



Hitachi's Continued Assault on Innovation

An Analysis of Hitachi's Enhanced Universal Storage Platform V Capabilities

Executive Summary

Hitachi's November 2007 announcement of enhancements to its Universal Storage Platform V (USP V) continues the consistent progression of the product line. While this announcement represents a seemingly small step in the realization of Hitachi's vision for storage services, it has big implications. Specifically, instead of just making new storage better, Hitachi continues to deliver on its promise of improving the efficiency of already installed storage assets.

To accomplish this, Hitachi has built on its May 2007 announcement of thin provisioning and extended this capability for externally attached storage. In other words, Hitachi can provide virtualization, thin provisioning and storage management services not just for its own new storage, but also for installed storage, all in one system. The key questions for storage executives are if it works and, if it does, what is the business case of adopting this approach. This white paper focuses on these two questions.

The answer to these two questions was best summed up by a quote from a storage manager who installed virtualization and thin provisioning on a single Hitachi USP V nine months ago: "It saved me an array...I got 30 terabytes for free." ITCentrix has confirmed that customers from Hitachi and its distribution partners have similar positive stories. While there are some applications unsuitable for thin provisioning and care needs to be taken on others, the software world and customer base is beginning to see that block-based virtualization, thin provisioning and storage services are trends they must embrace.

The business case for these enhancements is illustrated in the case study within this report. A financial company was expecting to buy two arrays over the next twelve months. The choices were:

- Add an additional array to the three installed already and an additional array in six months' time, or
- Add a USP V with external virtualization capabilities and evolve it to provide thin provisioning to the installed arrays over time.

The financial case was simple. The USP V will add 5 percent more usable capacity than the alternative over the next 12 months at half the cost, saving more than \$800K (even after

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*Storage Manager,
Large Financial Firm*

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accounting for migration expenses). It saves an array and is expected to allow the redeployment of a full-time equivalent. Figure 1 shows the summary results. Figure 3 (see page 10) in the case study provides more details. The ability of virtualization and thin provisioning to reduce storage administration was a significant factor. This was worth \$313,000 over three years.

