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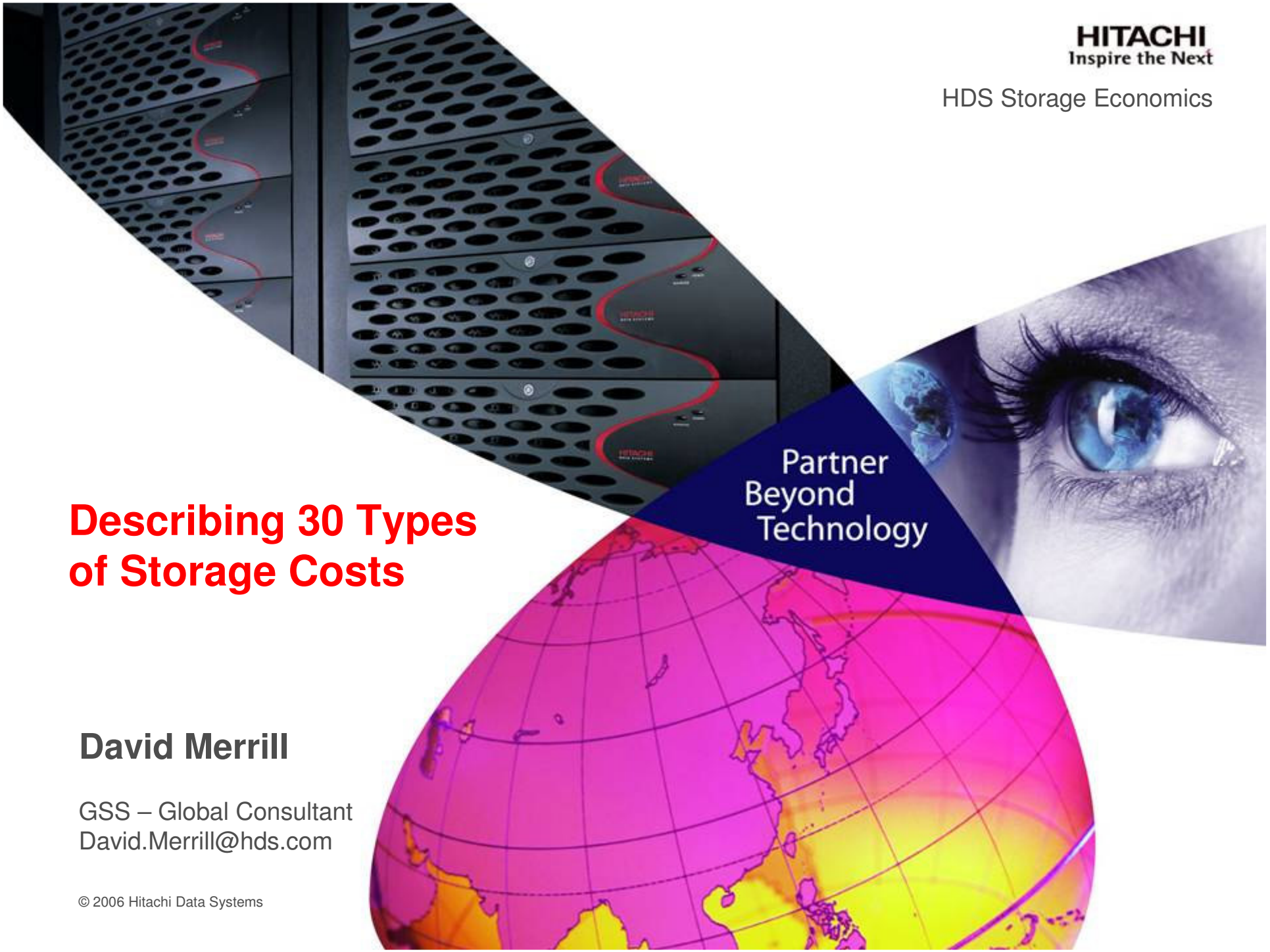
HDS Storage Economics



Describing 30 Types of Storage Costs

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Storage Economics - Theme

- World-wide economy is forcing new types of economic reviews to justify large IT spending
  - New people and perspectives are getting in the decision process
  - New metrics are being considered
- Price ≠ Cost
- Price-per-MB is the wrong metric in making storage decisions
  - Hidden costs are everywhere (Labor, Maintenance)
  - Capital expense (CAPEX) is not under pressure
  - Operating expense (OPEX) is paramount
- Cost reductions opportunities do exist in your storage infrastructure
  - New technologies, topologies, operation effectiveness

An Economic Opportunity Data Point…

Cost reductions options do exist in your storage infrastructure!

For every 12TB of installed and usable disk capacity….

….there is a *net* $1M OPEX reduction potential!

Waste Reduction ~25%
Outage time reduce ~20%
Mgmt Labor Effort ~15%
Maintenance Fees ~15%
Environmental ~ 10%
Misc Ops Efficiency ~5%
Other ~ 10%

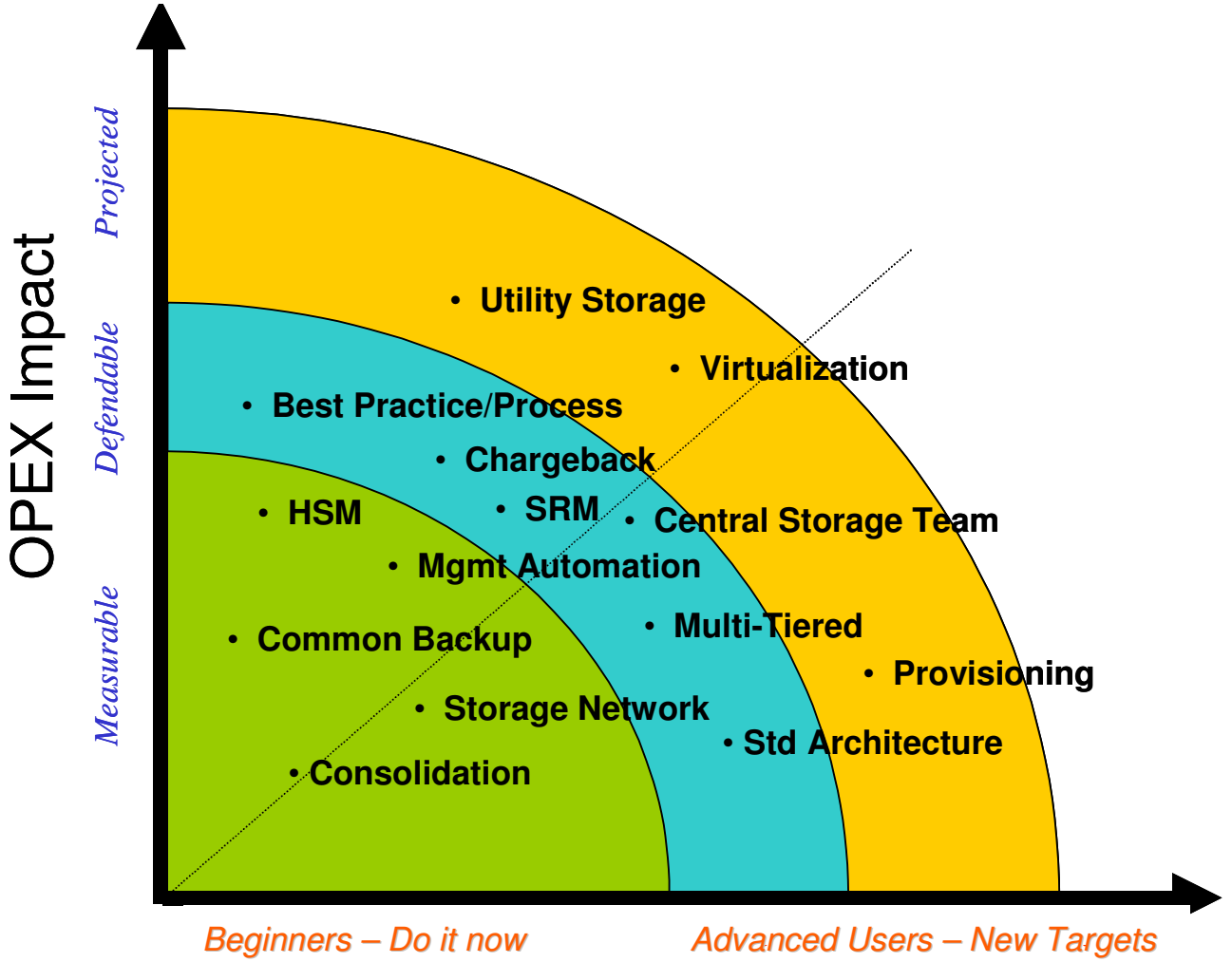
*Of course, “your mileage may vary”.
Net payback typically realized in 3 years.

Activities to Drive-down Storage Costs

How Can YOU Reduce OPEX in Storage Infrastructure?

- **Storage consolidation**
  - Fewer, larger frames that are easier to manage
  - Utilization and operations efficiency
- **Implementing networked storage**
  - Separation of disk and servers
  - Long distance, improved protection
- **Building and managing with storage architectures**
  - Consistent, structured, certified strategies
  - Operational, technical & organization architectures
- **Central storage team**
- **Multi-tiered storage services**
  - Multiple price points to meet various storage demands
- **Invest in best practices and management processes**
  - Operations, staff skills, document the proven methods

Methods, Actions to Reduce Storage Costs



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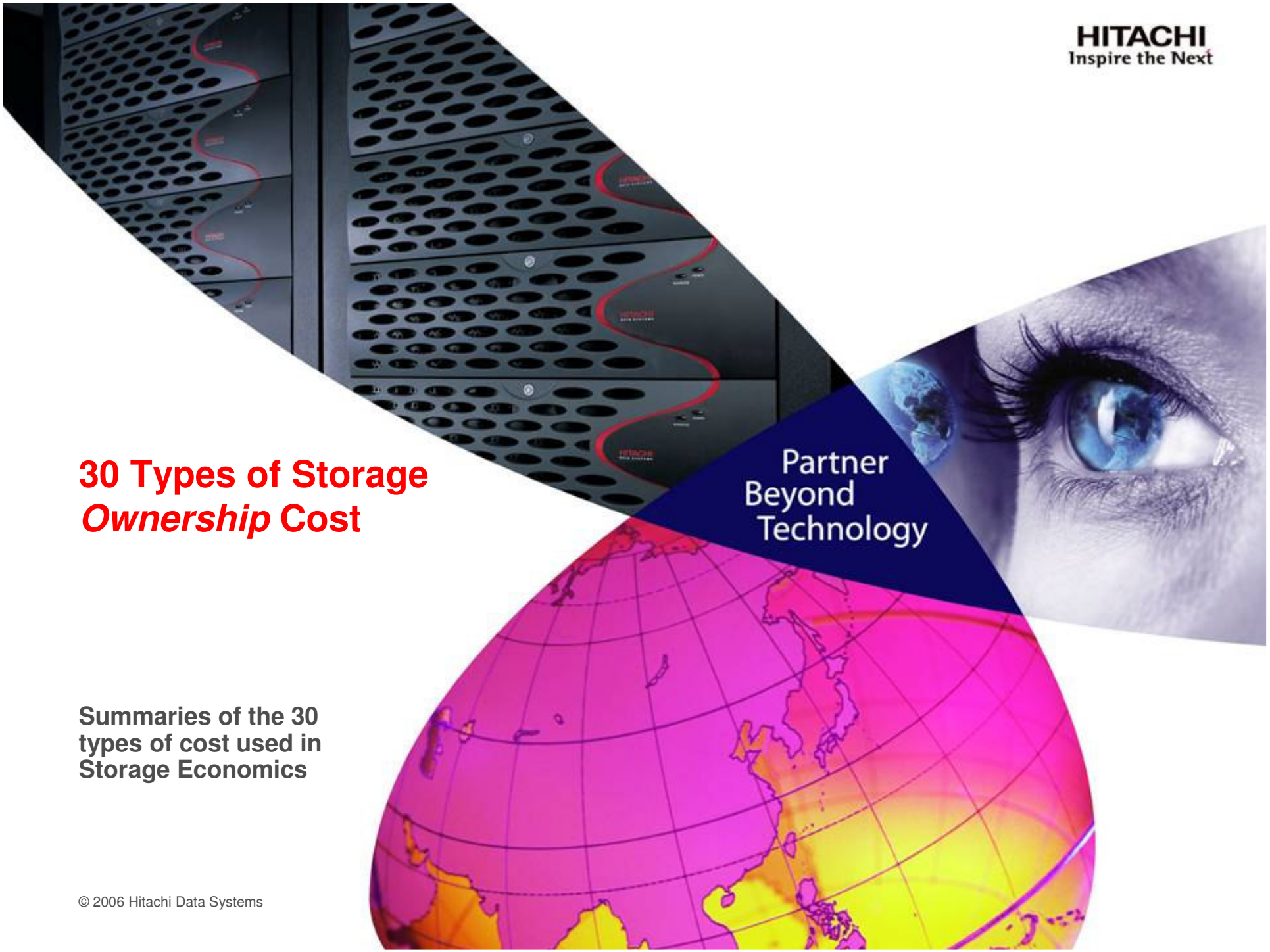

