



Total Cost of Ownership – Tape versus Disk

What you should consider

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ABSTRACT

Conducting a Total Cost of Ownership (TCO) analysis on the solutions you are considering can help avoid purchasing a solution that will be detrimental to your firm over time. Total Cost of Ownership can be defined as:

“A type of calculation designed to help enterprise managers assess both direct and indirect costs and benefits related to the purchase of any IT component. The intention is to arrive at a final figure that will reflect the effective cost of purchase, all things considered.”¹

This type of analysis can be used to assess an individual solution on its own merits. In addition, it may be used to conduct an opportunity / cost analysis across competing options. This white paper will review the construction of a simple TCO analysis tool, including common factors to consider, as well as demonstrate how it may be used to compare competing solutions.

INTRODUCTION

To better understand the TCO construct, it's helpful to start with definitions for Capital Expense (CapEx) and Operating Expense (OpEx).

CAPEX VS OPEX

Capital expense (CapEx) is what you'll initially pay when you buy your storage. CapEx generally includes the following one-time buy items:

- Hardware
- Software licenses
- Planning / architectural services
- Installation
- Integration
- Training

Purchasing departments are rewarded for pounding down a vendor's price. Budget conscious stakeholders receiving big discounts like to fancy themselves as superior negotiators. Between these two factors the initial capital outlay receives a disproportionate level of attention from most buyers.

In addition to the CapEx costs are operating expenses (OpEx) which are the on-going cost of owning and operating storage equipment. These costs are often composed of the following components:

¹ Rouse, Margaret. SearchDataCenter.com. Accessed May 2, 2014.

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- Service contracts
 - Power consumption
 - Floor space maintenance
 - Internal corporate “taxes”
 - Insurance
 - Cooling and air-handling
 - Service level agreements
 - Outage costs (planned and unplanned)
 - Personnel overhead (administration, management, etc.)

These costs are often insidious and add up over time, but are seldom considered during the purchase process because they generally don't occur until well after the point of sale.

Think of these OpEx costs like you would the insurance premiums paid on a large policy. If you add up the monthly payments over a 5 year period, for example, you'll quickly realize that you're paying a tidy sum of money to an insurer. In the case of storage, however, you're paying a tidy sum of money to the power company, your employees, hardware manufacturers, software vendors and others overtime.

Hitachi Data Systems estimated that the OpEx costs of a storage solution may be in excess of 80% of the total cost of ownership. If true, then focusing exclusively on the up-front purchase price of your storage buy is like navigating the Titanic around an iceberg by reference strictly to the ice you can see above water. We know how well that worked out.

Furthermore, OpEx is becoming a primary cost consideration for a growing number of buyers, particularly as they investigate outsourcing their storage to cloud services providers. Partly in response to this dynamic as well as the upward trend in operating expense items in general, CIOs are recognizing that OpEx considerations are becoming increasingly critical in their financial analysis.

TCO ANALYSIS

The actual TCO analysis is a multi-step process which requires some leg-work on the part of the buyer. While this may be time consuming, it's critical in conducting a TCO exercise that will be useful in making the appropriate purchase decision. However, a good storage vendor can help considerably in conducting a thorough, competitive analysis.



First, determine the factors which you should consider in your analysis. In general, it's easiest to start with the larger, finite costs typically associated with capital acquisition. They may include:

- Hardware
- Software licensing
- Planning and architecture
- Installation
- Training

Many users look at the initial CapEx list, compare the list against alternatives, and make their decision. However, stopping here neglects a host of items which, over the long run can easily exceed the cost of the initial purchase and which might significantly alter the selection if taken into consideration.