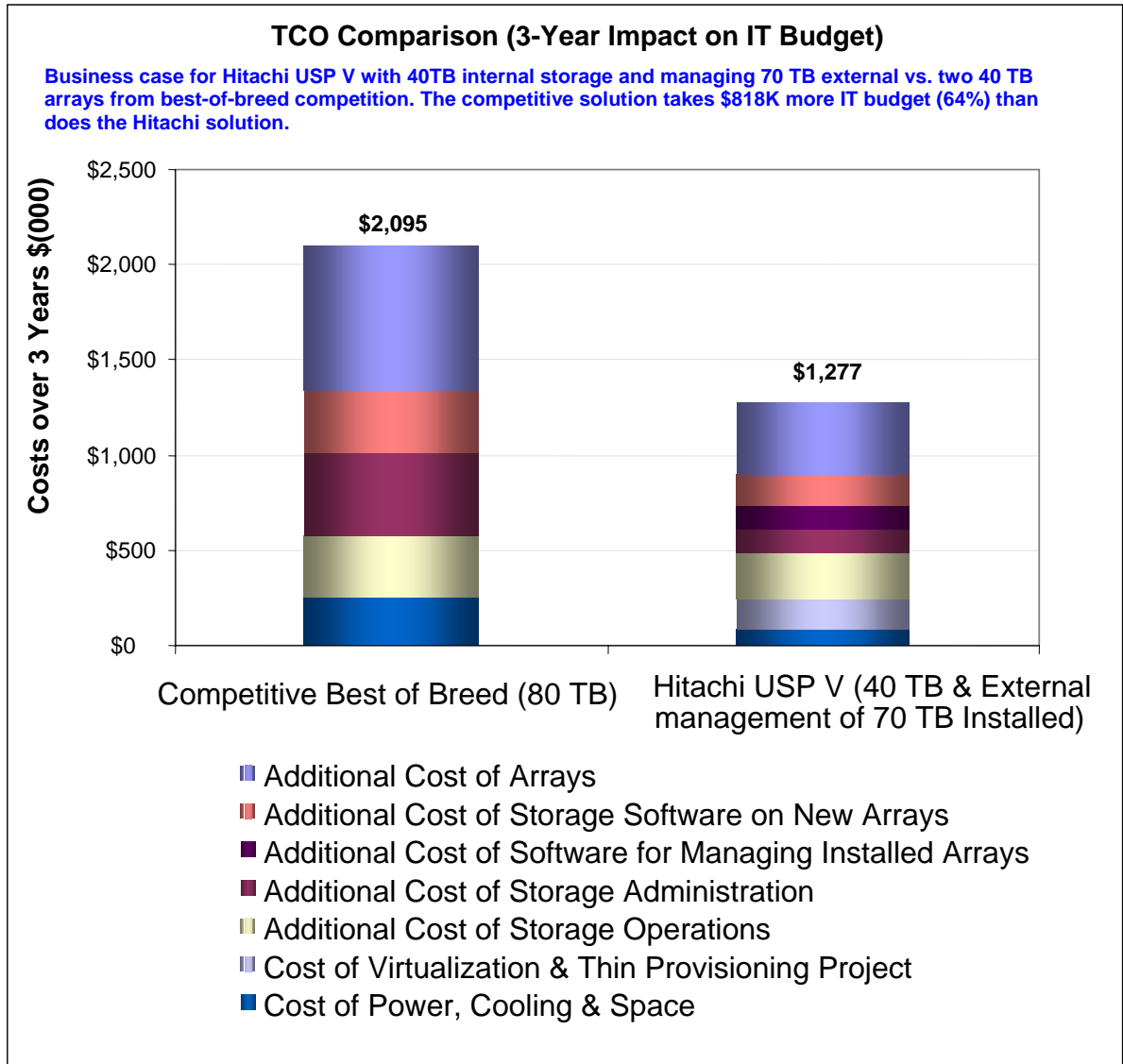


Figure 1 – TCO Comparison of Impact of Thin Provisioning for External Storage

This announcement of external thin provisioning, along with improved performance, support for 750 GB SATA drives internally on the USP V, and strong support for VMware, positions Hitachi as a clear leader in performance and functionality in high-end arrays. Storage executives should explore the potential to improve the functionality, efficiency and manageability of their installed storage assets by including Hitachi on all storage short lists.

Storage Dynamics

Storage Business Environment

Talk to most organizations about their storage infrastructure, and they will describe the proliferation of incompatible SANs stemming from the growth of new applications, mergers, acquisitions and many other causes. IT managers will discuss the sensitivity of management to the cost of storage as one of the reasons for so many different types of storage arrays in the data center. They will also note that storage provisioning is a time-consuming and onerous process.

Customers will stress the speed at which business is changing, the flattening of the globe and the need to react in hours or minutes to demands for new storage. Almost universally, customers will share their pain about the business disruption brought about by changes in storage infrastructure and the difficulty of migrating storage once it has been allocated.

As a result of these trends, the rapid adoption of server virtualization, particularly with VMware, is a major theme.

Backup and the challenges of meeting backup windows—and even knowing if disaster recovery systems actually work—is another point of uncertainty and risk for organizations. More experienced users will talk about failed attempts to implement storage resource management (SRM) systems across heterogeneous storage infrastructure. The impact of governance, compliance and escalating information risk is another common theme.

Increasingly, IT storage administrators are being asked to factor environmental issues into product procurement decisions. Awareness from executive management is actually creating discussions about disks that spin forever, denser storage controllers and escalating power consumption that contributes to power shortages in the data center.

Hitachi's Storage Infrastructure Vision

Many vendors see a single solution to the problems of storage: their product.

Hitachi's strategy, while having a strong product emphasis, is different in that it sees other vendors' storage products as an opportunity. Storage infrastructures are untidy and mixed. Rather than criticize how the problem happened, Hitachi has been providing pragmatic ways of linking heterogeneous storage together and providing seamless access and utilization of those installed resources. Instead of proposing to get rid of old storage in the data center, Hitachi has been proposing to breathe new vigor into those arrays and extend their life. This is a compelling message for many customers.

Hitachi saw the opportunity to provide services via a powerful storage controller. In disk terms, Hitachi designed a service controller that had the intelligence to discern where data resided and where there was free space. The basic premise of the Hitachi design is to allow the customer to decide what types of arrays to deploy for different applications and have the controller rationalize, through virtualization, the inherent incompatibilities in different array architectures. Very high performance and a network-centric device are fundamental

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to this approach. It's also important to have excess power provide a rich set of controller services that can be deployed across heterogeneous infrastructure. These services include virtualization, tiered storage, thin provisioning and data management services that enable quick and simple space optimization as well as remote replication capabilities.