30 Types of Storage *Ownership* Cost

Summaries of the 30 types of cost used in Storage Economics

General Categories that Constitute Storage Cost of Ownership

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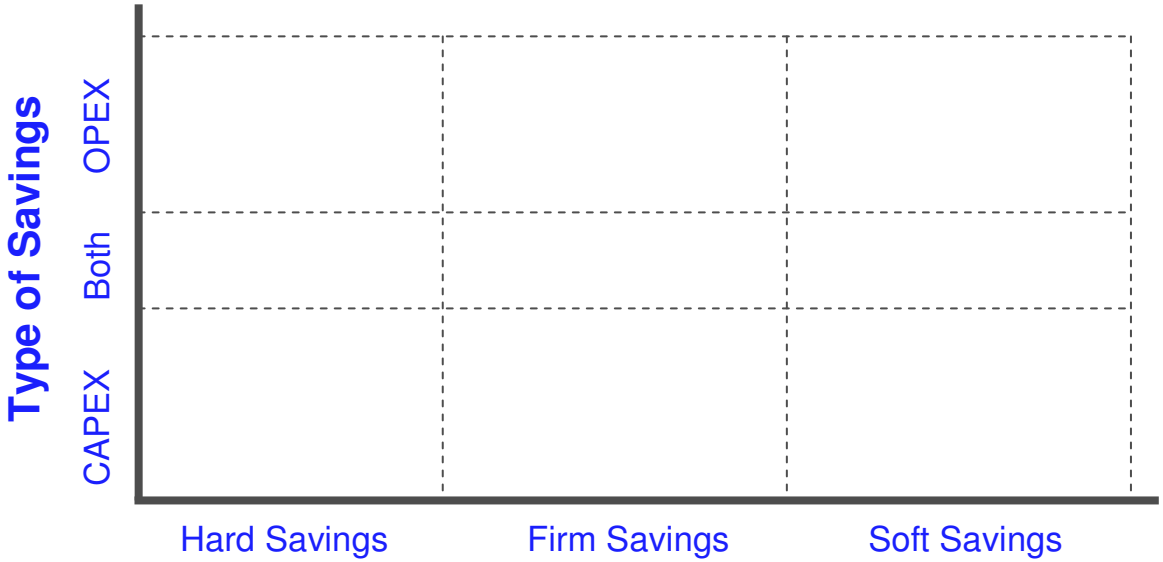
1. **CAPEX Costs**
   - Lease, Depreciation payments
   - Cost of capital
   - Residuals or scrap value
2. **OPEX Costs**
   - Maintenance contracts
   - Electricity
3. **Labor**
   - Storage Management labor
   - Contractor labor
   - Work efforts, tasks
4. **Business Impact**
   - Downtime
   - Staff productivity
   - Loss of revenue
   - Opportunity Loss
   - Cost of performance
5. **Risk**
   - Business resumption
   - Loss of data
   - Processing loss, revenue loss
   - Opportunity costs
6. **Compliance**
   - Potential company risk, exposure
   - Public scrutiny
   - Financial penalties
7. **Misc.**
   - Buying more than needed
   - Buying assets prematurely
   - Not realizing the useful life

30 Detailed Categories of Storage Costs

- Storage hardware purchase avoidance
- Storage software purchase avoidance
- Hardware maintenance cost reductions
- Software license fee reductions
- Time for backup windows
- Faster recovery times - catastrophic loss
- Faster recovery for non-catastrophic loss
- Storage Administration
- Weekly, common mgmt tasks
- Staff time spent for planned outages
- Business impact of planned outages
- Business impact - data path availability
- Business impact - storage subsystem availability
- Data center floor space
- Electricity costs (kWatt & BTU reduction)
- Servers acting as Storage Gateways
- Reducing the number of backup servers
- Storage and storage network management simplicity
- Time for workload balancing, re-provisioning storage
- Mean-time to provision (acquire, install) storage
- Compliance risk, penalties for retention, protection
- Reducing the number of tape libraries, tape drives
- Reduce developer time - access to DBMS copies
- Local storage network infrastructure reduction
- Long distance circuit cost reduction
- Business impact with faster storage performance
- Batch and performance increase with FICON
- Reduced waste, fragmentation of disk storage
- Downtime due to capacity problems, mgmt errors
- Disaster protection, reduced cost of risk

Graphing the Cost Characteristics



Timeframe to *start* savings

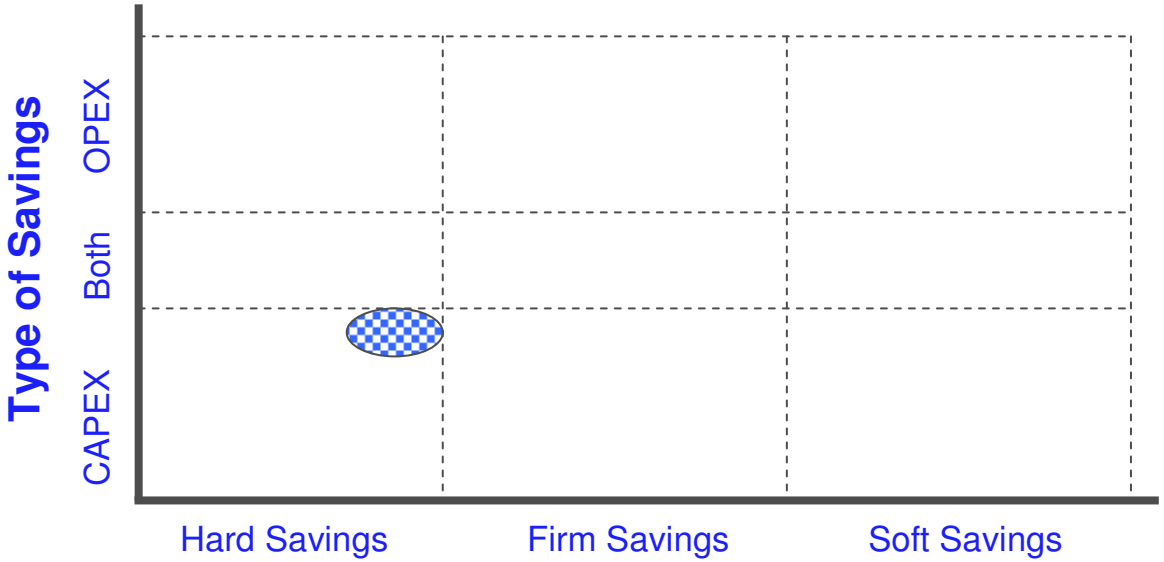
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

- We must appreciate the multiple dimensions of the savings
  1. CAPEX or OPEX savings (sometimes there is both)
  2. Hard (off the books) savings, firm or soft savings
     - Customer decides on the nature or applicability of savings
     - Highly subjective with firm and soft savings
  3. Time frame to start saving the money after the investments

#1 – Storage HW Purchase Avoidance

- Description
  - It is good if one investment can avoid other investments
  - New storage architectures may reduce or eliminate other types of investments
  - This category focuses on CAPEX or hardware purchases in the future
- Dependencies, Relationships
  - A key factor in this category is to calculate and project new growth
  - Finding new ways to handle growth can avoid future CAPEX
  - Look at upgrade cost avoidance as well as net-new costs
- Typical effort or activities to reduce these costs
  - SATA disk may replace the need to purchase/upgrade tape libraries
  - SANs may improve utilization to avoid other storage purchase
  - Tiered storage can reduce the costs of future storage growth

#1 – Storage HW Purchase Avoidance (cont.)



Typical Confidence in Savings

Timeframe to *start* savings

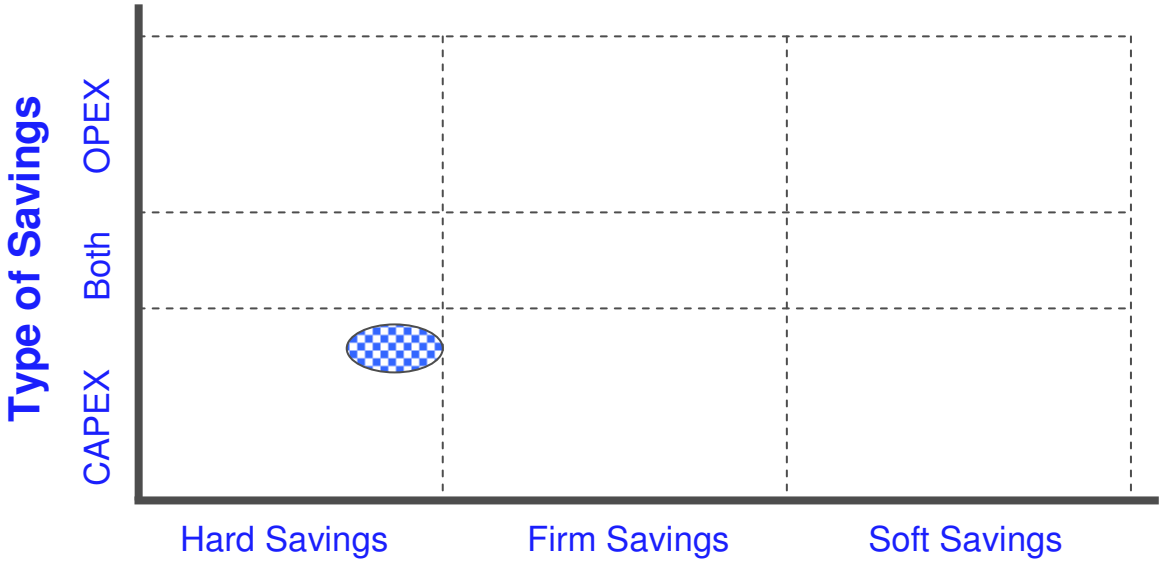
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

- **Other Comments, observations**
  - Customer may not readily accepts future avoidance, so you may have to use comparative cash-flow approach to show multi-year CAPEX forecasts
    - Then use NPV of the cash flow to show present value or today's $ of the capital avoidance
  - Reduction of CAPEX also reduced OPEX (i.e.. maintenance)
  - Most people will spend money to save money, with justification

#2 – Storage SW Purchase

- Description
  - Similar in construction to HW avoidance
  - Any time one investment can avoid other investments, it is good
  - New storage architectures can reduce or eliminate other types of software investments or software upgrades
  - This category focuses on CAPEX or software purchases in the future
- Dependencies, Relationships
  - Software often in balancing effort with labor, staff investment
  - Be aware of SW costs based on capacity, location, controllers, etc.
  - The more complex the storage architecture often leads to more software
- Typical effort or activities to reduce these costs
  - Virtualization and consolidation can reduce or avoid controller-based software licenses, start moving to capacity-based licenses
  - Tiered storage can reduce the SW need for subordinate storage

#2 – Storage SW Purchase (cont.)



Timeframe to *start* savings

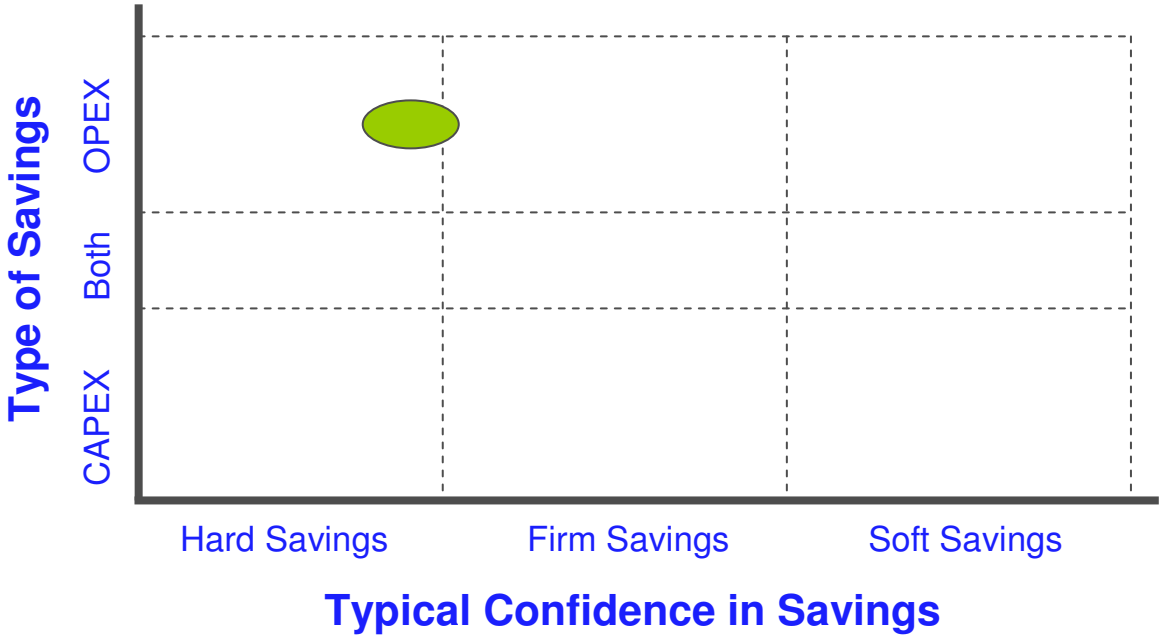
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

- Other Comments, observations
  - Reduction of SW licensed can also reduced OPEX (i.e.. SW maintenance fees)
  - Software does not tend to have the same price erosion as hardware
  - Future software needs (and costs) are hard to predict since new SW products are released frequently (don't know that you need it until it is announced)
  - Buying software to offset/avoid other software requires delicate rationale

#3 – Hardware Maintenance Cost

- Description
  - Most hardware, after an initial warranty period, incur monthly maintenance fees
  - As hardware is (pre-maturely) de-commissioned, future maintenance costs may be avoided
- Dependencies, Relationships
  - Early retirement of assets may incur a scrap-value or write-off of hardware assets
- Typical effort or activities to reduce/reclaim these costs
  - Collapsing and consolidating storage assets (SAN, storage arrays, tape systems) will reduce future maintenance costs
  - Demoting older arrays to Tier n where the SLA does not require strong support, maintenance costs can be cancelled, T&M costs would replace maintenance on an as-needed basis.

#3 – Hardware Maintenance Cost (cont.)



