Technology Highlight

New Study Details Importance of TCO for HPC Storage Buyers

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Q1- 2020

HYPERION RESEARCH OPINION

Total cost of ownership (TCO) is often assumed to be an important consideration for buyers of HPC storage systems. Because TCO is defined differently by HPC users, it's difficult to make comparisons based on a pre-defined set of attributes.

With this fact in mind, Hyperion Research recently conducted a worldwide study that asked HPC storage buyers about the importance of TCO in general, and about specific TCO components that have been mentioned frequently in the past two years by HPC storage buyers.

The study findings still don't point to a standard TCO definition that would satisfy most HPC storage buyers. The results do, however, confirm the importance of what happens during the period of ownership, after the storage system has been purchased. The findings show that for many HPC storage buyers, operating expenses–ranging from staffing needs and power to the cost of unscheduled downtimes–are just as important considerations in upfront buying decisions as the initial acquisition cost of the storage system.

The new study corroborates and adds to the findings of other recent Hyperion Research surveys.

- All the studies underscore the expanding role of HPC storage in the emerging era of digital transformation and AI, in both established and newer HPC markets. Hyperion Research forecasts that the global market for HPC storage systems will grow at a robust rate (7.0% CAGR), from $5.5 billion in 2018 to $7.0 billion in 2023.

- The new study in particular shows that HPC storage system requirements are becoming more complex and diverse. Iterative simulation methods and new HPDA-AI workloads are the most important factors driving the growth of HPC storage; unplanned system downtimes can be lengthy and costly; and recruiting and training qualified personnel is the most challenging aspect of storage operations for many HPC sites.

This paper presents key findings of the new study, along with supporting data.

KEY FINDINGS

Among the salient findings are the following:

- **Growth Drivers.** The largest factors driving the growth of HPC storage capacity were iterative simulation workloads and new workloads such as AI and other Big Data jobs.

- **Growth Inhibitors.** The most often-named challenge for HPC storage operations was recruiting and hiring qualified staff, followed by the time and cost needed to tune and optimize the storage systems.

- **Total Cost of Ownership.** Deliberately presented without a definition, TCO emerged as the second-most-important of all purchasing criteria for the surveyed group of HPC storage buyers, tied with "price" and trailing only "performance." Though the definitions respondents had in mind presumably differed in some particulars, as a group these buyers endorsed the importance of TCO. See Figure 1.

- **Downtime**. Almost half of the surveyed sites experience storage system failures once a month or more frequently. Downtimes range from less than one day to more than a week. A single day of downtime costs from under $100,000 to more than $1 million.

- **Satisfaction and Loyalty.** Although a large majority (82%) of respondents were relatively satisfied with their current HPC storage vendors, a substantial minority said they are likely to switch storage vendors the next time they upgrade their primary HPC system. The implication here is that a fair number of HPC storage buyers are scrutinizing vendors for competencies as well as price.

- **Storage Source.** HPC buyers as a group have grown sophisticated enough about storage to pay more attention to the product than to who sells it to them. The study showed that most buyers sometimes purchase storage at the same time as the HPC system it will support, other times separately. Many buyers don't care whether the storage system is sold by a dedicated storage vendor or a system vendor intermediary. It's the product and the support staff that count most.

A clear implication of this study is that to compete effectively, storage vendors need to deliver value far beyond the initial purchase price. They must pay attention to the full range of buyer considerations, including reliability, cost of management, responsive support and uninterrupted application user productivity.
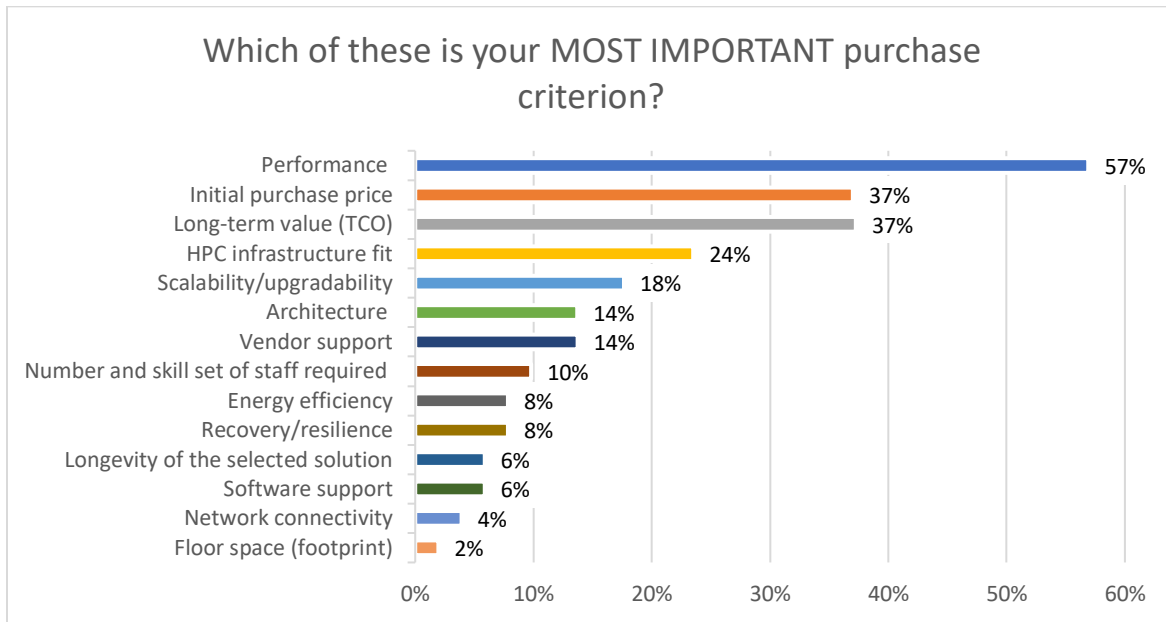
STUDY FINDINGS