Evolution - Hitachi's Announcement

Enhancements described in Hitachi's November 2007 announcement improve the performance of the USP V to a maximum of more than 4 million IOPS and a maximum bandwidth of 106 gigabytes/second. These are impressive figures, but of course they do not reflect the performance that could be achieved in real life.

A good question is why all that power is needed. It would be overkill for most 40 TB arrays. But put in the context of providing capabilities for external storage, the Hitachi design makes perfect sense.

It is difficult to assess the performance and throughput of storage controllers from paper specifications, but some indication of relative performance can be derived. Benchmarks are also good, but the only formal benchmarks are the SPC-1 and SPC-2 benchmarks. These benchmarks, although not perfect, give an indication of relative throughput.

Until very recently, IBM was the only leading storage vendor to contribute results from large storage arrays. Hitachi contributed its measurements on the USP V in October 2007 to the Storage Performance Council. The figure of 200,000 IOPS was the first single array product that had broken the 200K barrier. More impressively, Hitachi had a response time of less than five milliseconds and there was no "knee in the curve." This suggests that the array controller still had power and was constrained in the production of more performance by the maximum number of drives available. In other words, it has the capabilities to perform more I/Os from external drives. It confirms that Hitachi has a very powerful array storage system and, by many accounts, the most powerful in the industry.

Hitachi also made available 750 gigabyte SATA disks on the USP V and USP VM for internal (and external) access. Hitachi Dynamic Provisioning™ is now available for externally attached arrays and delivers thin provisioning with wide disk striping across multiple logical storage pools. Hitachi also announced that its virtualization will be the first supported by VMware's ESX Server, which allows virtualized externally attached arrays with non-disruptive application data mobility between servers and storage tiers. All of these functions are also now available on the USP VM product.

Adopting the Vision

Hitachi's vision is simple: to provide the best controller—with or without storage—to help manage arrays in the data center. By far the most compelling aspect of this announcement is the availability of external thin provisioning (Hitachi Dynamic Provisioning), which dramatically improves the cost effectiveness and reduces complexity of externally attached arrays.

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A main concern with thin provisioning is the need to carefully test and ensure service levels and stability for key applications. As such, a good starting point for implementing this vision is with less risky tier-2A storage. The lack of external thin provisioning in Hitachi's May 2007 announcement was a concern for some customers. As a result, many customers chose to test this capability on test and development systems utilizing internal thin provisioning. With this announcement, adoption of Hitachi Dynamic Provisioning will continue and likely escalate rapidly. Thin provisioning is probably the most powerful way of reducing storage waste and should be implemented aggressively.

Implementing front-end and back-end virtualization is an important early step to adopting Hitachi's architecture. Back-end virtualization allows very wide striping of the storage pools and spreading of I/O across the disks, helps balance performance and supports the use of large disks. While not a prerequisite, front-end virtualization services provide a way of grouping users and/or applications and understanding the performance they are receiving.

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Utilizing older arrays behind the Hitachi controllers is a good way of extending the life of assets, especially if they have expensive software on them. The USP V or USP VM can provide equivalent storage management services. Again, applying thin provisioning to external devices can significantly improve storage utilization.

The final step is putting full tier-1 storage behind the USP V controller. This should be done with strong testing of all functionality on an application-by-application basis. Very high I/O volumes should be migrated to the internal storage on the USP.

There are two additional organizational concerns users should consider in adopting the Hitachi products. First, it is vital that IT and the business clearly define service levels for tier-1 and tier-2 storage. The choice of storage type to meet those requirements should be given to the storage group.

The second issue relates to the adoption of thin provisioning, which will dramatically reduce the time taken to provision storage. This means the process of procurement must support more speedy acquisition of storage. If procurement becomes a bottleneck, thinly provisioned storage may not have enough physical storage to support applications.

Green Storage

Power usage in IT has captured the attention of the EPA, who, in a recent study, indicated that 1.5 percent of power in the US is used by data centers. About 20 percent of that is power for storage. Power consumption is becoming a major issue for the CFO and CEO.