Timeframe to *start* savings

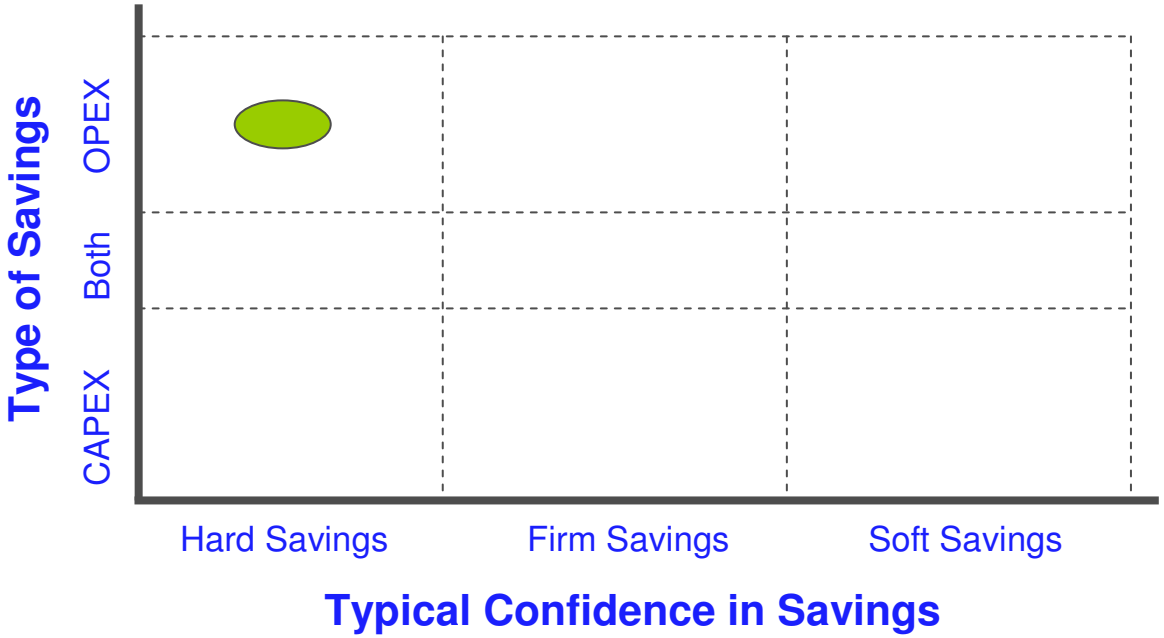
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

- Other Comments, observations
  - Be aware that it takes effort to cancel maintenance contracts
  - Sometimes the follow-through is not good and the asset maintenance arrangements are never changed
  - Some customer pre-pay for xx years of hardware maintenance

#4 – Software License Fees

- Description
  - Most software, after an initial warranty period, incur monthly maint fees
  - If software is (pre-maturely) de-commissioned, future maintenance costs may be avoided
- Dependencies, Relationships
  - Remember that you date your hardware, and marry your software….
  - Much more difficult to change software strategies than is hardware
- Typical effort or activities to reduce these costs
  - Collapsing and consolidating storage assets (SAN, storage arrays, tape systems) will reduce licenses and the associated fees
  - Demoting older arrays to Tier n where the SLA does not require strong support, software license fees can be cancelled

#4 – Software License Fees (cont.)



Timeframe to *start* savings

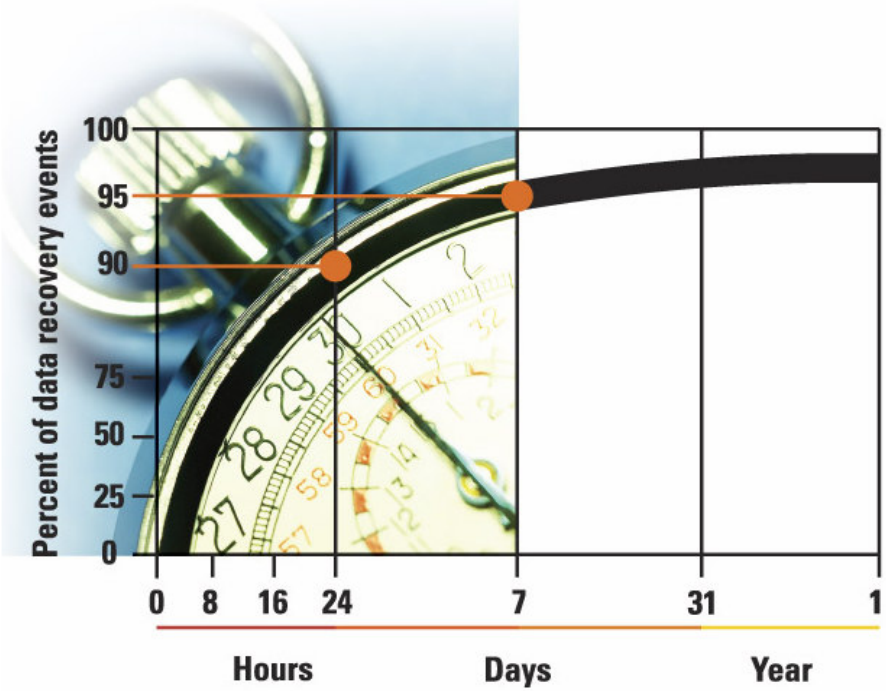
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

- Other Comments, observations
  - Performing a comprehensive software audit may find old licenses anyway, without necessarily changing the architecture

#5 –Time for Backup Windows

- Description
  - Reducing the time to create back-ups, both in the host processing time, and in DBMS off-line time, etc.
  - When system or DBMS downtime is reduced, business impact lowered
- Dependencies, Relationships
  - RTO, RPO
  - Backup medias, servers, backup network
  - Reducing backup windows is often related to reducing or changing backup infrastructure, target devices
- Typical effort or activities to reduce these costs
  - Moving to disk-based or VTS backup architectures
  - SAN-based or host-free backups
  - Reducing data protection of lower tiered storage in a TS architecture

Data Recovery Profile



Data recovery time frame —
Discovery time after problem occurred

- Most data recovery operations happen in a few days after the problem first occurred.
- 90% of recoveries occur within 24 hours.
- 95% occur within one week.
- 99% occur within one month.

RTO: Recovery Time Objective
(downtime)

How long it takes to recover from a data-loss event and "return to service." The amount of time the system's data is unavailable or inaccessible, preventing normal service.

RPO: Recovery Point Objective
(amount of data at risk)

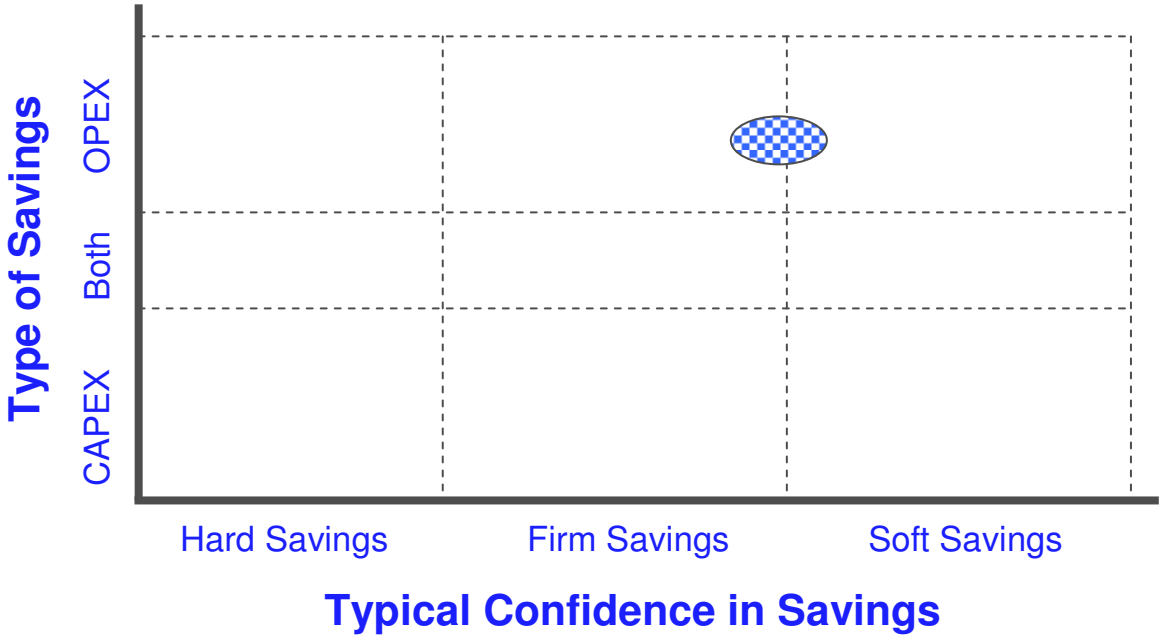
The amount of time between data protection events. Translates to the amount of data at risk of being lost.

Now	Problem occurs		Recovery complete	RTO
5 p.m.	5:30 p.m.		6:15 p.m.	45 minutes

R1 Last recovery event	Problem occurs	R2	Recovery complete	RPO
5 p.m.	5:30 p.m.	5:45 p.m.	6:15 p.m.	45 minutes

Source: Horison Information Strategies

#5 –Time for Backup Windows (cont.)



Timeframe to *start* savings

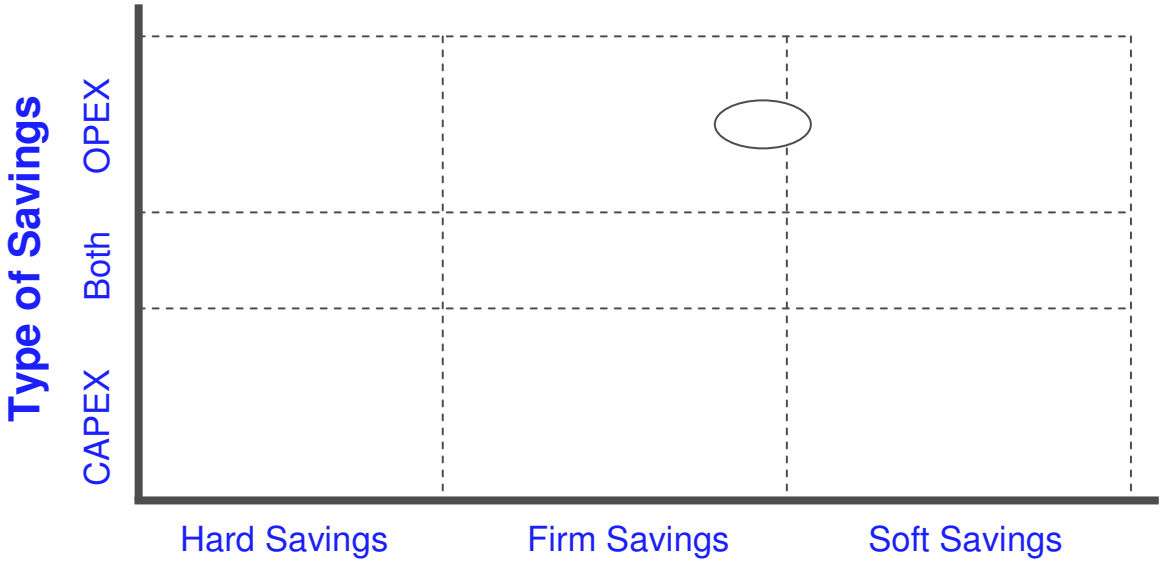
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

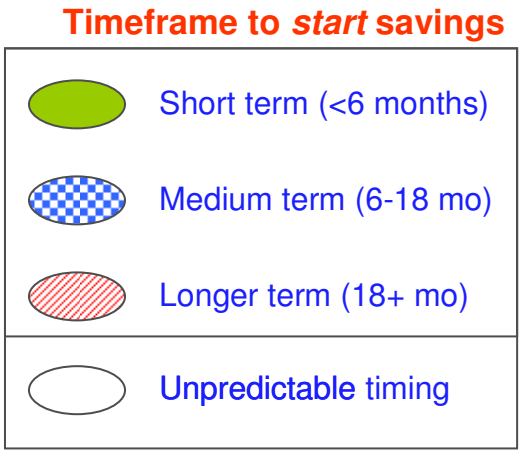
- Other Comments, observations
  - Backup time reduction is always a popular theme and work objective, but quantifying the business impact can be elusive unless is impacts business or operations

#6 –Recovery from a Catastrophic Event

- Description
  - If/when catastrophic outages hit, IT and business will suffer outage time
  - Engineering rapid recovery services can reduce application and business downtime.
  - For catastrophic events, business and IT resumption should have defined value to the enterprise
  - Being able to recover *faster*, can reduce risks and loss from an outage
- Dependencies, Relationships
  - Data recovery is just a fraction of the enterprise BC/DR plan
  - See also category #30
- Typical effort or activities to reduce these costs
  - Local and remote replication
  - 3DC or multi-site replication and recovery options
  - Less dependency on tape restoration, or slower media

#6 –Recovery from a Catastrophic Event (cont.)





- Other Comments, observations
  - Data recovery and other business areas (people, networks, hosts, telephones) have to be aligned relative to total business resumption
  - The timeframe for savings cannot be projected since we do not know when the next catastrophic event will be

Rank the Threats by Loss Expectancy

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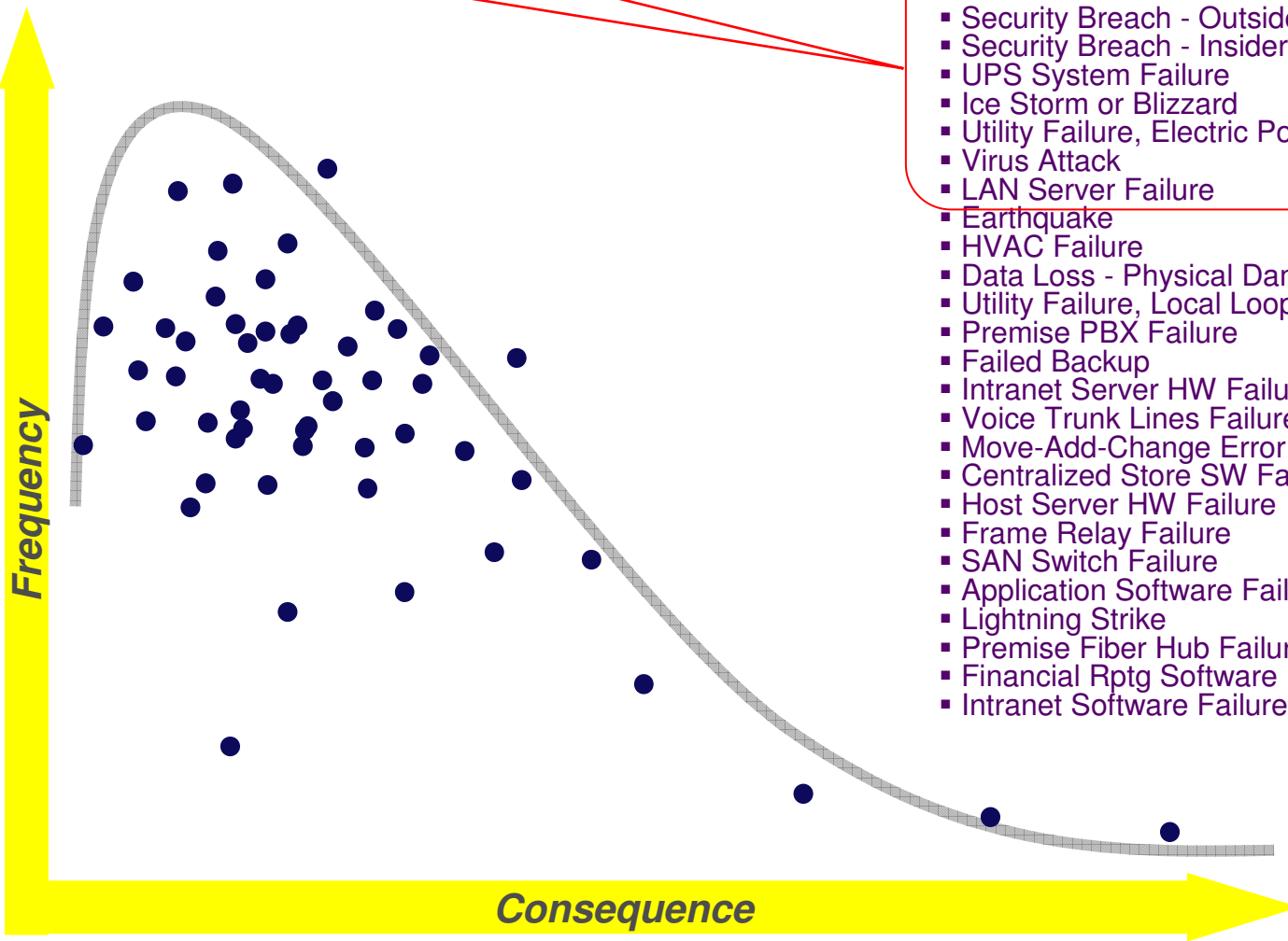
Focus on the MOST critical threats