Summary

In HPC storage systems purchasing there are things that can be easily measured, such as I/O performance and cost of acquisition, but often overlooked is the ongoing cost of operations and the negative impact that inconsistent and complex storage solutions can have on productivity and time to quality outcomes. As HPC becomes more widely disseminated with increasing adoption in the enterprise market, so does the need for a better understanding of how HPC storage impacts organizations, both from a productivity as well as from an infrastructure investment perspective.

To identify the key challenges in HPC storage deployments today, particularly in the areas of total-cost-of-ownership (TCO) vs. initial acquisition costs, Hyperion Research conducted a site survey that solicited feedback from data center planners and managers, HPC storage system managers, purchasing decision-makers and key influencers, and HPC storage system users, based in North America, EMEA and Asia.

While performance was the number one criterion for purchasing HPC storage (Figure 1), TCO was tied with the purchase price for second place.

FIGURE 1

HPC Storage Buyers' Most Important Purchase Criterion

Which of these is your MOST IMPORTANT purchase criterion?

| Criterion	Percentage
Performance	57%
Initial purchase price	37%
Long-term value (TCO)	37%
HPC infrastructure fit	24%
Scalability/upgradability	18%
Architecture	14%
Vendor support	14%
Number and skill set of staff required	10%
Energy efficiency	8%
Recovery/resilience	8%
Longevity of the selected solution	6%
Software support	6%
Network connectivity	4%
Floor space (footprint)	2%

Source: Hyperion Research, 2019

Demographics of the Survey Respondents

Employee populations among the surveyed sites varied from fewer than 500 to over 10,000 (Figure 2).

FIGURE 2: Number of Employees

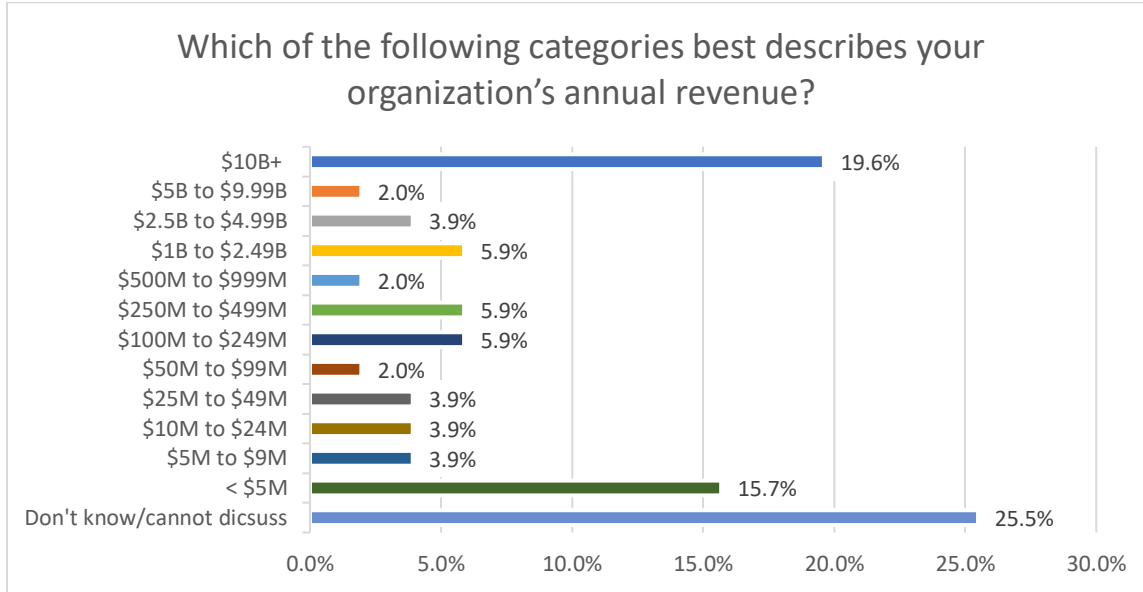| Number of Employees	Percentage
> 10,000	35%
5,000 - 10,000	4%
2,500 - 5,000	14%
500 - 2500	16%
< 500	29%
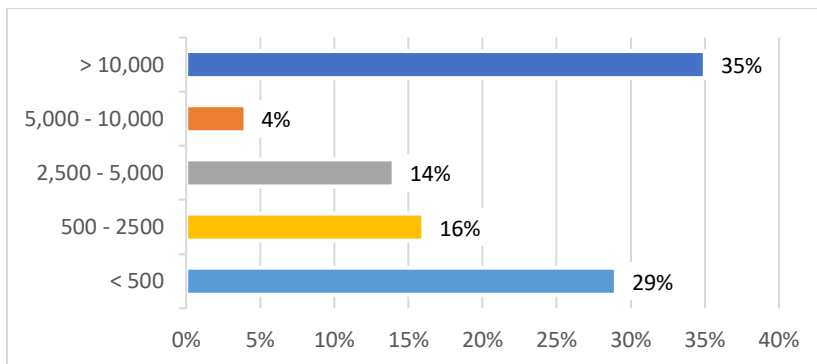
Source: Hyperion Research, 2019