There are two major components on storage arrays, the disk cabinets and the controller. The disk cabinets use commodity disks and are the major consumer of power and cooling resources for modular storage. The best way to reduce power for disks is to lower the number of drives and use denser devices. Functionality such as virtualization, wide striping, tiered storage and thin provisioning helps reduce the number of disks and saves power.

The controller is the other power user. For high-end configurations the controller dominates and uses more than 60 percent of the power. Here, the only ability to lower power comes from efficient controller design appropriate for the work to be done.

Hitachi has had a long-term corporate commitment to being carbon neutral. This takes into account the full life cycle of the products produced from design to manufacturing to user usage and finally disposal. It includes an objective that 70 percent of its major suppliers will also be carbon neutral. Hitachi produces very efficient controllers and is constantly redesigning them to reduce power. ITCentrix believes that Hitachi is a clear and strong leader in the storage industry in providing green storage.

Case Study

The IT management of a financial services company needs to provide additional storage capacity to meet an aggressive roll-out of a new function on the core business systems. These systems have three high-end storage arrays that support production systems, development, testing and data warehousing. The application currently uses 32 terabytes. A total of 70 terabytes is installed, and the additional capacity is required to take into account the RAID overhead, over-allocation and underutilization.

Installed Environment			
Original	Raw Terabytes	Utilization	Used Terabytes
Installed	15	~40%	6
Installed	25	~45%	11
Installed	30	~50%	15
Total	70	~46%	32

Table 1 - Current Installed Storage

The storage management team was faced with the following challenges:

- Add storage seamlessly and quickly in days or hours without any impact or interruption to production or support systems,
- Support the change in storage requirement as the applications migrate from an application architecture with a relatively small number of large servers to an architecture with a large number of small servers, or
- Add two arrays (80 terabytes raw capacity, 20 each) over the next 12 months to meet additional user application requirements of 40 terabytes.

The traditional approach would have been to carefully plan to install two arrays, one at the beginning of the year and another halfway through the year.

Traditional Approach

The traditional approach would have been to carefully plan to install two arrays, one at the beginning of the year and another halfway through the year. The results of adding the storage are given in Table 2, below.

Traditional Array Approach			
Original	Raw		Used
	Terabytes	Utilization	Terabytes
Installed	15	~40%	6
Installed	25	~45%	11
Installed	30	~50%	15
New (2 arrays)	80	~50%	40
Total	150	~48%	72
Additional	80	~50%	40

Table 2 – Adding Traditional Arrays to Meet Storage Requirement

An additional 40 terabytes of usable storage would be added. Traditionally it would take about four months for the storage arrays to be operational as data has to be moved from current systems to the new arrays with significant disruptions to application availability.

The advantages of this approach are that the storage management system would remain the same, and there would be no training required. In addition, the risks and costs of adopting the new technology are minimized.

Virtualization and Thin Provisioning Approach

The approach that Hitachi now recommends is to add a single array and implement a virtualization storage service across all the arrays by attaching the installed competitor's high-end storage to the Hitachi USP V.

Within this virtualization system, two additional services are recommended: tiered storage and thin provisioning for capacity internal and external to the USP V. The results of the approach are shown in Table 3 below. The table shows that only one array of 40 terabytes raw capacity has to be added, providing 28 terabytes of usable capacity. An additional 14 terabytes of usable capacity is realized from better utilization of the installed arrays.

Hitachi USP V with Virtualization and Thin Provisioning of Installed Storage			
Original	Raw		Used
	Terabytes	Utilization	Terabytes
Installed	15	~60%	9
Installed	25	~65%	16
Installed	30	~70%	21
New (1 array)	40	~70%	28
Total	110	~68%	74
Additional	40		42

Table 3 – Using Virtualization and Thin Provisioning to Add Capacity

Because the virtualization and thin provisioning are applied to the installed storage, only one array was required to meet the additional usable storage requirements. The applications with the most aggressive service level agreements (SLAs) will be migrated to the internal storage of the USP V, and the remainder will continue to reside on the current arrays.

The benefits to the customer of the proposed Hitachi approach are:

Because the virtualization and thin provisioning are applied to the installed storage, only one array was required to meet the additional usable storage requirements.