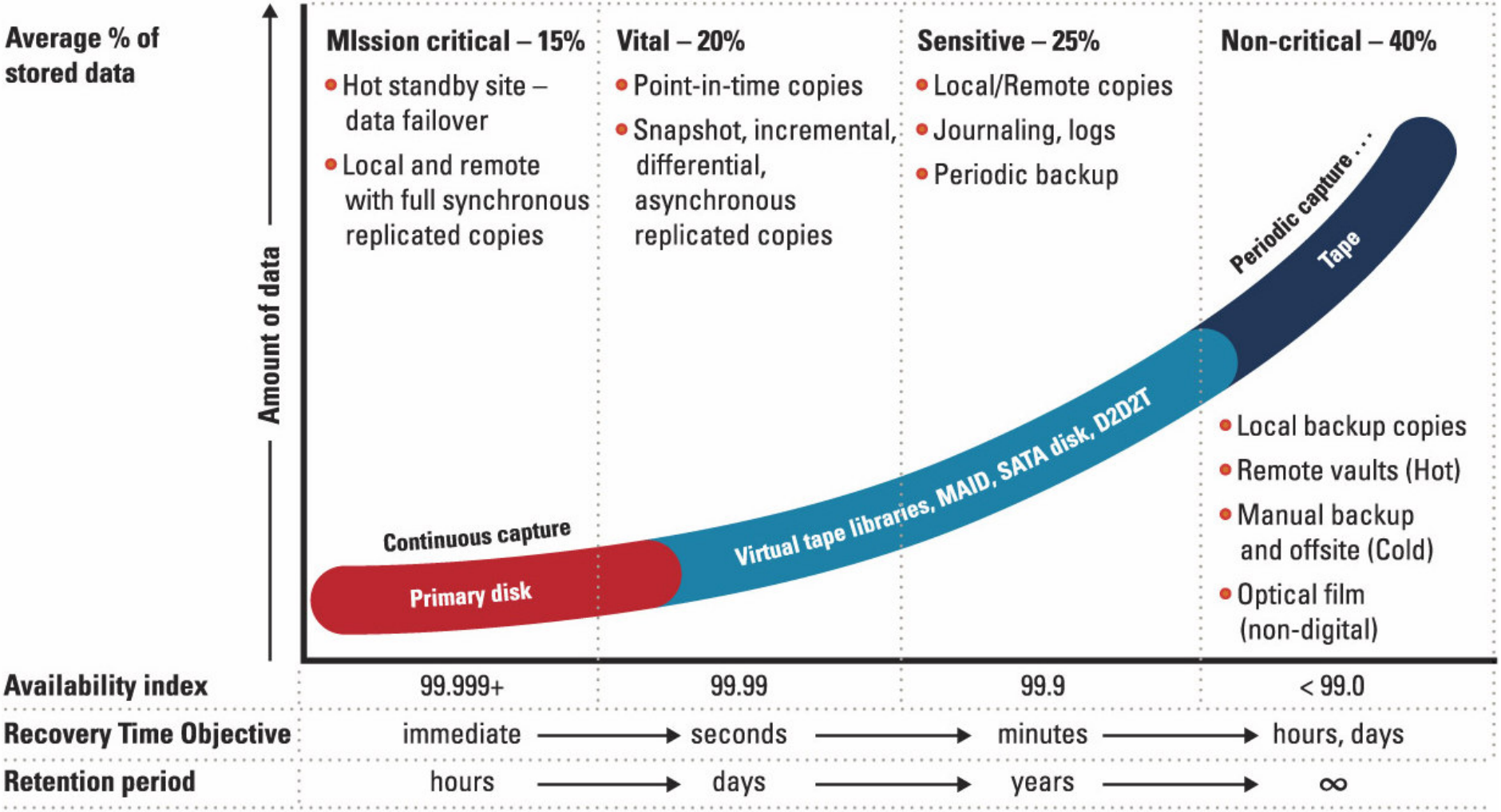
Annualized Loss Expectancy (ALE)

▪ Data Corruption – Logical Error	1,179,274	US$
▪ Centralized Server HW Failure	680,767	US$
▪ Security Breach - Outside Sabotage	181,833	US$
▪ Security Breach - Insider Sabotage	86,874	US$
▪ UPS System Failure	70,144	US$
▪ Ice Storm or Blizzard	69,197	US$
▪ Utility Failure, Electric Power Failure	56,470	US$
▪ Virus Attack	50,396	US$
▪ LAN Server Failure	35,843	US$
▪ Earthquake	32,961	US$
▪ HVAC Failure	17,156	US$
▪ Data Loss - Physical Damage	6,296	US$
▪ Utility Failure, Local Loop Failure	5,840	US$
▪ Premise PBX Failure	5,723	US$
▪ Failed Backup	4,840	US$
▪ Intranet Server HW Failure	4,289	US$
▪ Voice Trunk Lines Failure	2,788	US$
▪ Move-Add-Change Error	2,206	US$
▪ Centralized Store SW Fail	2,206	US$
▪ Host Server HW Failure	2,198	US$
▪ Frame Relay Failure	1,081	US$
▪ SAN Switch Failure	703	US$
▪ Application Software Failure	541	US$
▪ Lightning Strike	65	US$
▪ Premise Fiber Hub Failure	14	US$
▪ Financial Rptg Software Fails	13	US$
▪ Intranet Software Failure	11	US$
Total:	2,499,728	US$

#7 –Recovery from a Non-Catastrophic Event

- Description
  - Engineering rapid recovery services can reduce application and business downtime.
  - For non-catastrophic events, faster business and IT resumption have some defined value to the enterprise
  - Non-catastrophic events are more common, and faster recovery is seen as a business critical capability
- Dependencies, Relationships
  - Data recovery is just a fraction of the enterprise recovery plan
  - Strong ties to the backup/recovery strategies, but goes beyond these…
- Typical effort or activities to reduce these costs
  - Local replication, snap copies
  - Augment backup processes with local data protection (disk based)
  - Less dependency on tape restoration, or slower media

Treating Data Protection Differently



Source: Horison Information Strategies

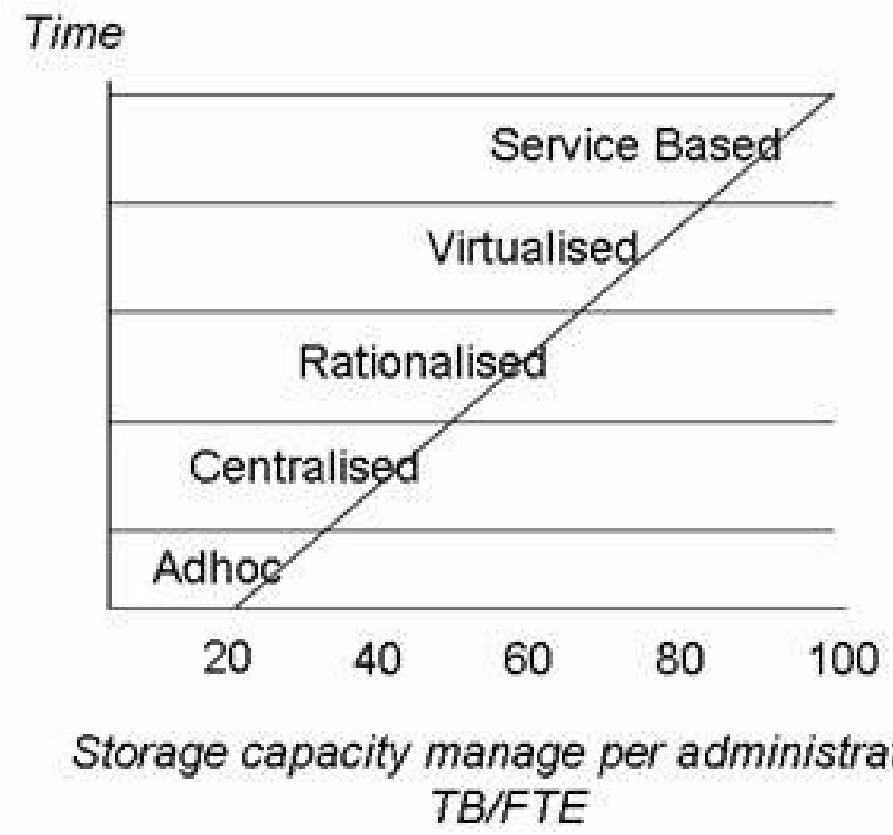
#7 –Recovery from a Non-Catastrophic Event (cont.)

- Other Comments, observations
  - The timeframe for savings cannot be projected since we do not know when the next event will be, but it will be soon. Non-catastrophic data loss occurs very frequently
  - Disk-based solutions have to augment traditional tape options

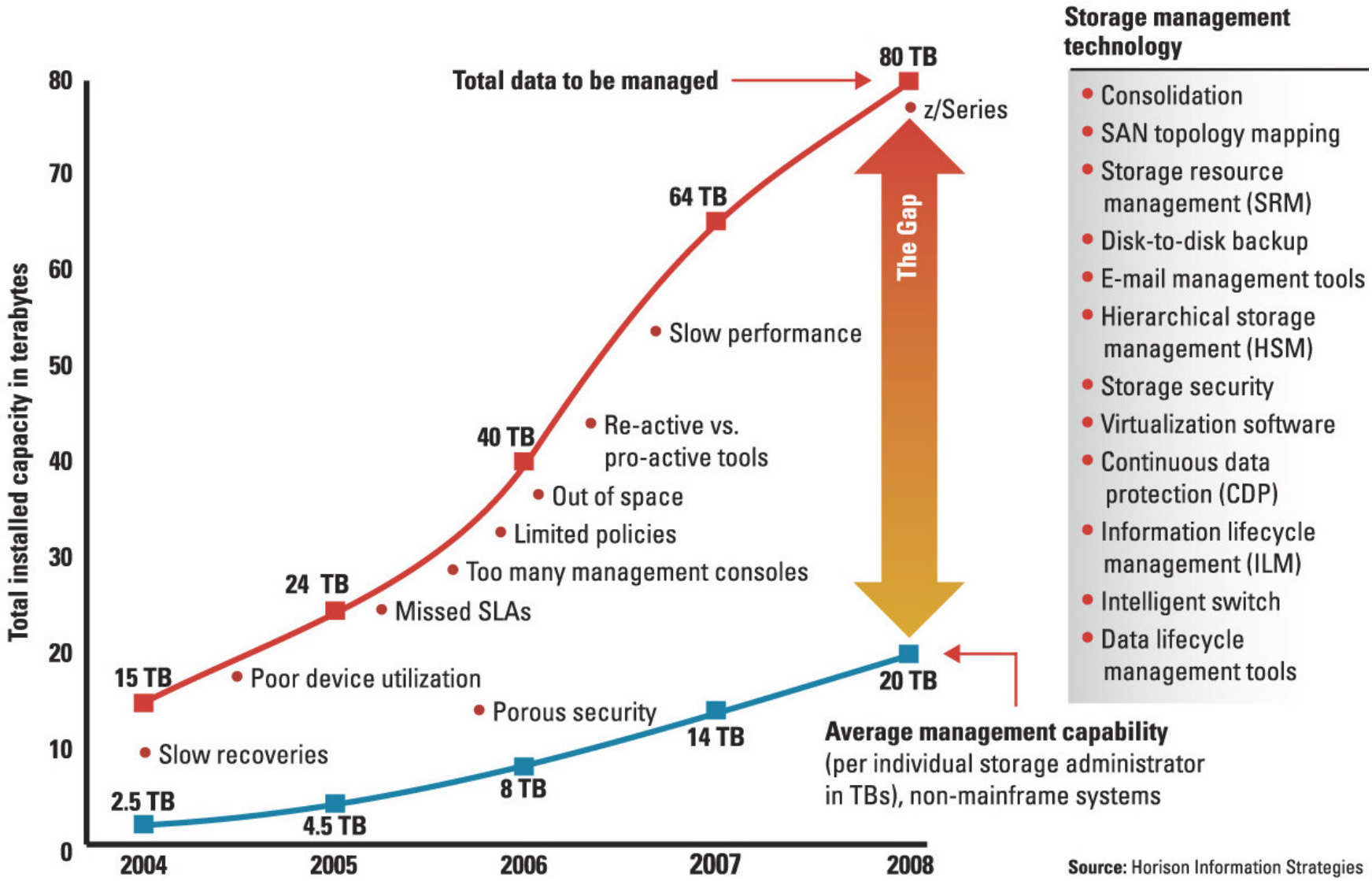
#8 –Storage Administration

- **Description**
  - Advancements in architectures, software, intelligent subsystems can reduce the aggregate full-time equivalent (FTE) staff per installed TB
  - Pooled storage, Tiered Storage has higher “Managed TB-per-FTE” than stand-alone islands or DAS
- **Dependencies, Relationships**
  - Cost of labor can be 35-45% of Storage Infrastructure TCO, therefore labor is a big target for cost reduction or improvement (must do more with less)
  - Care in not double-counting costs associated with #9. #10, #19, #20
- **Typical effort or activities to reduce these costs**
  - Storage area networks
  - Larger storage arrays (consolidation)
  - Tiered Storage, virtualization
  - Storage areas management software
  - Operational best practices and procedures
  - Organization optimization for the storage infrastructure