Consequently, a thorough TCO analysis will also include costs normally found in the operating expense bucket of an organization's budget as well as line items on a vendor quote. These items are generally well defined and therefore should be easy to incorporate in your TCO analysis:

- Floor space operating cost
- Hardware maintenance contracts
- Software support contracts
- Power consumption (power, cooling, air handling)
- Personnel expense

Depending on the extent of your operational requirements or the level of detail to which you need to go in order to make a solid decision among competitive options you may also want to include costs associated with less well defined items such as:

- SLA penalties
- Scheduled downtime costs
- Estimated revenue losses incurred by unplanned outages
- Cost of idle personnel and equipment
- Cost of leased personnel and equipment during the outage

These last costs are often considered “soft” in nature since they are difficult to quantify due to their non- predictable frequency and severity. These costs are often



influenced by the size and scope of your business operation as well as the industry in which you participate. Unplanned outages in the financial services sector can have large, negative monetary consequences while similar outages in an HPC laboratory environment may not. Recent research indicates that up to 65% of IT users may lose \$20,000 or more per hour of data center downtime depending on their industry.²

COST DATA

Once you've determined the factors you'll include in your analysis, the next step is to collect the cost data. As previously mentioned this can be time consuming.

However, good information leads to good decisions so take the time and effort needed to gather good information.

PURCHASE COSTS

Hard costs, those which are readily quantified, will be the easiest to gather. Costs attributed to initial purchase, service or maintenance contracts, installation and training are all readily available from your vendor or vendors. The ease with which this data is gathered makes it simple to do a purchase price comparison only. Thus, it's one reason buyers frequently don't go beyond the purchase discounts they get up front when comparing vendors.

The initial list price discounts are enticing and the analysis easy. What better recipe for disaster over the long run?

Now that the easy collection is done, the real work begins. You'll need to ascertain what the costs are for the less quantifiable or predictable variables. For instance, how much power will the storage solution consume in a year? How much downtime do you expect and what's the cost per hour of business lost? To get to this kind of information, you'll need to review the vendor's technical specifications, visit with your facilities people, and consult with your finance department to determine how much revenue your organization generates on an hourly basis.

POWER CONSUMPTION

Power consumption is normally specified in watts or BTU in vendor documents. These figures must then be converted to kilowatt hours (kWh) over the span of a year based upon usage patterns. Don't forget to include the cooling as it can easily double power consumption numbers! With the power consumption now known, multiply it by the price per kWh your firm is being charged. Getting this information may require conversations with the folks in finance or facilities who are more likely to see this information than the data center administrators.

Repeat this exercise for every piece of hardware you'll acquire in the solution and extend the annual cost out for every year you include in your analysis. You may also want to include accelerators for forecasted power cost increases i.e., inflation, depending on how far into the future you run your analysis.

² Ponemon Institute. 2013 Study on Data Center Outages. September 2013.



FLOOR SPACE

Similar efforts will need to be conducted to determine the cost of operating your data center floor on a per square foot basis. Once again, your facilities and finance personnel should be able to help you determine what the internal business “tax” is for data center floor space per square foot per year. This tax may include facilities maintenance, insurance, property taxes, and other operational considerations. With this information in hand, you can reference the vendor specifications to determine how much floor space will be required for a particular solution. Multiply the solution footprint by the cost per square foot of the tax rate you received from facilities or finance. This will give you the annual floor space cost associated with the solution under consideration.

PERSONNEL

Personnel costs are among the big ticket items on an IT budget. Without people to set up, configure, manage, update, troubleshoot, and secure your solutions, they don’t work. The level of difficulty and time required for your people to carry out tasks can vary greatly based upon the solution’s complexity and usability. Irrespective of the solution, there will be direct costs associated with your people that should be considered i.e., the number of hours they spend working with the solution times the fully burdened hourly cost of their time. These costs alone can add quickly to the overall TCO of a solution.

Beyond the direct personnel costs are the opportunity costs of other work that could be done, but isn’t because people are dealing with the solution. If working with that solution is the only task they have, then the opportunity cost of the solution is negligible. However, that is seldom the case since people are normally assigned multiple tasks. While this opportunity cost component can be difficult to quantify within a TCO analysis, it should be kept in mind all the same. This is particularly true if the opportunity / cost of a solution is so great, due to complexity or usability issues, that you are required to add head count to your operation in order to complete other work.