- Increased utilization of internal USP V storage
- Increased utilization of externally attached storage
- Reduced management complexity (reduction by one person)
- Improved ability to add storage capacity

The Hitachi approach does require migration from an existing environment and changes to current processes and procedures for storage management, as well as careful testing and qualification of virtualization and thin provisioning on an application-by-application basis. The cost is approximately six person-months for the planning and migration. Additionally, streamlining of procurement processes will be required.

Figure 2 shows the benefit: only 40 TB and one array were necessary with the Hitachi solution, which was half the cost of competitive offerings and had less than 50 percent of the environmental impact.

Case Study Conclusions

The customer has determined that the to-be state offers superior advantages because it gives them

- The ability to add storage to applications seamlessly and quickly (in hours vs. months) without any interruption to applications,
- Better support of a large number of small servers through the use of virtual ports, and
- A way to avoid the purchase of an additional array providing 40 terabytes of free storage.

The financial company did not need a complex business case to decide between buying one array or two. Figure 2 below shows the benefit: that only 40 TB and one array were necessary with the Hitachi solution, at half the cost of competition and less than 50% of the environmental impact.

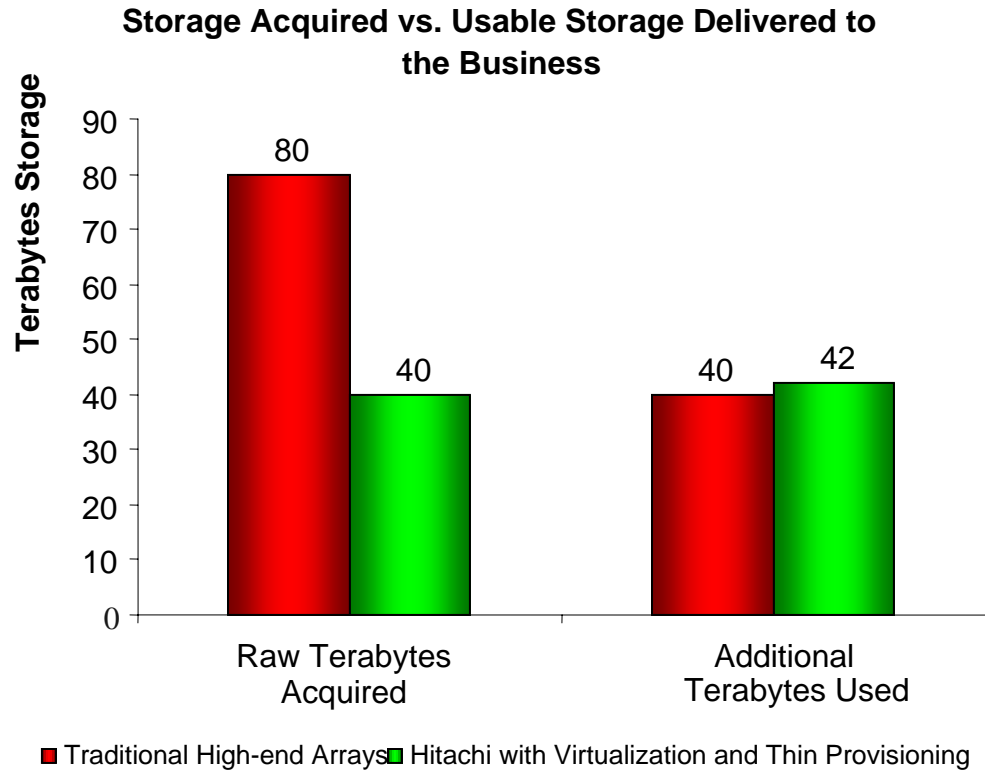


Figure 2 – Storage Acquired vs. Usable Storage Delivered to the Business

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In addition to the hardware savings, the company believed that it would reduce its storage management headcount by one person and would implement new storage arrays much faster, thus delaying the requirement to buy new storage. On balance, the customer has determined that these benefits are well worth the one-time migration cost.

Figure 3 shows the TCO comparison of the two alternatives. The Hitachi solution shows an \$818,000 saving on the IT budget. The competitive solution is 64 percent higher in IT budget impact than the Hitachi solution is. The ability of virtualization and thin provisioning to reduce storage administration was a significant factor in the cost reduction, saving one additional headcount. This was worth \$313,000 over three years.

The formal business case is shown in Table 4: a net present value of \$727,000 with a payback of four months and an ROI of 287 percent.