Storage Management Maturity & Labor



Closing the Management Gap



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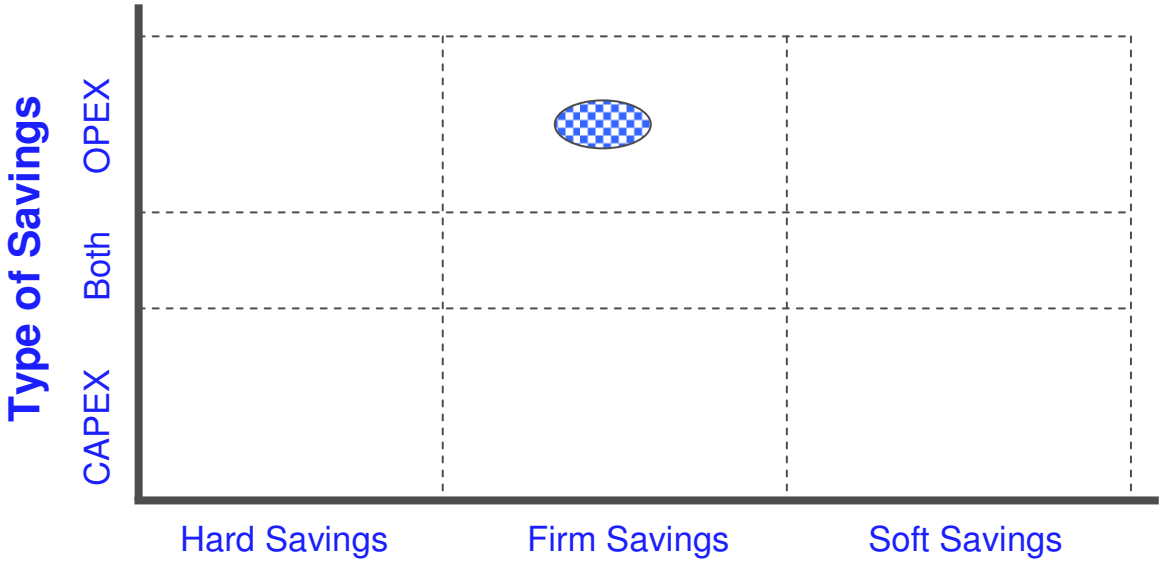
#8 –Storage Administration (cont.)



Timeframe to *start* savings

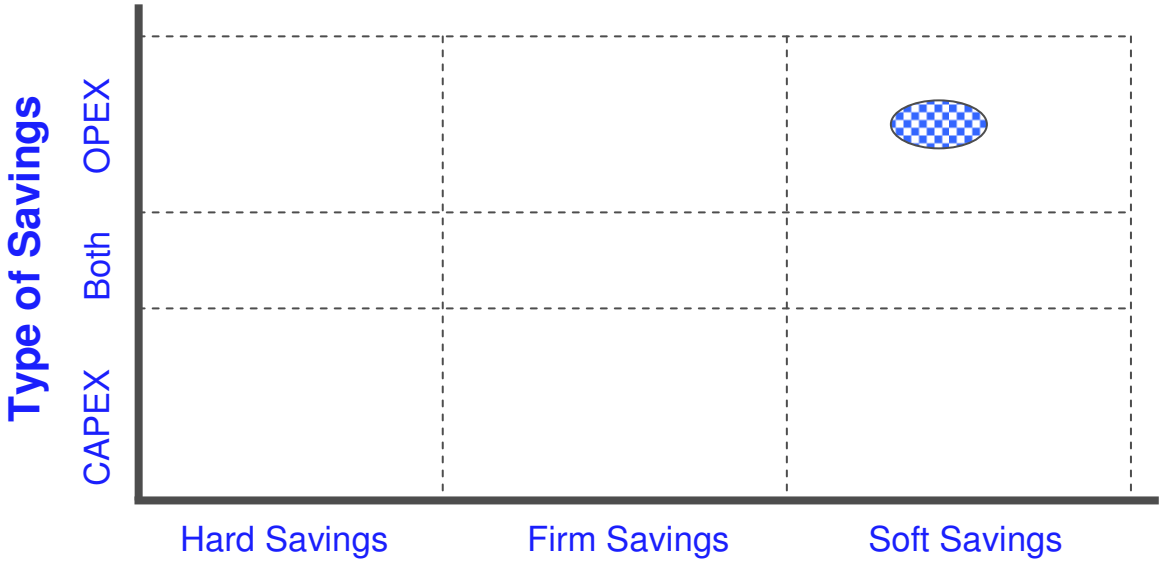
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

- Other Comments, observations
  - TB-per-FTE is a common measurement, but not very meaningful
  - IT is without industry benchmarks or best practices (inconsistent tasks and division of labor)
  - Don't compare TB-per-FTE with others, use only as internal benchmark

#9 –Weekly Mgmt Tasks

- Description
  - Advanced storage management software and improved practices can reduce the number of repetitive work tasks related to storage infrastructure management
  - Reducing these tasks will:
    - Reduce overall staff labor needed to manage storage
    - Improve any human error factor within the management
- Dependencies, Relationships
  - Care in counting both this cost and #8 Reduce Storage Mgmt Labor
  - Labor savings is offset by significant investment in SW, processes
  - This item can be a micro-element of the total admin labor cost factor
- Typical effort or activities to reduce/reclaim these costs
  - Storage Area Management software investments
  - Review and implementation of ITIL based best practices, processes
  - Organization improvement; elimination duplicated effort, staff

#9 –Weekly Mgmt Tasks (cont.)



Timeframe to *start* savings

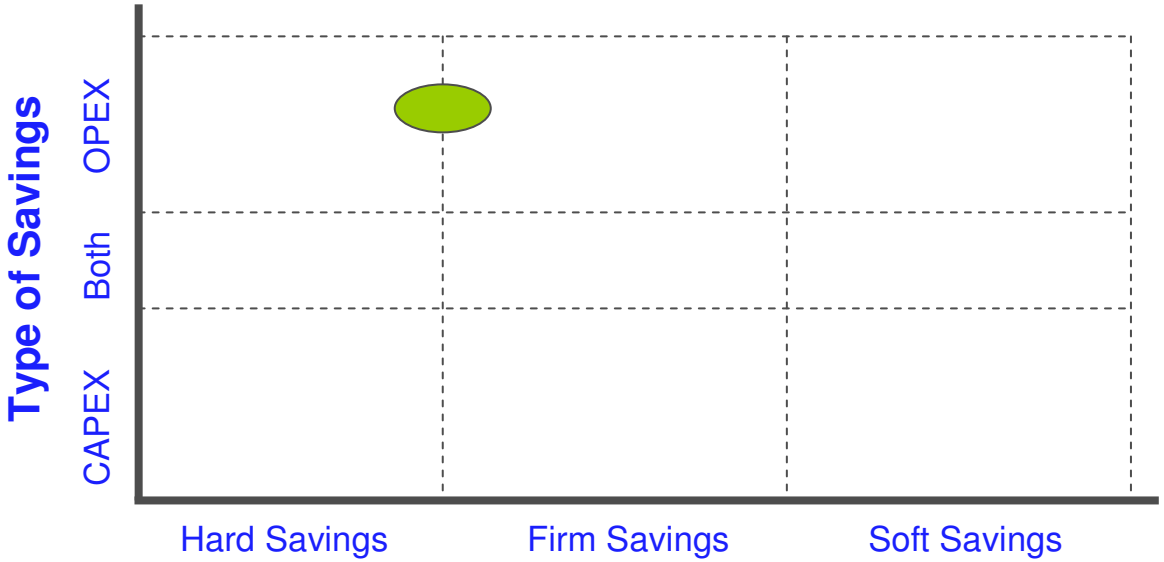
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

- Other Comments, observations
  - The customer has to be able to measure and know the weekly tasks involved with management (otherwise, how to measure reduction?)
  - Saving time in this area does reduce workload, but not necessarily FTE
  - Savings are seen as soft, labor utilization, improvement, lack of overtime, etc.

#10 – Staff/Contractor Time on Planned Outages

- Description
  - Planned outages for capacity or microcode often involves extra time
    - Contractor or vendor time ($1500 per incident)
    - Staff support time
  - Hot microcode or upgrade on-the-fly can reduce this labor element
- Dependencies, Relationships
  - Enterprise class storage, directors can handle non-disruptive upgrades
  - Strong processes are needed to avoid an outage
  - Each vendor's maintenance support cost, structure is different
- Typical effort or activities to reduce these costs
  - Move to enterprise class storage and network infrastructure
  - Some modular or DAS disk are the prime systems to target for replacement or change in this area

#10 – Staff/Contractor Time on Planned Outages (cont.)



Timeframe to *start* savings

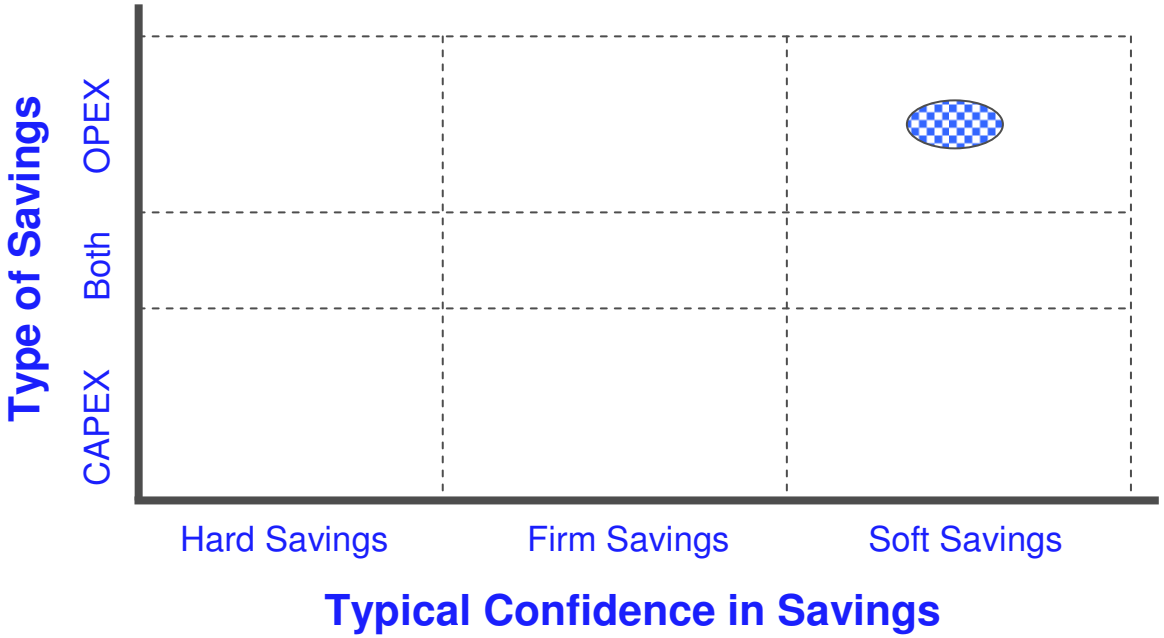
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

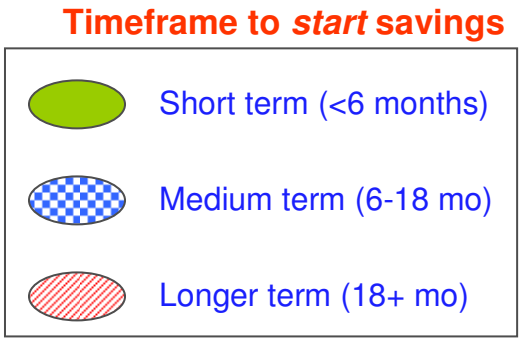
- Other Comments, observations
  - High growth areas may experience multiple outage periods (monthly), this can be reduced or avoided
  - The architecture has to be rugged (People, process, products)
  - Over-time factor for hourly people vs. salaried people @ upgrade time
  - This item can be a micro-element of the total admin labor cost factor

#11 – Business Impact: Planned Outages

- Description
  - Any outage, planned or unplanned, incurs an impact to the business
  - Planned outages have been common and expected, but if they can be reduced, there is a business up-side to take advantage of
- Dependencies, Relationships
  - Customer needs to be able to quantify more hours/period of up-time
  - We cannot reduce the number of microcode changes or capacity upgrades to simply improve this cost factor
  - See also cost factor #10
- Typical effort or activities to reduce/reclaim these costs
  - Some modular or DAS disk are the prime systems to target for replacement or change in this area
  - Move to enterprise class storage and network infrastructure

#11 – Business Impact: Planned Outages (cont.)



