and that an IT staff member will need to order each new drive and replace each failed drive—sapping a total of ~50 minutes of productive time for each failure. ESG’s model categorizes these avoided costs over time as an incremental benefit of utilizing IBM FlashSystem and estimates the value at \$112,248 over three years.
- **Reduced General Storage Management Labor:** Tier-1 performance disk systems carry with them a significant storage administrator burden to set up and manage over time. RAID group setup, system tuning, tiering, and other ongoing management tasks can be onerous. To account for these labor costs, ESG assumes that an organization will dedicate 1.5 full time equivalent workers (FTEs) for every 100TB of storage capacity in the environment. In contrast, IBM FlashSystem is a simpler, all-flash architecture managed through an intuitive, best-of-breed graphical user interface. To account for this advantage over the status quo, ESG assumes a 30% reduction in the FTEs allocated to manage the configured IBM FlashSystem compared to the PMO. ESG categorizes this efficiency as a benefit because it is unlikely that the customer would reduce headcount, but rather it is assumed that the customer would refocus labor on other more strategic initiatives—thereby deriving value from that refocused labor.
- **Freed-up Server Resources and Avoided Application Licensing Costs:** Obviously the core differentiator between an IBM FlashSystem and a traditional disk-based system is the fact that the latency of storage is going from milliseconds to microseconds. This fact can have a profound impact on the host tier to which the storage is connected: Server CPUs will spend much less time waiting for read and write requests to be served from storage. By diminishing wait times, the storage system is allowing the CPU to be more productive, which means fewer servers may be required to support the same software footprint. This reduces the server OpEx of the environment and, for applications licensed on a server node- or CPU socket-basis, a commensurate reduction in application licensing costs would be experienced by the customer. To account for this benefit, ESG assumes that the transition from the PMO to IBM FlashSystem would yield a conservative 25% improvement in server CPU utilization, which leads to a total estimated benefit of \$42,566 over the time horizon in the areas of server reallocation, slower server growth over time, and reduced application licensing costs tied to the smaller server footprint for the default scenario ESG examined.
- **Reduced Helpdesk Requirements for IT:** Another impact of reduced storage latency is the fact that users will receive improvements in their application experience. One way this impacts IT is that fewer users will complain to IT about the performance of applications. In the PMO scenario, ESG assumes that each database application user will submit one helpdesk ticket every four months related to poor application performance that can be tied back to storage performance. Furthermore, ESG assumes that each ticket will require 15 minutes of time and energy from an IT staffer to respond to the issue. By implementing IBM FlashSystem, ESG assumes that 80% of these tickets will be eliminated. Similarly, when supported by the PMO, ESG assumes that each VDI user will submit one helpdesk ticket every three months related to unacceptable latency that can be tied back to storage performance. Again, ESG assumes each ticket will require 15 minutes of time and energy from an IT staffer to respond to the issue and that 80% of these tickets can be eliminated via a transition to IBM FlashSystem. The end result is an estimated net economic benefit to the IT helpdesk of \$61,915 over three years.
- **Return Earned on Avoided Costs:** One final IT efficiency consideration is that for every avoided cost—whether categorized as reduced TCO or counted as an economic benefit—the opportunity exists for the

customer to reinvest savings and earn an economic return. ESG's model assumes that the hypothetical customer described by the default scenario is able to realize a 5% annual return on all avoided costs. The result is a total return of \$150,746 over three years.

As previously mentioned, by reducing storage latency, a system is able to deliver an improved application user experience. ESG's model attempts to quantify what this improvement in end-user experience may mean financially to the hypothetical customer described in the default scenario. A detailed breakdown of user improvement benefits follows:

- **Fewer Users Abandoning Transactions:** One way improving user experience can yield financial benefit to the customer in this scenario is by reducing the number of customer transactions that are abandoned due to poor customer-facing application performance. In the PMO scenario, ESG assumes that three transactions are being abandoned per day due to storage performance. ESG also assumes that each transaction is worth, on average, \$50 to the organization and that the amount of customers utilizing the application is growing at an annualized rate of 15%. ESG's model estimates that by moving from the PMO to IBM FlashSystem, 75% of abandoned purchases tied to storage performance can be eliminated, resulting in an economic benefit over the time horizon of \$163,978.
- **Increases in User Productivity:** While improving customer experience is one way an organization can reap an economic benefit from better storage performance, another way is by improving the application experience of employees. In the default scenario modeled, employees fall into two camps: database application users and VDI users. When considering database application users in the PMO, ESG's model assumes that each user submits five transactions per hour and suffers a 30 second lag for each of those transactions. Furthermore, ESG's model estimates that by moving from the PMO to IBM FlashSystem, 50% of lag time can be eliminated. The result is a productivity benefit to database application end-users of \$371,685 over three years. Similarly, when considering VDI users, ESG's model assumes that certain events sap user productivity. Those events include boot storms (three estimated to occur per week, impacting 80% of the user community and lasting for 60 seconds each), scan storms (two estimated to occur per week, impacting 65% of the user community and lasting for 45 seconds each), and other latency spikes (impacting each user five times per week and lasting for 30 seconds each on average). Once again, ESG's model estimates that by moving from the PMO to IBM FlashSystem, 50% of lag time can be eliminated. The result is a productivity benefit to VDI users of \$154,816 over three years.
- **Reduced Helpdesk Requirements for End-users:** The final aspect of improving employee-facing application performance considered by ESG's model is the fact that happier users will less frequently take time out of their day to complain to IT about application performance. As discussed previously, in the PMO scenario, ESG assumes that each database application user will submit one helpdesk ticket every four months related to poor application performance that can be tied back to storage performance. ESG assumes that the submission of each ticket and follow up discussion with IT will sap 15 minutes of productive time from the end-user. Similarly, when supported by the PMO, ESG assumes that each VDI user will submit one helpdesk ticket every three months related to unacceptable latency that can be tied back to storage performance. Again, ESG assumes that submitting these complaints and following up with IT when the ticket is being resolved will require 15 minutes of end-user time. ESG's model assumes that by implementing IBM FlashSystem, 80% of these tickets will be eliminated. The end result is a net economic benefit of \$54,176 over three years in the form of saved user time.

The Bigger Truth

The conclusion of this study clearly and resoundingly shows that for the workloads and parameters outlined, IBM FlashSystem can not only meet, but can also handsomely beat the cost-benefit profile of traditional disk. Of course, any model is only as good as its assumptions, which is why all of the assumptions—which err toward the conservative—are clearly laid out in this report. The impressive outcomes are as follows: *ESG’s analysis of a typical heterogeneous enterprise workload running on IBM FlashSystem yields an estimated 76% ROI over the baseline of traditional performance storage—lowering TCO by more than \$950K while adding performance benefits in the range of \$1.2M over the modelled three-year time horizon.*

The ability to beat the “norm” is across both CapEx (nearly 40% reduction) and OpEx (over 56% reduction); the latter will not come as a surprise to many, but the former certainly will. Meanwhile, on the ROI side of things, this analysis has intentionally stayed very conservative, focusing in on measurable *internal* IT efficiency and user improvements. This is not to suggest a lack of additional potential positive impacts on the business; the opportunity for such improvements as faster customer service, new software releases happening faster, or shorter batch work completions is a plausible, tangible outcome of a change to IBM FlashSystem, but placing specific monetary value on such factors is variable. The validation ESG has modelled did not need to be artificially bolstered by attempting to enumerate and include those additional benefits. It is safe to assert that in most instances, the actual ROI of IBM FlashSystem will be even greater than what is described in this report.

Overall, this is an impressive set of findings: IBM’s flash portfolio is already achieving significant market traction and if the perceived “expense” of flash can be countered, as this research shows it can, ESG believes that users will continue to find additional use cases for it. Moreover, as users see that IBM FlashSystem can do more than just meet the economics of traditional performance disk—by delivering *better TCO and ROI*—budget procurement discussions should become considerably less painful. There will be no need to try to emotionally appeal to the aspiring-techno-geek gene in IT and business executive teams; instead, the discussion can be carried on in the language that everyone prefers: economics. To date, the idea that flash can meet and beat disk in terms of economics has been largely an assertion; this analysis shows that with IBM, it is achievable.



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