SERVICE LEVEL AGREEMENTS

Service level agreements will vary widely by industry as well as by Recovery Point Objective (RPO) and Recovery Time Objective (RTO). Each is likely to have its own penalty assessment which needs to be taken into consideration. Since service level violations are not uniformly predictable, determining costs associated with them becomes difficult. In such cases, you may have to rely upon historical data and trend it forward as a simple example. Alternatively, you may compute SLA costs associated with outages based upon the expected mean time between failure (MTBF) information which vendors typically provide when asked. For instance, if a vendor specifies 99% up time, then you might calculate that you’ll suffer a SLA violation for which there will be a defined penalty 1% of the time – or roughly 87.6 hours out of the year. Those kinds of SLA penalties can become expensive quickly and more than offset any sweetheart savings you thought you received from the vendor at the point of purchase.



PLANNED AND UNPLANNED OUTAGES

Planned and unplanned outages or service bottlenecks are normally the reason for SLA agreement violations which were previously discussed. However, these outages also result in idle time for personnel as well as increased costs for temporary equipment and personnel in some cases.

At the organizational level, these outages, particularly those which are not planned, may result in lost revenue if the outage prevents the business from conducting revenue generating transactions. This is particularly true for financial institutions. These costs may also need to be considered in a TCO exercise.

As with the SLA agreement component, you will need to either look at historical outage patterns and costs or calculate the outage based upon the MTBF from the vendor. With that information you can calculate the frequency of outages and the costs that will be incurred when they happen given the cost per hour of lost business.

Using the 99% vendor MTBF referenced in the SLA section, you should expect to have your solution out of operation just over 87 hours during the course of a year. If this outage means your organization has to lease temporary equipment and personnel to bridge that gap, multiply those hourly lease rates by 87.6 hours to calculate the expected cost of that outage. As with the SLA agreement calculation, these outage level costs can be significant.

Conversely, if your organization does not lease temporary equipment and personnel to bridge the outage gap and simply stops operating for that period of time because it can, then multiply the lost revenue per business hour by the hours out of service. As with the facilities tax referenced earlier in this paper, you will need to work with finance to determine the rate at which your organization is losing revenue on an hourly basis because it can't transact business.

For example, assume your organization loses \$1,000 an hour for every hour it can't conduct business. With an expected outage time of 87 hours per year, you may estimate that solution will cost your business \$87,000 annually because it's operational "only" 99% of the year. Once more, the cost of the outage, even if only an expected cost, can easily sink any savings you may enjoy up front.

You can take the TCO analysis one step further when comparing multiple solutions. If a competing solution has an uptime of 99.9%, then you should expect the solution to be off line only 8.8 hours out of the year. At \$1,000 per hour of lost revenue, a solution that reduces expected downtime by 80 hours (the difference between 99.9% availability vs 99%) will result in a significant TCO advantage, nearly \$80,000 per annum for every year during the lifetime of the product.



TCO MODELING

Now that you've gathered your data, it's time to put it into a tool with which you can easily conduct your analysis. One simple tool you can use is a spreadsheet model using a Profit & Loss Statement (P & L) style format. This form of model will allow you to easily capture the line items previously discussed for every year in your TCO exercise. You can build a simple model for each solution involved and readily compare the total cost across your options. From here, you can conduct sensitivity or "what if" analysis to understand how changes in various components over time will affect each solution's TCO. It's possible you'll also gain a deeper understanding of cost centers within your operation that may lead to efficiency improvements elsewhere.

The Tape and Disk TCO examples in Tables 2 and 3 have been simplified for both solutions. Figures are based upon the assumptions shown:

- 1 PB raw storage
- List Price
- 100% operational utilization
- 100% storage utilization
- \$.15 kWh
- \$200 per square foot per year
- Next Business Day (NBD)
- 5 year storage period
- No storage growth
- No technology refresh cycles

The baseline for both models is kept as simple and homogeneous as possible for initial comparison purposes. From here a user can inject additional assumptions around the storage utilization rate for tape and disk based on the customer's unique requirements, as well as data compression rates, power costs, and floor space costs. Customers may also add in additional costs for personnel, outages, SLAs, and the time value of money as needed.