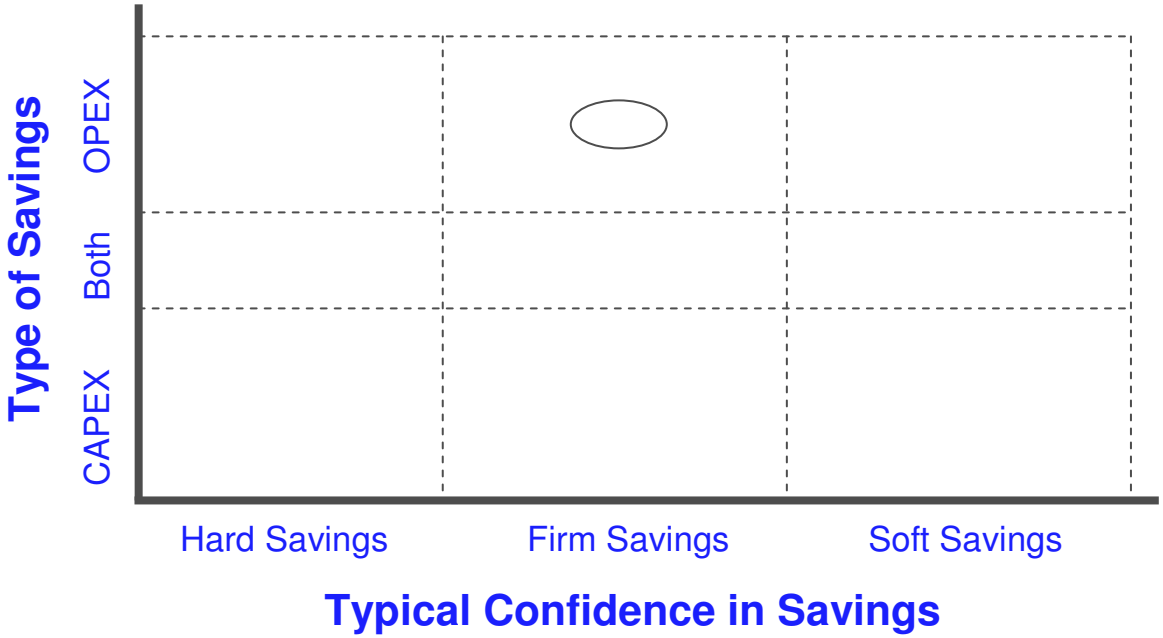


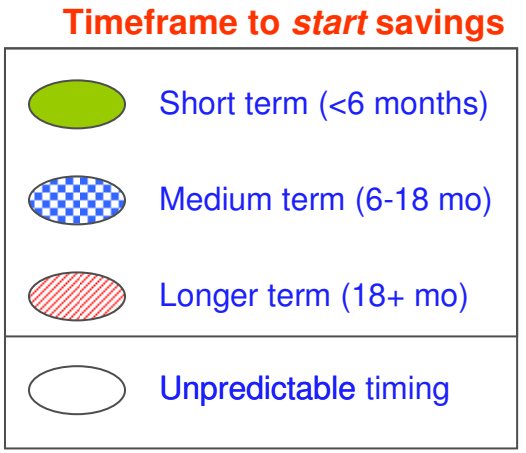
- Other Comments, observations
  - The architecture has to be rugged (People, process, products)
  - Need to quantify more revenue or business due to more on-line time
  - Storage is only one fraction of the total on-line time
  - Savings are soft since the infrastructure is used to scheduled outages

#12 – Business Impact: Data Path Availability

- Description
  - The storage infrastructure starts with the storage adapter (NIC, HBA), and ends with the disk or tape system
  - The data path is the first leg of the overall storage infrastructure availability rating
  - Different solutions produce different proven or rated data path percentiles
- Dependencies, Relationships
  - We are counting only the data path here; servers, applications and storage arrays also contribute to the total HA picture
  - Keep in balance, data path HA as compared to the host, storage, app
- Typical effort or activities to reduce these costs
  - Highly available FC connections/fabric have the best HA features
  - Upgrades from DAS and some PtP is often necessary
  - NAS can be improved, but HA NAS options are also available
  - Directors have better HA ratings than switched
  - Topologies also impact the total data path HA rating

#12 – Business Impact: Data Path Availability (cont.)





- Other Comments, observations
  - There is a balance between HA, cost, distance and performance
  - Savings timeframe is unpredictable since we cannot forecast the next data path failure

#13 – Business Impact: Subsystem Availability

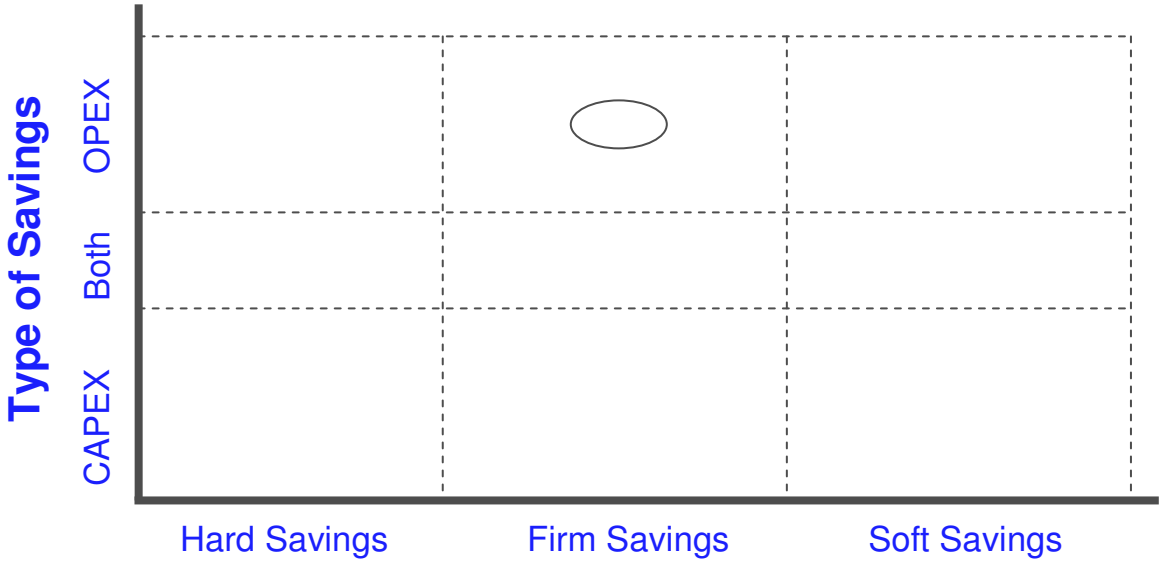
- Description
  - Storage infrastructure availability relies heavily with the disk system
  - Different solutions produce different rated or guaranteed HA percentiles
- Dependencies, Relationships
  - We are counting only the storage system here; servers, applications and storage network also contribute to the total HA picture
  - Ability to perform non-disruptive upgrades or micro-code changes
- Typical effort or activities to reduce these costs
  - Enterprise systems are engineered for various duty cycles
    - Cache, mirroring, Multiple processors, internal control and data path
    - FC disk based systems are engineered differently then S-ATA
    - Modular systems, NAS systems, desktop systems are all different
  - The core disk architecture may need to be changed out to achieve improved subsystem availability (compared to the current install base)

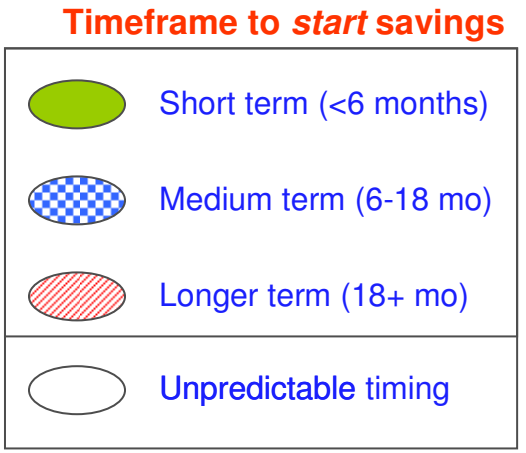
The Impact of Downtime

Application classification		Non-critical	Operationally important	Vital	Mission critical
% Uptime		99%	99.9%	99.99%	99.999%
Minutes of unavailability per year		5000	500	50	5
Industry sector	Revenue $/hour	Lost revenue per year			
Energy	$ 2.8 M	$ 233.0 M	$ 23.3 M	$ 2.33 M	$ 233 K
Telecom	$ 2.1 M	$ 175.0 M	$ 17.5 M	$ 1.75 M	$ 175 K
Finance	$ 1.5 M	$ 125.0 M	$ 12.5 M	$ 1.25 M	$ 125 K
Retail	$ 1.1 M	$ 91.7 M	$ 9.17 M	$ 917 K	$ 91.7 K
Transportation	$ 0.67 M	$ 55.8 M	$ 5.58 M	$ 558 K	$ 55.8 K
Health care	$ 0.63 M	$ 53.0 M	$ 5.30 M	$ 530 K	$ 53 K

Source: Horison Information Strategies

#13 – Business Impact: Subsystem Availability (cont.)



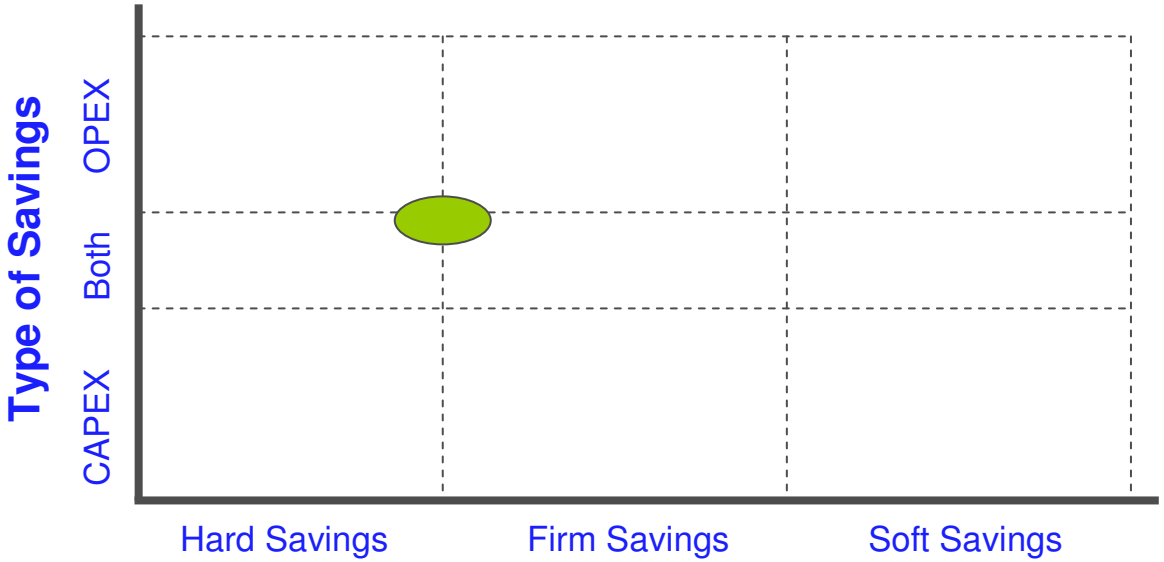


- Other Comments, observations
  - Since price ≠ cost, we have to be careful in matching the price with the necessary availability and duty cycle (you get what you pay for)
  - SATA is not rated for 24x7xnever usage patterns
  - We do not know when an unexpected sub-system outage may occur
  - HDS 100% availability guarantee can be factored in to this category

#14 –Data Center Floor space

- Description
  - IT assets occupy raised floor space in a data center
  - Lease, rental of the space, as well as power, conditioning add to the cost of space
  - Reducing floor space may avoid or delay DC build-out in the future
- Dependencies, Relationships
  - Sometimes a flat rate of floor space may include power, cooling, etc.
  - Newer arrays have higher TB-per-m^2, therefore better use of space
  - Motivated to reduce space when expansion plans are imminent
- Typical effort or activities to reduce/reclaim these costs
  - Storage and server consolidation
  - Avoid capacity and frame upgrade through utilization improvements

#14 –Data Center Floor space (cont.)



Timeframe to *start* savings

- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

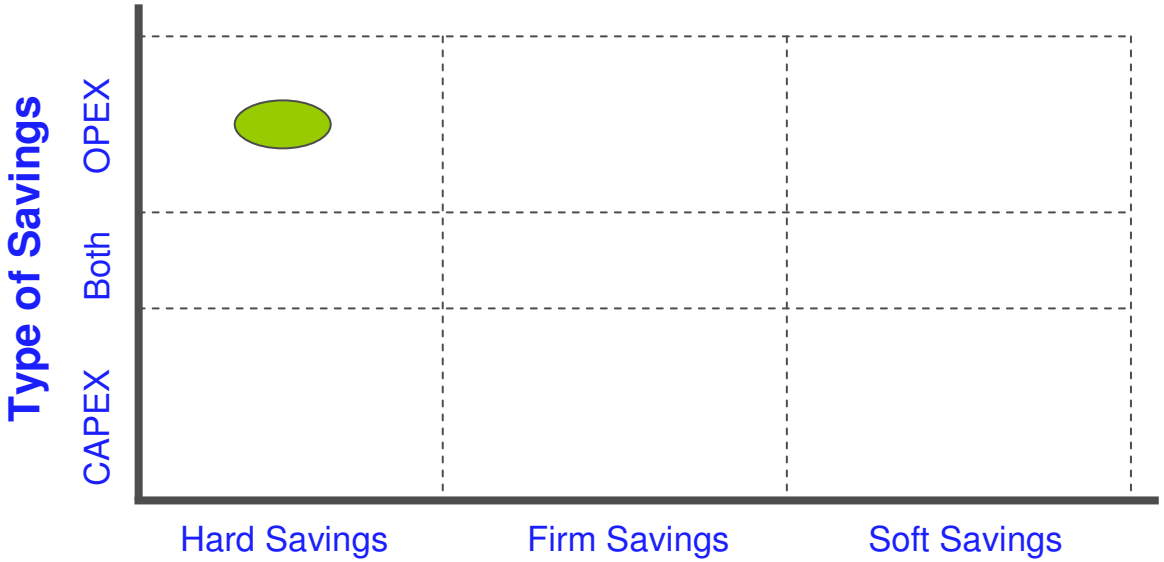
Typical Confidence in Savings

- Other Comments, observations
  - Consolidation for some DAS may not yield real space savings
    - Storage removed from the chassis, but the space is not reclaimed
  - Do not double count kVA or BTU if bundled into floor space costs
  - Some don't recognize this as savings since xx m^2 is a sunk cost
  - Virtualization may raise these costs by holding onto older assets
  - Moving from DAS to centralized arrays may also increase DC space

#15 – Cost of Electricity

- Description
  - Each storage array, library, switch or gateway consumes electricity (measured in watts, Kwatts, or kVA)
  - The BTU (converted to watts) required for air conditioning, cooling can also be calculated
  - In addition to the direct wattage, the infrastructure may have to finance power conditioning, backup systems (generators, batteries)
- Dependencies, Relationships
  - Main electric bill for the DC is a real cost, but storage will only be a %
  - Battery backup, UPS and power conditioning costs could double or triple the rated kVA rating of a device
- Typical effort or activities to reduce these costs
  - Consolidation to newer arrays (higher density) disk systems
  - Replacing older, less efficient systems

#15 – Cost of Electricity (cont.)