TCO Comparison (3-Year Impact on IT Budget)

Business case for Hitachi USP V with 40TB internal storage and managing 70 TB external vs. two 40 TB arrays from best of breed competition. The competitive solution takes \$818K more IT budget (64%) than does the Hitachi solution.

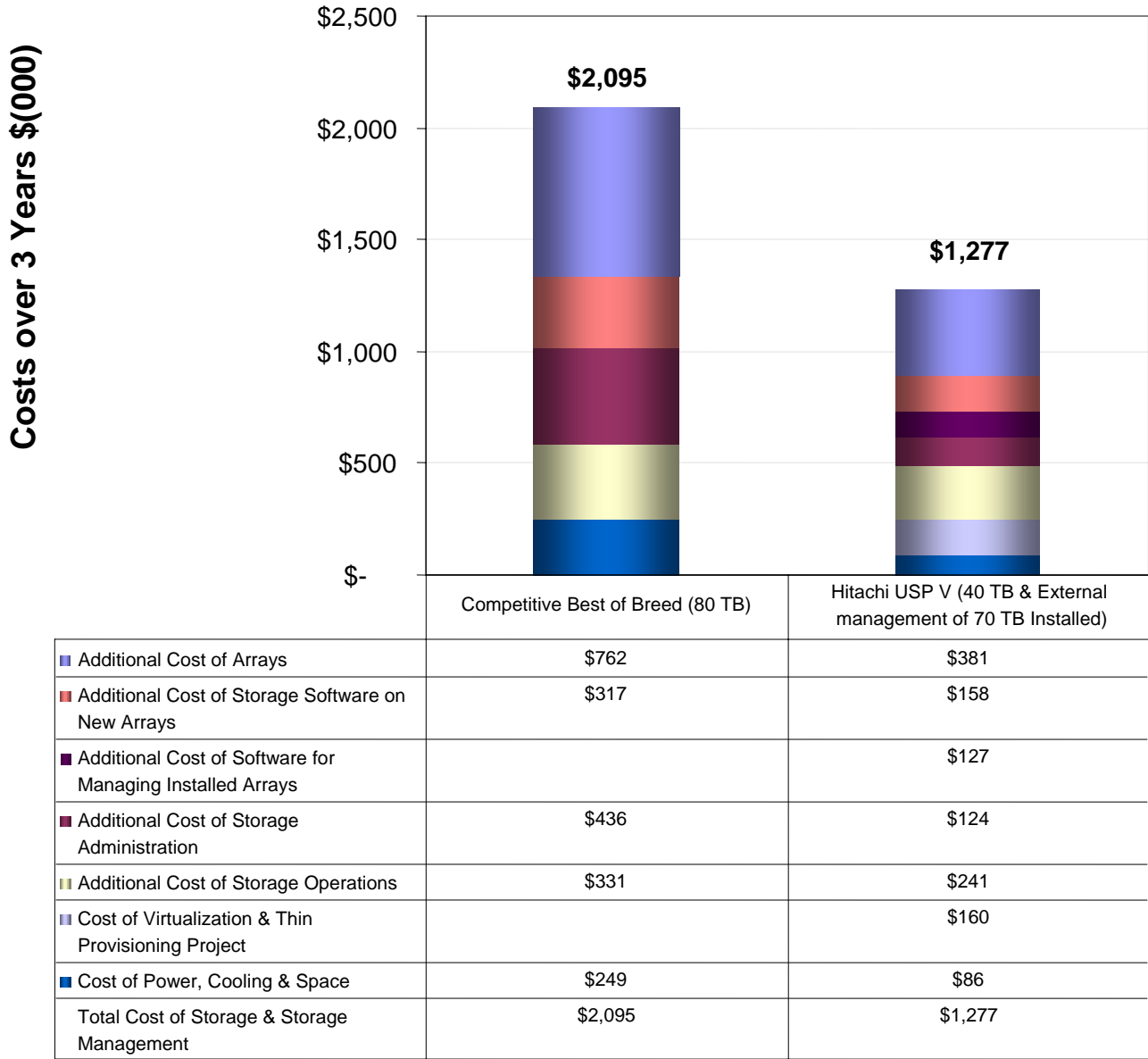


Figure 3 – TCO Comparison between Alternatives

Business Case for Hitachi USP V with 40TB Internal Storage and Managing 70 TB External vs. two 40 TB Arrays from Best of Breed Competition				
Project Costs (\$000)	Startup	Year 1	Year 2	Year 3
<i>Adoption Costs of Implementation of Virtualization & Thin Provisioning</i>	\$65	\$12	\$12	\$12
<i>Additional Software Costs for Managing Installed Arrays</i>		\$42	\$42	\$42
<i>HDS Implementation Services</i>	\$30	\$10	\$10	\$10
<i>Net Project Cost</i>	\$95	\$64	\$64	\$64
TCO Benefits (\$000)				
<i>Reduced Cost of Storage</i>		\$147	\$117	\$117
<i>Reduced Cost of Storage Software</i>		\$53	\$53	\$53
<i>Reduced Cost of Storage Operations</i>		\$30	\$30	\$30
<i>Reduced Cost of Storage Administration by One Person after Implementation</i>		\$63	\$125	\$125
<i>Reduced Cost of Power, Cooling & Space</i>		\$54	\$54	\$54
<i>Total TCO Benefits</i>		\$347	\$379	\$379
Financial Analysis (\$000) - TCO only				
<i>Net Value IT Benefits (TCO \$000)</i>	(\$95)	\$283	\$315	\$315
<i>Cumulative Value IT Benefits (TCO \$000)</i>	(\$95)	\$188	\$503	\$818
<i>Net Present Value (7% Discount Rate, TCO \$000)</i>	\$727			
<i>Annual ROI IT Benefits (TCO)</i>	287%			
<i>IRR (Internal Rate of Return) IT Benefits (TCO)</i>	325%			
<i>Payback Period (months) IT Benefits (TCO)</i>	4			

Table 4 – Business Case for Hitachi USP V vs. Traditional Arrays

Recommendations and Conclusions

Hitachi continues to execute by delivering on critical user functionality requirements for the most demanding storage applications. Hitachi has had a clear leadership role in providing virtualization storage services for high-end users with its USP V and VM series.

Advancements such as storage virtualization and thin provisioning are gaining momentum in the industry, and Hitachi has uniquely incorporated these beneficial technologies within a tier-1 storage system and extended these functions to externally attached arrays. This commitment to investment protection, along with its ability to deliver on supporting mission-critical applications, is impressive.

ITCentrix observes that customers facing sprawling SAN infrastructure, high migration costs, expensive tier-1 storage constraints and high maintenance costs often express a desire to reduce overall storage TCO. Our advice to these customers is as follows:

- Get clear on establishing tier-1 guidelines with the line of business and communicate these parameters liberally and forcefully.
- Give storage administration the authority to apply these policies and limit tier-1 storage to those applications that truly require such capabilities. Default all other storage to tier-2 and archive accordingly based on retention policies.
- Consider virtualizing both front-end server and back-end storage resources as well as utilizing thin provisioning to facilitate a more flexible infrastructure. However, users should prepare for a substantial planning and migration process to establish this capability.

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- This process should carefully consider organizational factors and incentives to align activities with the business capabilities enabled by virtualization and thin provisioning.

Hitachi is increasingly demonstrating that its vision includes positioning itself as an innovator primarily in controller design and supporting software. Hitachi appears to be a leading proponent of the avoidance of dreams of owning the entire data center. Rather, its aim appears to add customer value by recognizing and accommodating the diversity of installed storage assets at customer sites.

By introducing external thin provisioning, increased performance, high capacity SATA devices and VMware support on the USP V, and with the USP VM diskless as a direct competitor to virtualization appliances, Hitachi delivers the broadest variety of options to heterogeneous storage virtualization. Behind this flexibility is a consistent set of architectures and storage management products. ITCentrix believes that the USP V and USP VM represent the most advanced and flexible storage platform in the industry, with heterogeneous virtualization and cross-array heterogeneous tiered storage. In our view, no competitor comes close to this vision.

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About ITCentrix

ITCentrix is a consultancy that primarily serves the needs of CIOs and technology professionals. Its main emphasis is on using tools and analytic modeling techniques to advise clients on increasing company performance through improved resource allocation and better infrastructure management.

The company's products and services have been used at several hundred organizations in North America, Europe, the Asia-Pacific region and emerging countries to focus investments on returning optimal business value.