As Figure 3 shows, the study captured a wide range of organization sizes, with annual revenues from less than $5 million to more than $10 billion.
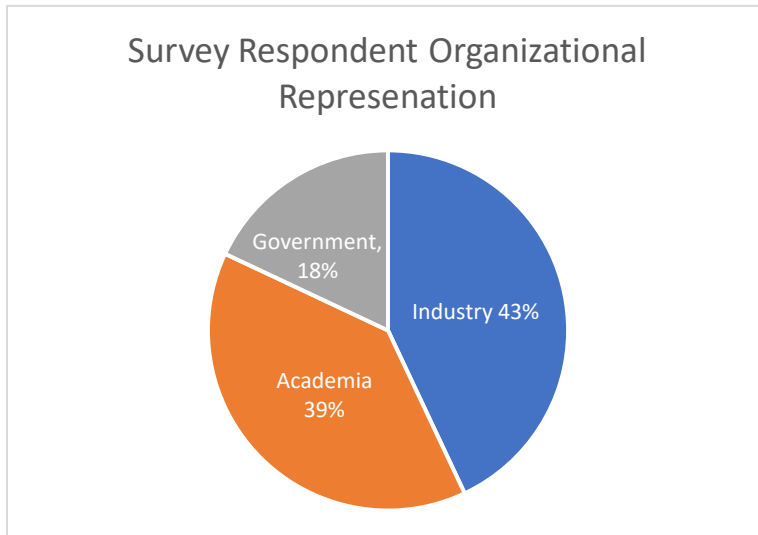
FIGURE 3

Annual Revenues of Respondent Organizations

Which of the following categories best describes your organization's annual revenue?

Category	Percentage
$10B+	19.6%
$5B to $9.99B	2.0%
$2.5B to $4.99B	3.9%
$1B to $2.49B	5.9%
$500M to $999M	2.0%
$250M to $499M	5.9%
$100M to $249M	5.9%
$50M to $99M	2.0%
$25M to $49M	3.9%
$10M to $24M	3.9%
$5M to $9M	3.9%
< $5M	15.7%
Don't know/cannot dicsuss	25.5%

Source: Hyperion Research, 2019

As Figure 4 shows, the major market sectors were well represented in the study.

FIGURE 4: Major Market Sectors

Survey Respondent Organizational Represenation

- Industry 43%
- Academia 39%
- Government, 18%

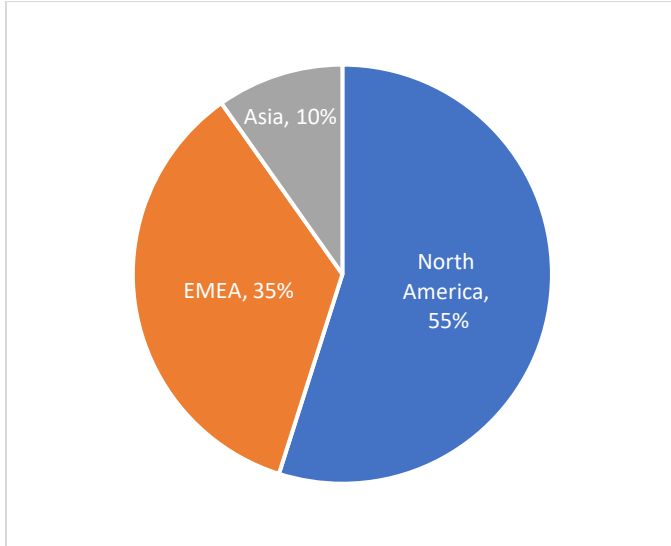Source: Hyperion Research, 2019

The major geographic regions for HPC were represented as well (Figure 5)