Table 1: TCO Model (Tape)

	Solution - (Spectra T950)					
	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Acquisition Costs						
Library	\$92,754	\$0	\$0	\$0	\$0	\$92,754
Tape Drive(s)	\$75,800	\$0	\$0	\$0	\$0	\$75,800
Installation	\$10,500	\$0	\$0	\$0	\$0	\$10,500
Tape Media*	\$36,000	\$0	\$0	\$0	\$0	\$36,000
Training	\$0	\$0	\$0	\$0	\$0	\$0
Other (Shipping Ins.)	\$920	\$0	\$0	\$0	\$0	\$920
Software Licenses	\$40,000	\$0	\$0	\$0	\$0	\$40,000
Installation	\$0	\$0	\$0	\$0	\$0	\$0
Training	\$0	\$0	\$0	\$0	\$0	\$0
Other	\$0	\$0	\$0	\$0	\$0	\$0
Media	\$0	\$0	\$0	\$0	\$0	\$0
Sub Total	\$255,974	\$0	\$0	\$0	\$0	\$255,974
Operating Costs (Service)						
Service (Library)	\$0	\$6,639	\$6,639	\$6,639	\$6,639	\$26,556
Service (Tape Drives)	\$0	\$5,836	\$5,836	\$5,836	\$5,836	\$23,344
Service (Software)	\$0	\$2,500	\$2,500	\$2,500	\$2,500	\$10,000
Service (Other)	\$0	\$0	\$0	\$0	\$0	\$0
Sub Total	\$0	\$14,975	\$14,975	\$14,975	\$14,975	\$59,900
Operating Costs (Facilities)						
Power Consumption (Library & Drives)	\$970	\$970	\$970	\$970	\$970	\$4,850
Floor Space	\$1,800	\$1,800	\$1,800	\$1,800	\$1,800	\$9,000
Sub Total	\$2,770	\$2,770	\$2,770	\$2,770	\$2,770	\$13,850
Soft Costs						
Administration (Personnel)	\$0	\$0	\$0	\$0	\$0	\$0
SLA Penalties	\$0	\$0	\$0	\$0	\$0	\$0
Planned Outage	\$0	\$0	\$0	\$0	\$0	\$0
Unplanned Outage	\$0	\$0	\$0	\$0	\$0	\$0
Sub Total	\$0	\$0	\$0	\$0	\$0	\$0
Total	\$258,744	\$17,745	\$17,745	\$17,745	\$17,745	\$329,724

NOTE: Configuration based upon List Price for Spectra Logic T950 library (single frame) with 400 slots containing (4) LTO-6 tape drives and media. See Table 1 above for complete list of assumptions common to both TCO examples. Changing configuration to TS1140 or even TS1150 will further improve the TCO calculations for the tape configuration since fewer slots, media, and drives are likely to be required resulting in lower acquisition costs and potentially lower power consumption costs over time.

Tape media was included within the initial acquisition and therefore characterized as part of the initial CapEx. However, it could just as easily be categorized as OpEx. Any media purchases made in out years (none included in this model) would normally be placed within the OpEx bucket.

In the case of tape storage, the OpEx component of the solution is 22% of the total 5 year cost and 29% of the initial acquisition cost. By adding in additional OpEx components like solution administration and management as well as outages of various kinds, the OpEx as a percentage of both the initial purchase price and the overall solution cost can rise dramatically. magnify the operating expense portion as a percentage of the total. For example, if the disk solution shown above were discounted by 40% from list at the point of purchase, the OpEx as a percentage of the total cost and initial purchase price would be 36% and 55% respectively.