Timeframe to *start* savings

- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

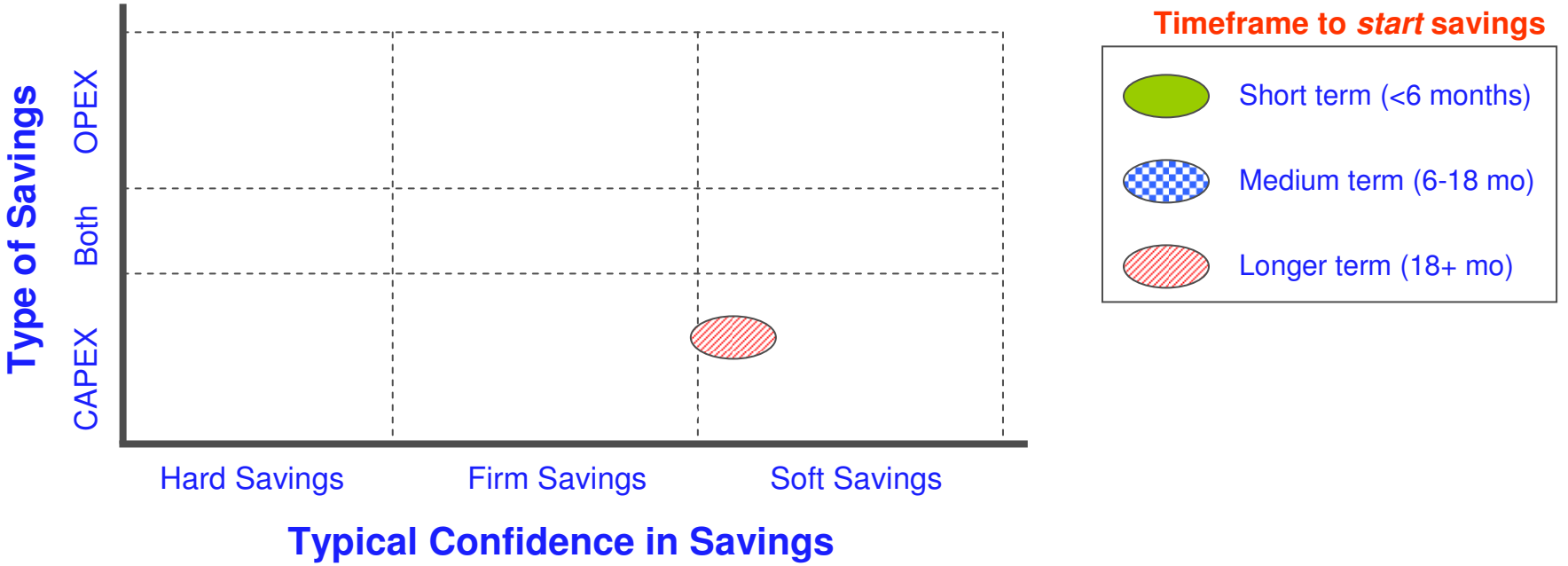
Typical Confidence in Savings

- Other Comments, observations
  - Besides monthly power costs, reducing kVA will reduce power conditioning equipment, battery backup systems
  - Electricity savings for DR w/ replication should double the costs
  - Newer systems can run 'hot', so if they hold relatively low capacities the electricity cost per TB or footprint space may be unnaturally high
  - Virtualization may raise costs by keeping older, less efficient arrays in use as lower tiered capacity

#16 – Servers Acting as Storage Gateways

- Description
  - Many times (Intel) servers are used as NFS or CIFS hosts to storage pools for less formal storage control
  - These servers require labor, software costs, floor space
- Dependencies, Relationships
  - Removing these servers
    - Puts the hosts back into the pool for general use
    - Reduces the risk of management, software, license fees associated with NAS pooled storage
- Typical effort or activities to reduce/reclaim these costs
  - Create a formal NFS gateway or filer architecture in front of the storage pool (NAS, iSCSI, FC, etc.)
  - Adopt formal management processes and controls for all storage, regardless of the connection scheme or protocol

#16 – Servers Acting as Storage Gateways (cont.)

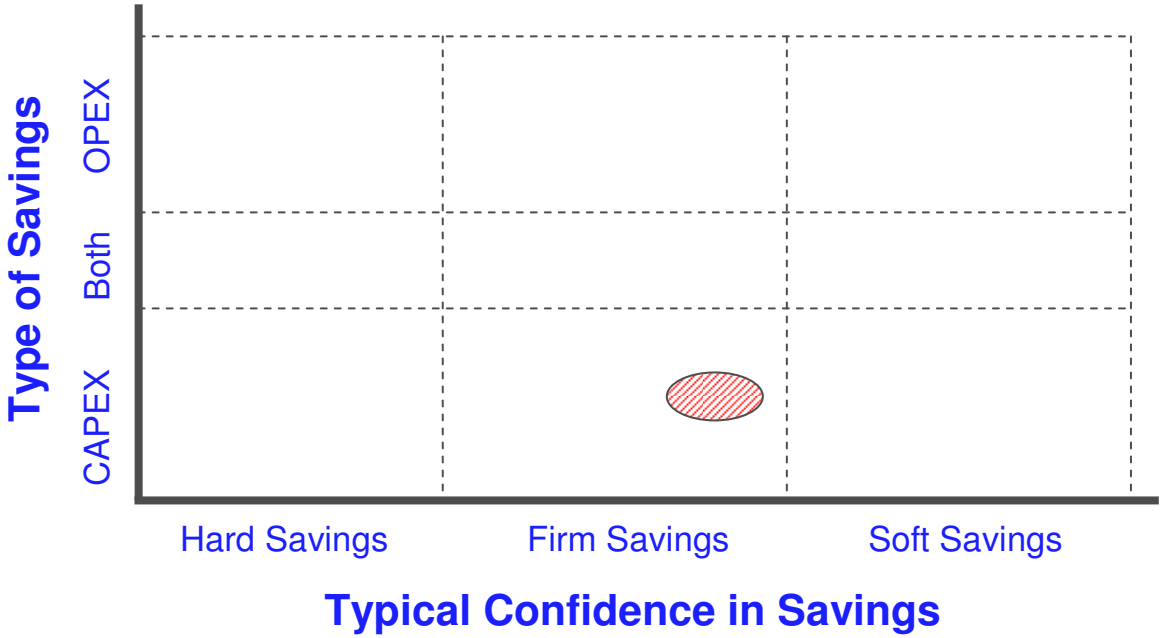


- Other Comments, observations
  - Investments in gateways and filers may be more expensive to purchase than small servers, but the management cost, SW cost and risk of data loss cost will off-set in the long term

#17 – Backup Servers

- Description
  - Backup servers are expensive resources (HW, SW, labor) to manage data protection and recovery of company information
  - The backup server infrastructure (clustering) can grow to be a large and complex environment on its own
- Dependencies, Relationships
  - Backup methods, architecture and tools used will drive the number of servers
  - Geographic dispersion of targets and hosts
- Typical effort or activities to reduce/reclaim these costs
  - Local copies from mirroring, snap copies, sync replication
  - Advanced data protection schemes

#17 – Backup Servers (cont.)



Timeframe to *start* savings

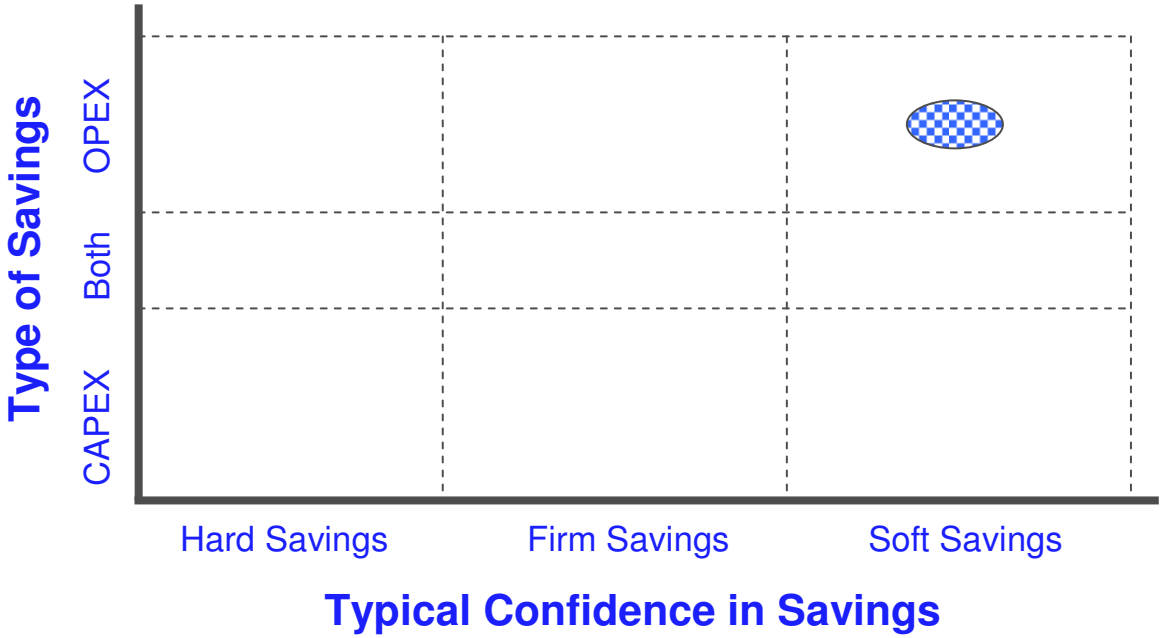
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

- Other Comments, observations
  - Backup infrastructure optimization can reduce future CAPEX costs

#18 – Storage Network Management

- Description
  - Network components in the storage infrastructure are relatively new and continue to grow
  - These circuits and devices need local/specialized management skills
- Dependencies, Relationships
  - Storage architecture type, protocol type, HBA or NIC type, etc.
  - Geographic location of hosts, fabrics, storage, tape
- Typical effort or activities to reduce these costs
  - Integrated SRM or storage mgmt tools
  - Consolidation of fabrics and protocols
  - Single pane of glass mgmt of storage, network elements, HBA, etc.

#18 – Storage Network Management (cont.)



Timeframe to *start* savings

- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

- Other Comments, observations
  - Collusion/coordination of storage network and data network teams
  - This item can be a micro-element of the total admin labor cost factor

#19 – Time for Balancing, Performance, Reclamation

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- Description
  - Labor effort needs to be spent to achieve optimal performance of storage assets, balance workloads, and reclaim space
  - Abandonment of these tasks results in over-spending CAPEX when adequate resources may already exist
  - Performance problems may impact processing time, customer satisfaction of revenue
- Dependencies, Relationships
  - Balance of the time/effort vs. the resources saved
  - Skills and documented best practices of storage management
- Typical effort or activities to reduce these costs
  - Invest in ITIL or operational best practices, improvements
  - SRM and performance enhancement software, audit and services
  - Formal or informal chargeback

#19 – Time for Balancing, Performance, Reclamation (cont.)

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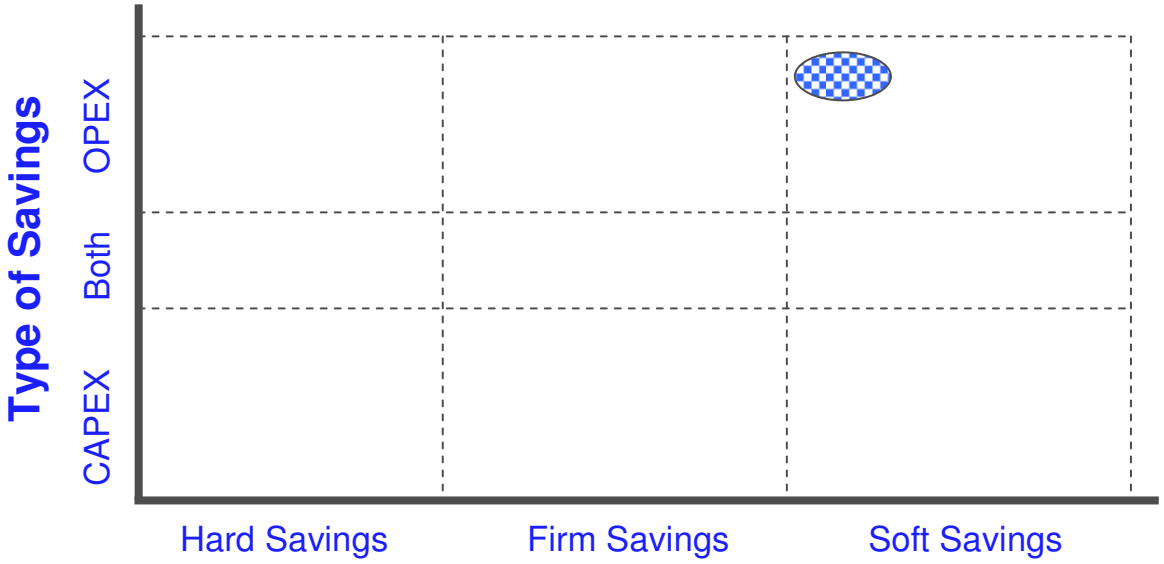


Timeframe to *start* savings

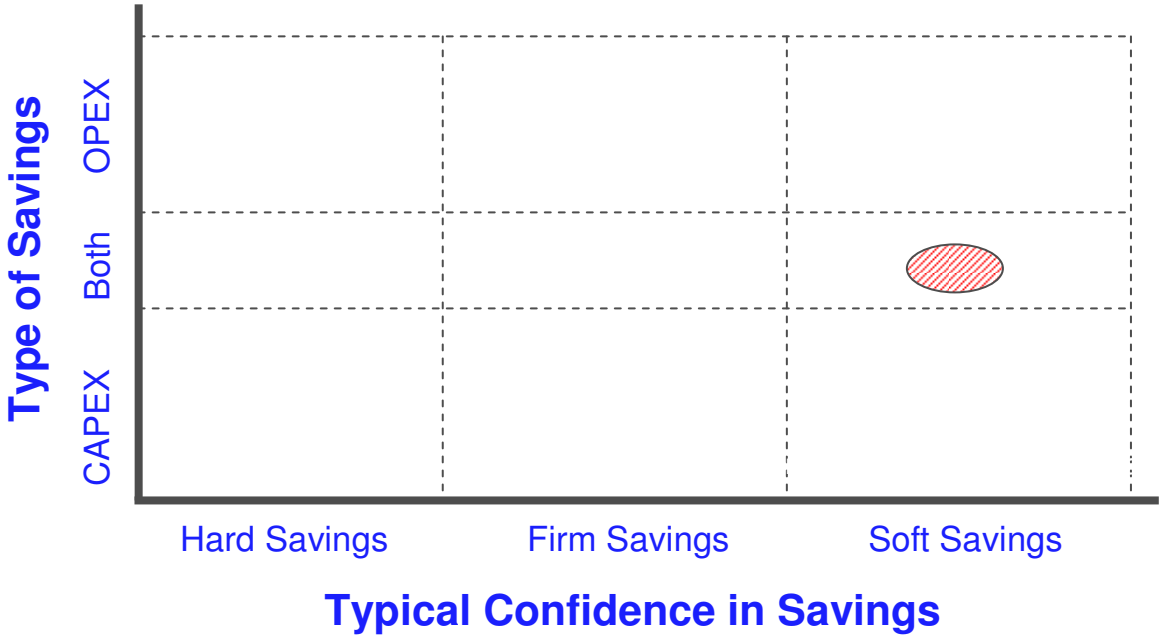
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

- Other Comments, observations
  - Conundrum of cost of waste vs. the cost of labor
  - Don't let software investments overshadow best practices and common processes that have been successfully deployed elsewhere in IT
  - This item can be a sub-element of the total admin labor cost factor or weekly storage management tasks

#20 – Mean-time to Provision

- Description
  - Storage provisioning takes time
    - Business agility improves with faster IT resource allocation
    - Lead time to order from the vendor
    - Internal time to provision the LUNs, create volumes, etc.
- Dependencies, Relationships
  - Waiting on capacity can impact IT productivity, revenue potential
  - Highly dependant on capacity planning effectiveness, forecasting, end-user accountability, chargeback
- Typical effort or activities to reduce these costs
  - Capacity on demand, storage utility
  - Tiered storage (unplanned capacity comes in on lower tier)
  - SRM tools to manage and allocate faster, policy based intelligence

#20 – Mean-time to Provision (cont.)