FIGURE 5

World Geographic Regions

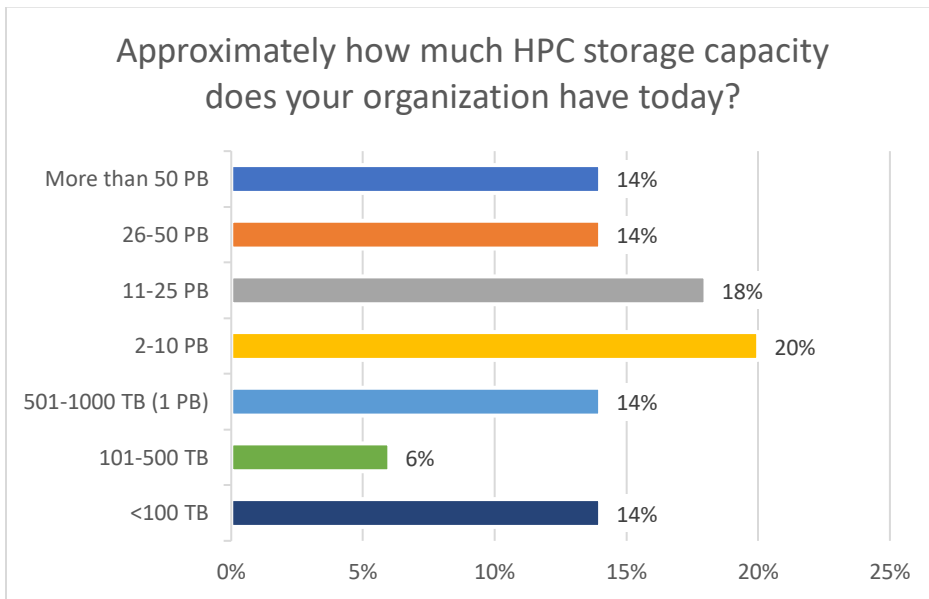

Source: Hyperion Research, 2019

Figure 6 shows the combined storage capacities of the sites' HPC systems today.

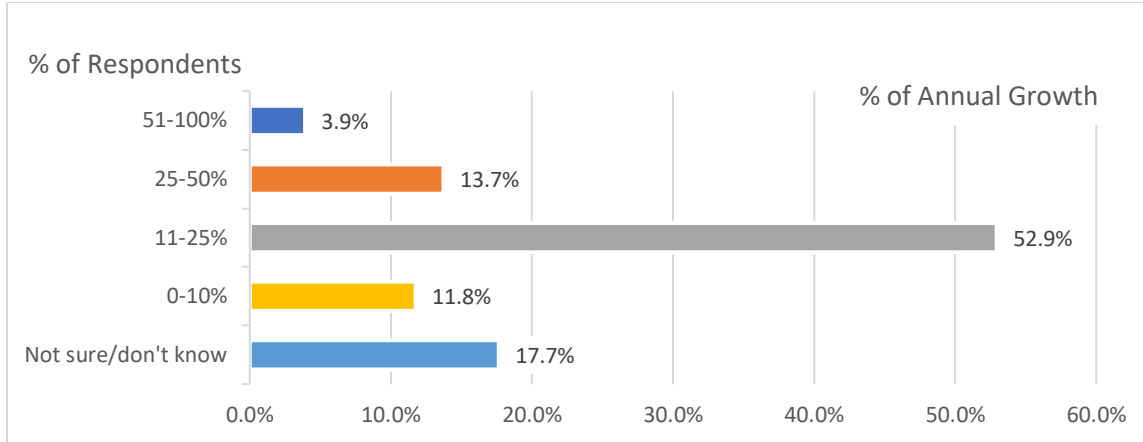## FIGURE 6

Current HPC Storage Capacity

Source: Hyperion Research, 2019

Figure 7 displays the annual growth of storage capacity for the surveyed sites.

FIGURE 7

## Annual Growth in HPC Storage Capacity

Source: Hyperion Research, 2019

The most often-named driver of the sites' HPC storage growth (Figure 8) is the increase in iterative (multiple-run) simulations. Today's more powerful HPC systems can allow many more attempts at a problem solution to be made in an allotted timeframe. In the past, car designers might have been able to try out 3-4 designs in their part of the development cycle. Today, that process may involve hundreds or thousands of runs—and for regulatory and liability reasons, all that data may need to be stored for the market lifetime of the vehicle in question. Iterative methods are especially common in the manufacturing industry (parametric modeling), the financial services industry (stochastic modeling) and the weather/climate sector (ensemble modeling).