Table 2: TCO Model (Disk)

	Solution - Competitor (NetApp Disk)					
	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Acquisition Costs						
FAS3250AE-10G-Base-R6	\$21,931	\$0	\$0	\$0	\$0	\$21,931
DS4246-0796-24A-OP-R6-C	\$418,440	\$0	\$0	\$0	\$0	\$418,440
Installation	\$26,422	\$0	\$0	\$0	\$0	\$26,422
Training	\$0	\$0	\$0	\$0	\$0	\$0
Other (Shipping Ins.)	\$0	\$0	\$0	\$0	\$0	\$0
Software Licenses	\$0	\$0	\$0	\$0	\$0	\$0
Installation	\$0	\$0	\$0	\$0	\$0	\$0
Training	\$0	\$0	\$0	\$0	\$0	\$0
Other	\$0	\$0	\$0	\$0	\$0	\$0
Media	\$0	\$0	\$0	\$0	\$0	\$0
SUBTOTAL	\$466,793	\$0	\$0	\$0	\$0	\$466,793
Operating Costs (Service)						
Warranty (Hardware)	\$0	\$0	\$0	\$26,422	\$26,422	\$52,845
Service (Software)	\$1,643	\$2,191	\$2,191	\$2,191	\$2,191	\$10,408
Service (Other)	\$0	\$0	\$0	\$0	\$0	\$0
Sub Total	\$1,643	\$2,191	\$2,191	\$28,613	\$28,613	\$63,253
Operating Costs (Facilities)						

Once you've had the chance to review the individual TCO components for alternative solutions to see which may result in larger operating expenses into the future, you can then set the options side-by-side for direct comparison purposes. The next table provides a direct side-by-side comparison of the tape and disk shown.

Table 3: Side-by-Side TCO Models: 5 Year TCO

	Spectra Logic T950 Total	NetApp Disk Total	
Acquisition Costs			
T950 Library	\$92,754	\$21,931	FAS3250AE-10G-Base-R6
Tape Drives - LTO6	\$75,800	\$418,440	DS4246-0796-24A-0P-R6-C
Installation	\$10,500	\$26,422	Installation
Training	\$0	\$0	Training
Other	\$920	\$0	Other
Software Licenses	\$40,000	\$0	Software Licenses
Installation	\$0	\$0	Installation
Training	\$0	\$0	Training
Other	\$0	\$0	Other
Media	\$0	\$0	
Sub Total	\$255,974	\$0	
Operating Costs (Equipment)			
Service (Library)	\$26,556	\$52,845	Service (Hardware)
Service (Tape Drives)	\$23,344	\$10,408	Service (Software)
Service (Software)	\$10,000	\$0	Service (Other)
Service (Other)	\$0	\$0	
Sub Total	\$59,900	\$63,253	
Operating Costs (Facilities)			
Power / Cooling (Library & Drives)	\$4,850	\$78,695	Power / Cooling disk arrays
Floor Space	\$9,000	\$12,400	
Sub Total	\$13,850	\$91,095	
Soft Costs			
Administration (Personnel)	\$0	\$0	
SLA Penalties	\$0	\$0	
Planned Outage	\$0	\$0	
Unplanned Outage	\$0	\$0	
Sub Total	\$0	\$0	
Operating Costs (Facilities)			
Power / Cooling (Library , drives	\$4,850	\$78,695	Power / Cooling disk arrays
Floor Space	\$9,000	\$12,400	
Sub Total	\$13,850	\$91,095	
Soft Costs			
Administration (Personnel)	\$0	\$0	
SLA Penalties	\$0	\$0	
Planned Outage	\$0	\$0	
Unplanned Outage	\$0	\$0	
Sub Total	\$0	\$0	
Total	\$329,724	\$621,141	

Based on the side-by-side comparison it's easy to see that the tape storage solution cost over 5 years is only 53% of that for a comparable disk solution. However, by including customer specific factors related to storage capacity utilization and compression, the TCO difference on a per Terabyte (TB) usable storage basis may be significantly greater. This differential would be greater still by deploying TS1140 or TS1150 tapetechnology instead of LTO.