FIGURE 8

Most Important Driver of HPC Storage Growth
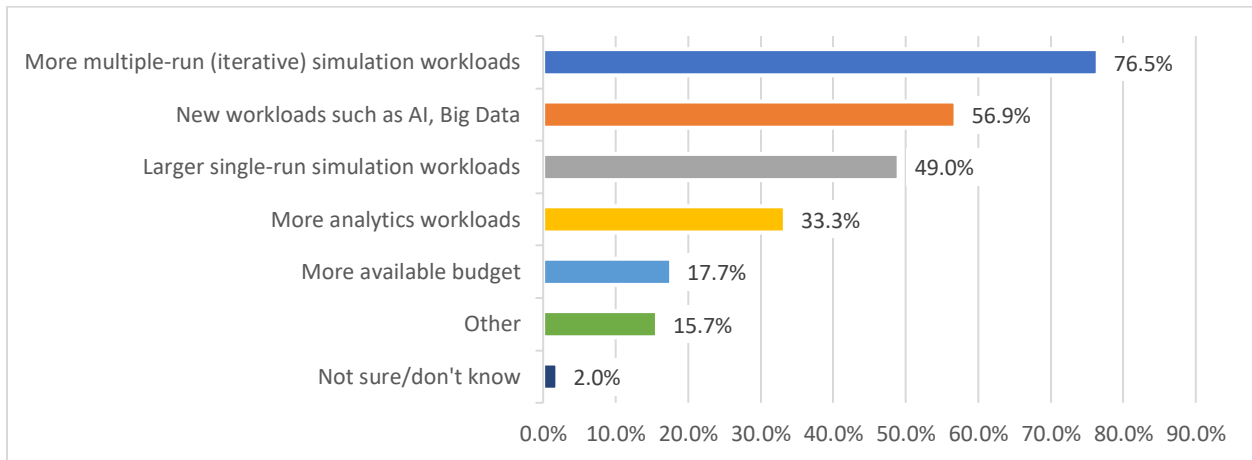
Source: Hyperion Research, 2019

People, Productivity and Operations—Three Aspects of TCO

Although HPC storage buyers don't agree on a single TCO definition, three areas are generally accepted as contributing to TCO: people (staffing), productivity and operations. This section presents survey findings in these areas.
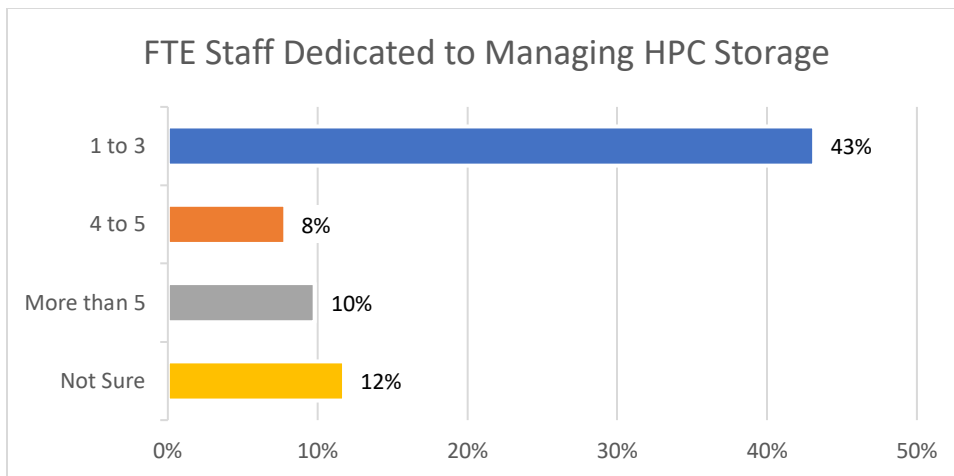
People

In the average HPC storage deployment, skilled technical staff are required to manage day-to-day operations, tune and retune to sustain performance, and manage changing workloads. The complexity of open source file systems typically requires a larger and more skilled staff to keep the storage system operating at peak level. Recruiting, training and retaining skilled staff at an affordable level is getting more difficult, as the demand for these skilled technicians grows with the expansion of HPC into the enterprise and the emergence of new technologies and use-cases.

Storage staffing among the respondents ranged in size, from one to more than five FTEs per site (Figure 9).

FIGURE 9

Number of FTE Staff Managing HPC Storage

FTE Staff Dedicated to Managing HPC Storage

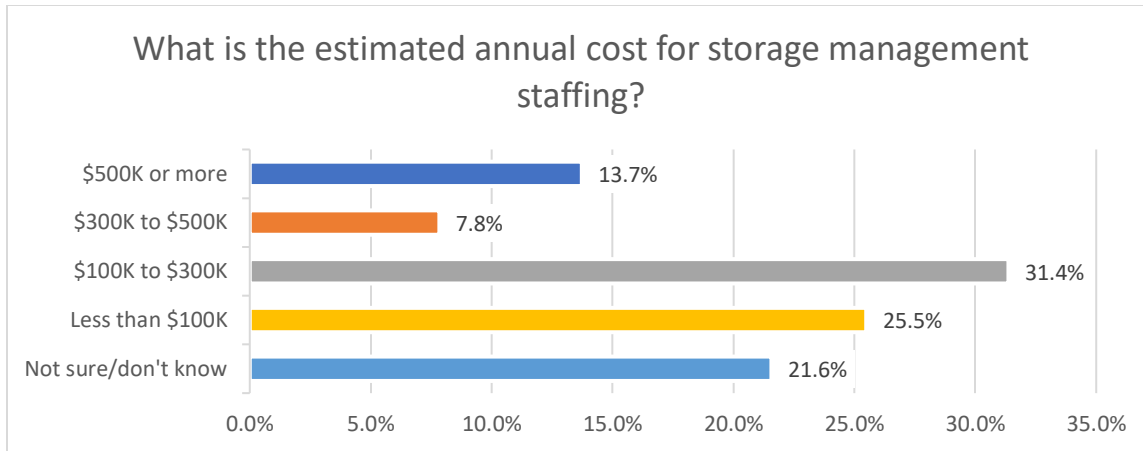| Category	Percentage
1 to 3	43%
4 to 5	8%
More than 5	10%
Not Sure	12%

Source: Hyperion Research, 2019

The estimated annual costs for the sites' HPC storage staff vary considerably and sometimes top $500,000, presumably at sites employing multiple people to manage the storage operations (Figure 10).