For instance, the costs shown above are for 1 PB of raw storage in which case the cost per TB for the two solutions would be \$329.70 and \$621.14 per raw TB for tape and disk respectively over a 5 year period. If one were to look at the TCO for usable storage over that same time frame and assume that tape may provide an 80 utilization rate while disk may only provide a 60% utilization rate due to disk overhead and parity purposes, then the costs shown above would be for 800 TB and 600 TB of usable storage for tape and disk. The resulting cost per TB over 5 years works out to \$412.15 / TB and \$1,035.23 / TB for tape and disk respectively. In this case, the TCO for the tape solution is only 39.8% of that for the disk solution while providing 33% more usable storage.

When you compare the OpEx costs of both solutions over time you also see a significant disparity, particularly in the outer years of the model. In chart 1 below you can see that the OpEx cost of tape increases significantly in year 2. This is due to the fact that the solution has come off warranty and support contract costs have kicked in. In contrast, the disk solution is still within the warranty period. Despite that fact, the tape OpEx curve remains below that of disk, primarily due to differences in power consumption between the solutions. However, the tape OpEx curve levels off at year 2 while the disk OpEx curve bounds up steeply in year 4, increasing overall TCO considerably.

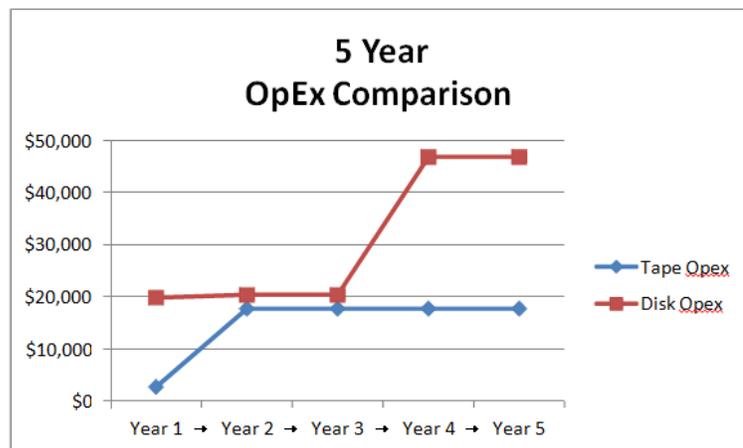


Figure 1: Five year OpEx comparison



TCO DECISION

Now that you've collected the data, put it into your TCO model and done some simple analysis, you can more clearly assess the options and make an appropriate decision. Many customers do not conduct investigations beyond the initial purchase price. Without knowing the full costs of owning and operating a solution, they may subject themselves to significant cost pressures in the future which are related to service contract accelerators, significant down-time losses, exorbitant power consumption requirements, and other hidden costs.

A storage vendor who gives away hardware and software up front or who consciously avoids discussions around on-going operating expenses may be counting on large service contracts with annual accelerators or up-lifts to bolster revenue while subjecting the customer to significant on-going costs that greatly increase solution TCO. If customers are not aware of this, they may readily jump at large up-front discounts only to discover their costs are spiraling out of control after the gear is installed and they're under service contract.

Building a simple TCO model like that discussed in this paper readily helps you avoid unforeseen costs as well as ask much better questions of your storage vendor. Some storage vendors count upon buyers neglecting to conduct full due diligence on TCO as part of their sales strategy. Spectra Logic not only can assist you with a sound TCO analysis up front, but also provides tape storage technology that does more than many alternatives to drive down operating expenses through power efficiency, density, small footprints, and superb availability.

CONCLUSION

Like the portion of an iceberg above water, cost is more than just the price you see. Savvy buyers understand this and utilize the tools at their disposal to ensure they see as much of the total cost iceberg as possible.

Knowing the factors that affect TCO, taking the time to gather the data, then plugging it into the appropriate analytical model is critical in making a smart storage purchase decision.

Granted, TCO analysis should not be the only purchase factor. It should be incorporated along with technology fit, usability, and even aesthetics when deciding which solution to acquire and should be a critical component in making the kind of storage purchase decision which will positively affect your organization well beyond the point of purchase.

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