FIGURE 10

Annual Cost for Staff Managing HPC Storage

What is the estimated annual cost for storage management staffing?

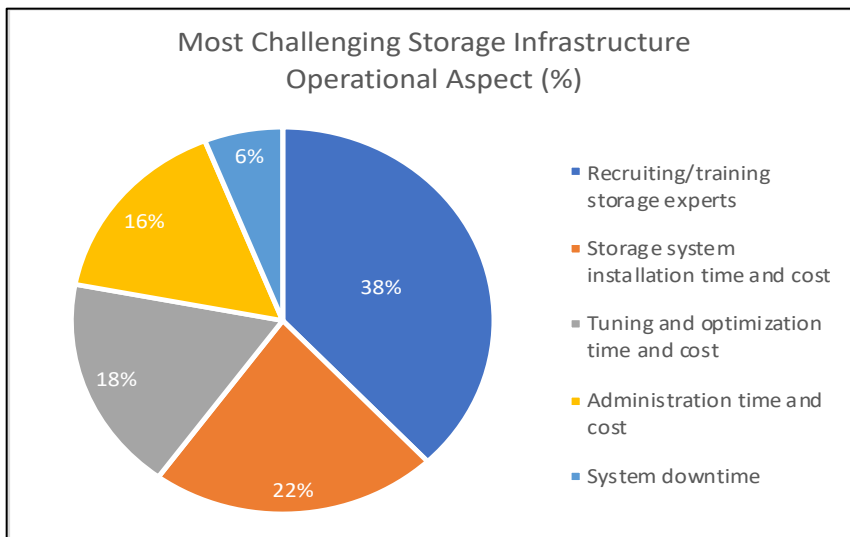| Category	Percent
$500K or more	13.7%
$300K to $500K	7.8%
$100K to $300K	31.4%
Less than $100K	25.5%
Not sure/don't know	21.6%

Source: Hyperion Research, 2019

Figure 11 shows that a people issue – recruiting and training storage staff – is also the most frequently cited challenge the sites associate with HPC storage operations.

FIGURE 11

Operational Challenges in Storage Infrastructure

Most Challenging Storage Infrastructure Operational Aspect (%)

- Recruiting/training storage experts: 38%
- Storage system installation time and cost: 22%
- Tuning and optimization time and cost: 18%
- Administration time and cost: 16%
- System downtime: 6%
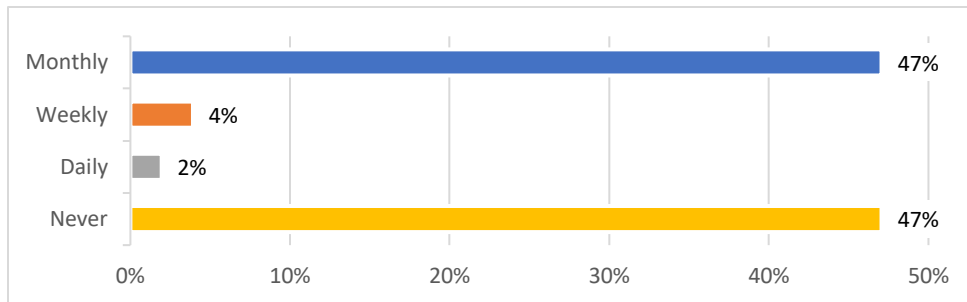
Source: Hyperion Research, 2019

Productivity

Supporting high productivity for users of HPC servers (scientists, researchers, analysts and engineering staff) is of paramount importance to data center managers and other senior officials at HPC sites. In some industries, a day of downtime can cost the organization more than $1 million in lost revenue. Lack of storage system resiliency in the face of failures and changing requirements has been an ongoing issue for some file systems. Optimal time to customer problem resolution is particularly challenging when there are multiple layers in the customer support chain.

As Figure 12 indicates, more than three-quarters of the surveyed sites had episodes in the past year when storage issues reduced productivity. For one in eight sites, this occurred more than 10 times in the past 12 months.

FIGURE 12

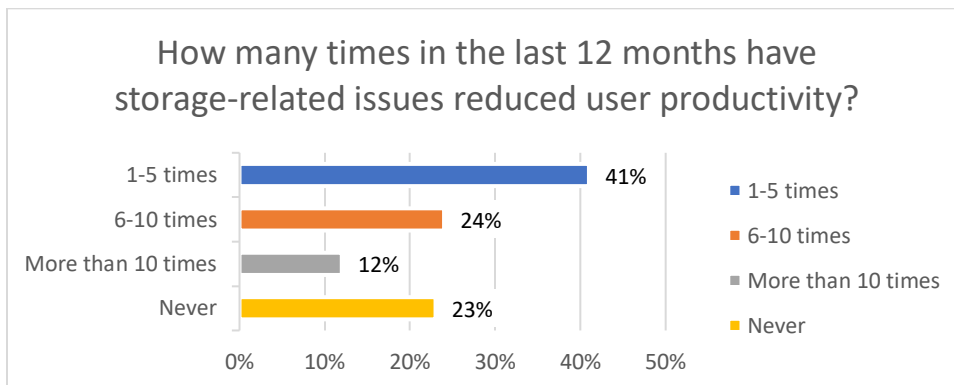## Frequency of Tuning and Re-Tuning

Source: Hyperion Research, 2019

Figure 13 shows that about half the surveyed sites tune their storage systems once a month or more often, while the other half said they never do this.

FIGURE 13

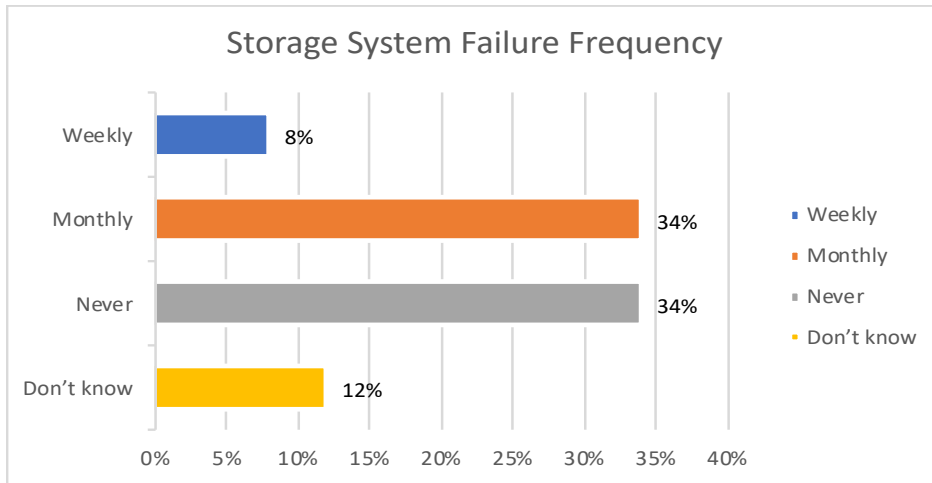## Storage Issues Reducing Productivity

Source: Hyperion Research, 2019

A substantial minority of sites said they experience storage system failures, defined as very significant episodes, on a monthly or weekly basis. Figure 14.
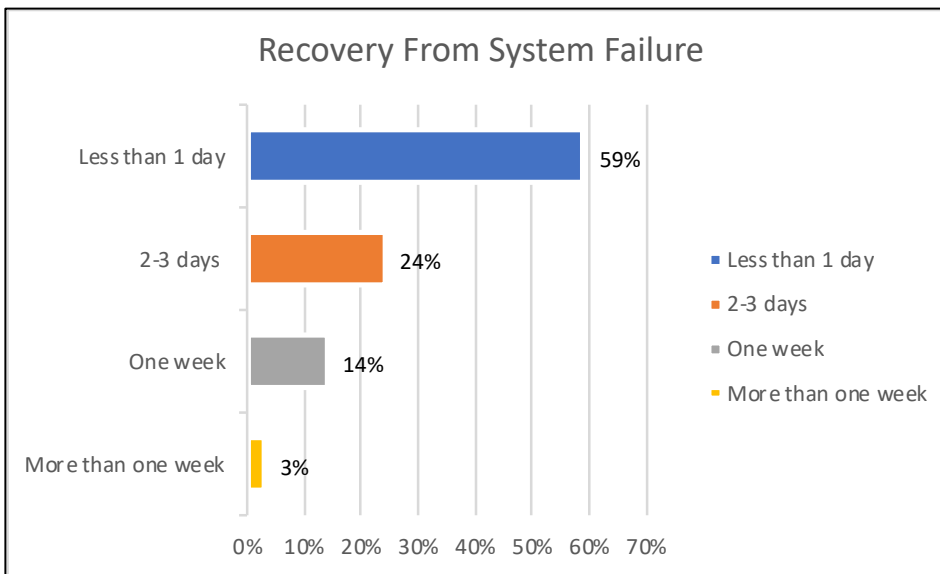
FIGURE 14

Storage System Failure Frequency

- Weekly: 8%
- Monthly: 34%
- Never: 34%
- Don't know: 12%

Legend:
- Weekly
- Monthly
- Never
- Don't know

Source: Hyperion Research, 2019

In most cases, recovery from a storage system failure took less than 24 hours, but in some cases this process took a week or more (Figure 15).
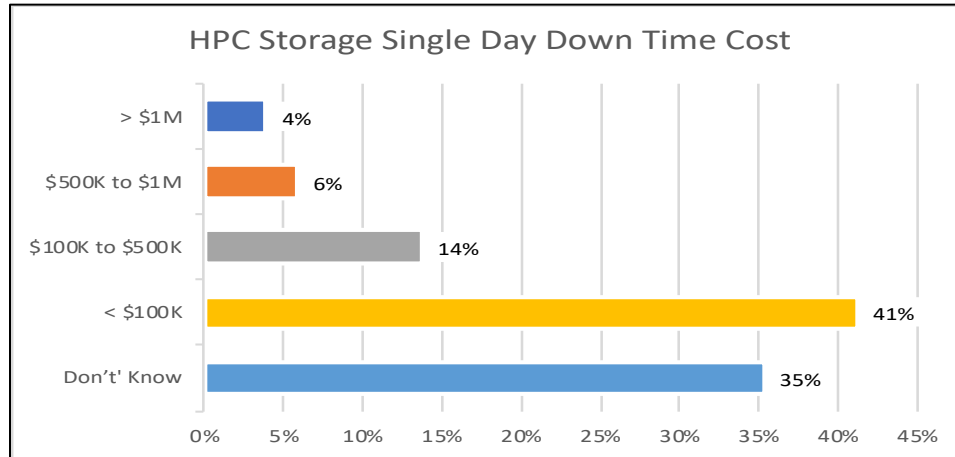
FIGURE 15

Recovery From System Failure

- Less than 1 day: 59%
- 2-3 days: 24%
- One week: 14%
- More than one week: 3%

Legend:
- Less than 1 day
- 2-3 days
- One week
- More than one week

Source: Hyperion Research, 2019

But even in cases where recovery from a storage system failure takes only one day, the cost can exceed $100,000. Figure 16.

FIGURE 16

HPC Storage Single Day Down Time Cost

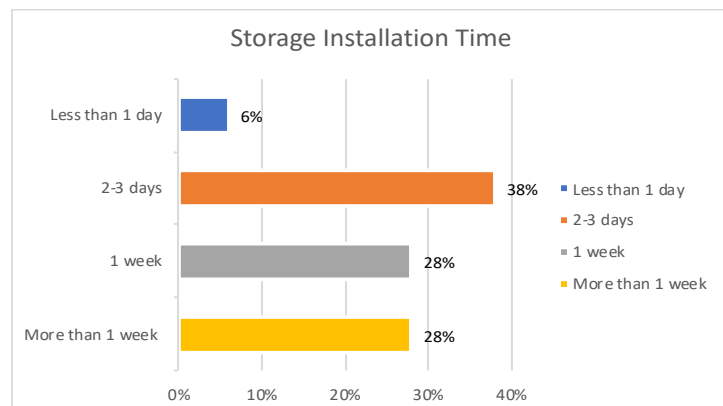| Category	Percentage
> $1M	4%
$500K to $1M	6%
$100K to $500K	14%
< $100K	41%
Don't' Know	35%

Source: Hyperion Research, 2019

Operations

Serving the HPC infrastructure needs of an organization is important and challenging work. Keeping the system performing at peak levels as workloads, applications and users are changed and added, causes disruption and stress under the pressure of pending deadlines.

Installing an HPC storage system can take from under one day to more than one week, the respondents reported (Figure 17).

FIGURE 17

Storage Installation Time

Category	Percentage
Less than 1 day	6%
2-3 days	38%
1 week	28%
More than 1 week	28%

Source: Hyperion Research, 2019

FUTURE OUTLOOK

TCO is a term variously used in the HPC community and therefore deliberately presented to respondents of this study without a definition. This had the advantage of enabling the respondents to apply their own definitions. When they did, TCO emerged as one of the top purchasing criteria of the surveyed sites—tied in importance with "price" and second only to the "performance" of HPC storage systems under consideration.

As a category, the study shows, HPC storage systems have become significantly more important in the current era of digital transformation and high-performance data analysis, including AI methods such as machine and deep learning.

To meet emerging requirements for what the U.S. Department of Energy calls "extreme heterogeneity" —the convergence of simulation and analytics, traditional and enterprise environments, and interoperation with cloud infrastructures—HPC storage systems, like other parts of the HPC ecosystem, have become more complex and more challenging to manage in many cases. As the study shows, HPC storage systems are subject to downtimes that can increase costs while lowering productivity, and finding qualified job candidates to help manage HPC storage systems can be a major challenge. These trends are likely to continue.

With these factors in mind, Hyperion Research advises HPC sites to evaluate a wide range of HPC storage vendors before making a purchase decision. There are important differences in the vendors' products, strategies and support. A wider search could pay large TCO dividends.

About Hyperion Research, LLC

Hyperion Research provides data-driven research, analysis and recommendations for technologies, applications, and markets in high performance computing and emerging technology areas to help organizations worldwide make effective decisions and seize growth opportunities. Research includes market sizing and forecasting, share tracking, segmentation, technology and related trend analysis, and both user & vendor analysis for multi-user technical server technology used for HPC and HPDA (high performance data analysis). We provide thought leadership and practical guidance for users, vendors and other members of the HPC community by focusing on key market and technology trends across government, industry, commerce, and academia.

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