Timeframe to *start* savings

- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

- Other Comments, observations
  - Provision and usage behaviors need to be understood in order to optimize limited resources
  - Faster provisioning cannot replace (or discourage) good forecasting, capacity planning

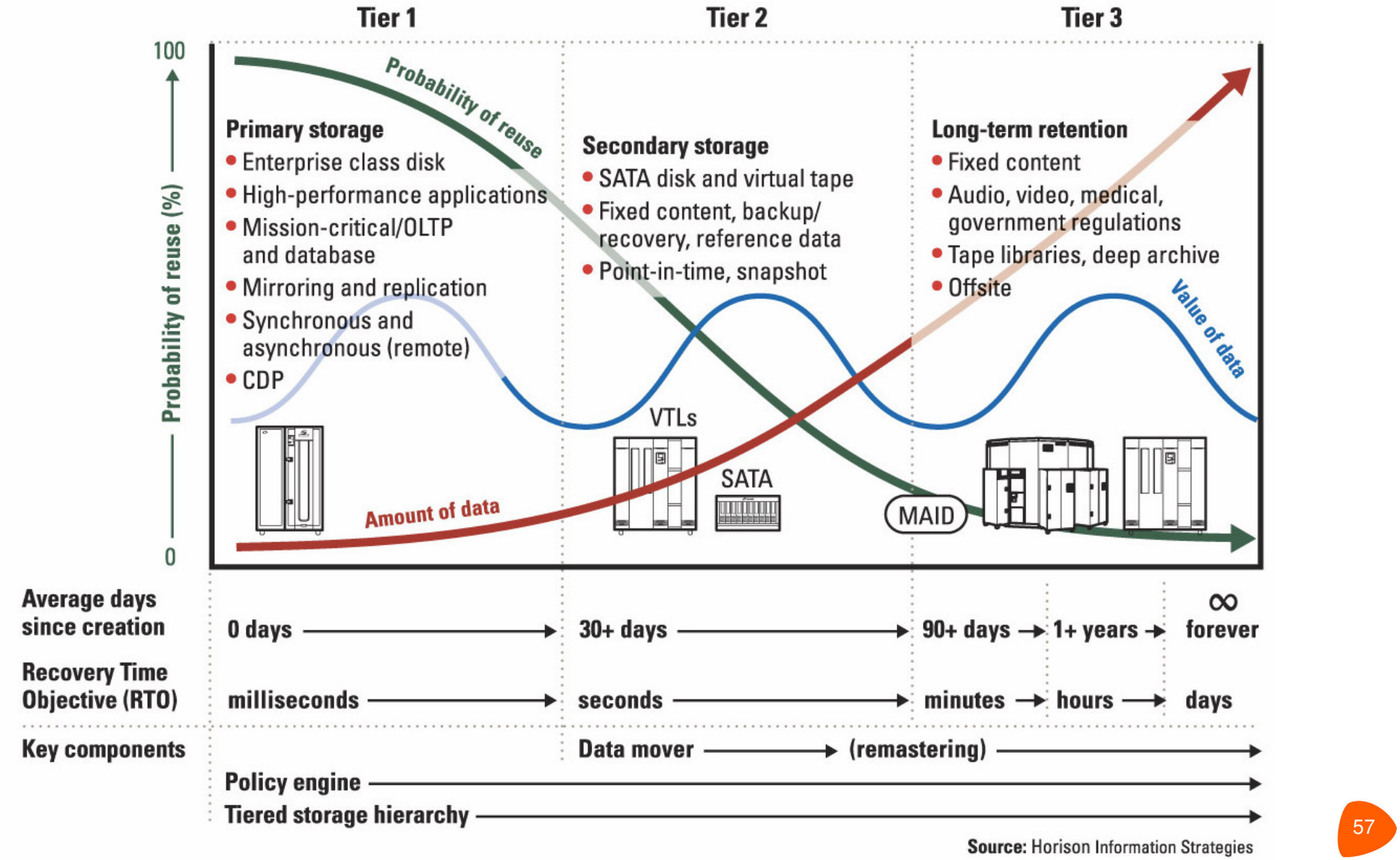
#21 – Compliance Risk, Penalties

- Description
  - If compliance requirements exist, but are unsatisfied within the storage infrastructure, there exists levels of rated risk
  - Risk can be manifest in terms of
    - Public exposure
    - Financial penalty
    - Criminal liability

- Dependencies, Relationships
  - As opposed to inadvertent data loss, compliance requirements for data protection/recoverability can be seen as a risk of intentional disregard
  - Can also factor in the time to deliver compliance reports, data

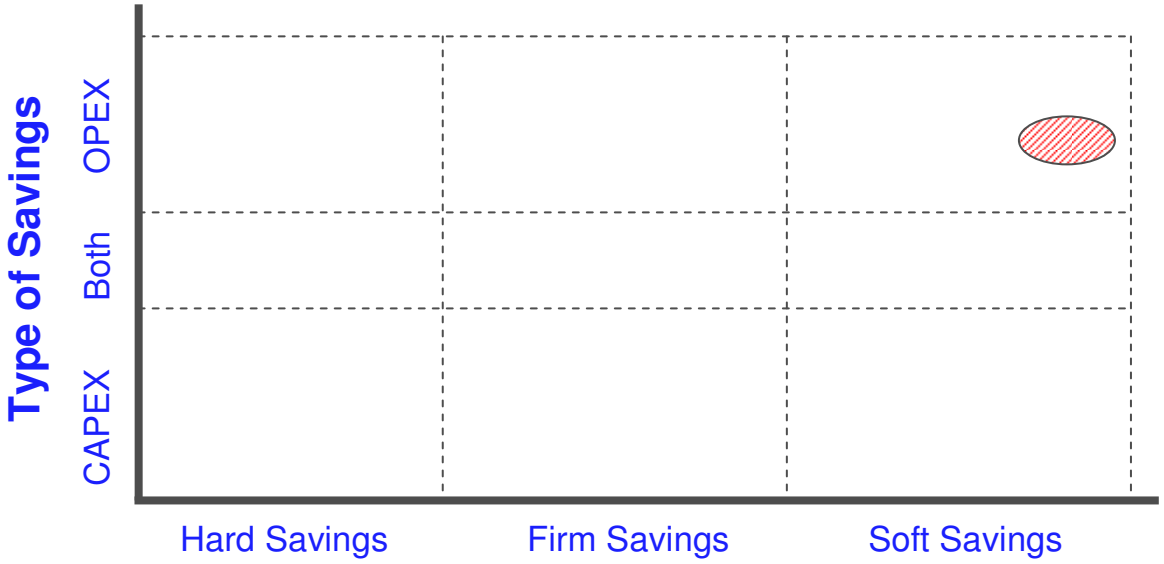
- Typical effort or activities to reduce these costs
  - Archive solutions for structured (email) and unstructured data
  - Lifecycle protection for data, long term retention requirements

Compliance and Retention



Source: Horison Information Strategies

#21 – Compliance Risk, Penalties (cont.)



Timeframe to *start* savings

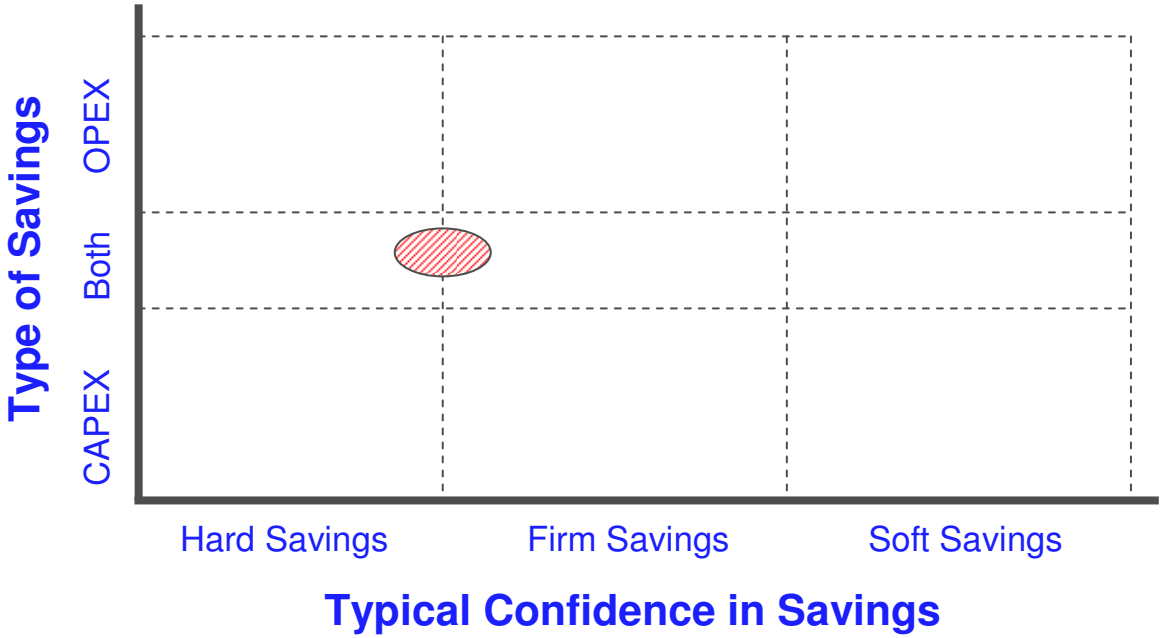
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

- Other Comments, observations
  - Compliance risks differ greatly between market segments
    - Banking, finance, health care, national security etc.
  - As the probability of compliance investigation increase, the cost of savings come more realistic (harder)
  - What is the ROI of your CFO *not* going to jail?

#22 – Tape Drives, Libraries, Media

- Description
  - Tape infrastructure constitutes a critical protection media for most IT
  - Media costs, storage, transportation, libraries all form into storage TCO
- Dependencies, Relationships
  - Media can be used for simple data protection, retention and disaster/business continuity activities
- Typical effort or activities to reduce these costs
  - Higher density media, drives
  - Near-line (VTS) for media reduction
  - Disk augmentation (in certain cases) for data protection

#22 – Tape Drives, Libraries, Media (cont.)



Timeframe to *start* savings

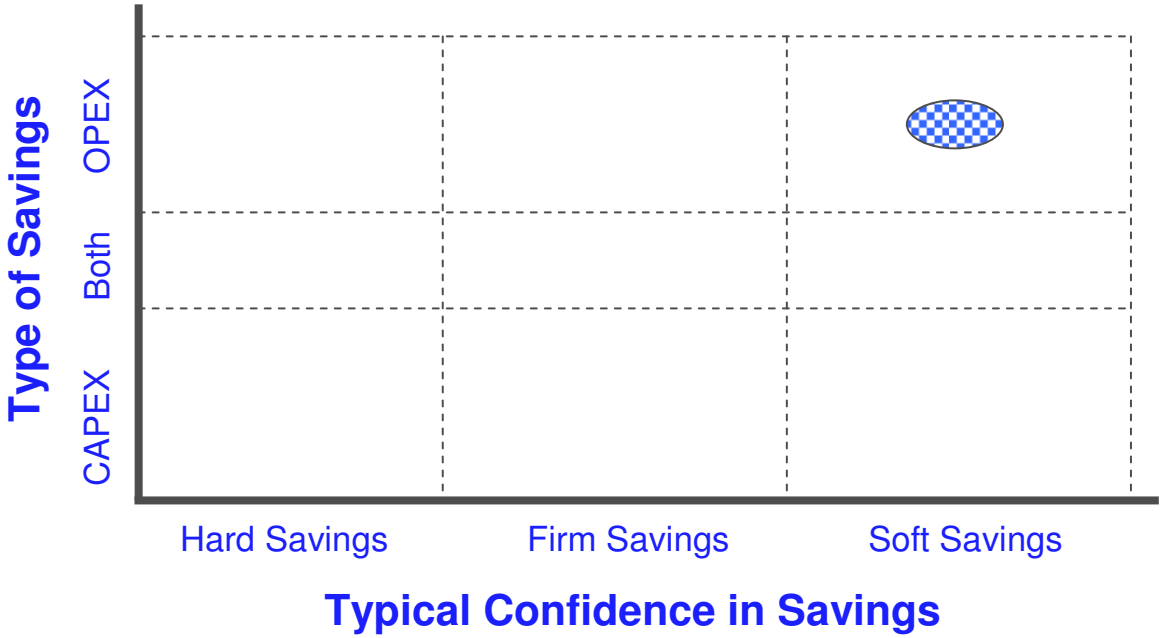
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

- Other Comments, observations
  - Some believe that high density S-ATA and MAID architecture can replace many tape functions
  - Density per tape can be higher than the disk (spindle)
  - Less focus on tape replacement, rather tape augmentation for data and business protection

#23 – Developer Time Access to DBMS

- Description
  - Developers rely on data, database copies for testing, warehousing
  - Limited access to copies or live DBMS can impact development time
- Dependencies, Relationships
  - Types of DBMS
  - Version control
- Typical effort or activities to reduce these costs
  - Snap copies or mirrors to provide near real-time access to data and DBMS several times a day, shortening development time
  - Tiered Storage architecture

#23 – Developer Time Access to DBMS (cont.)



Timeframe to *start* savings

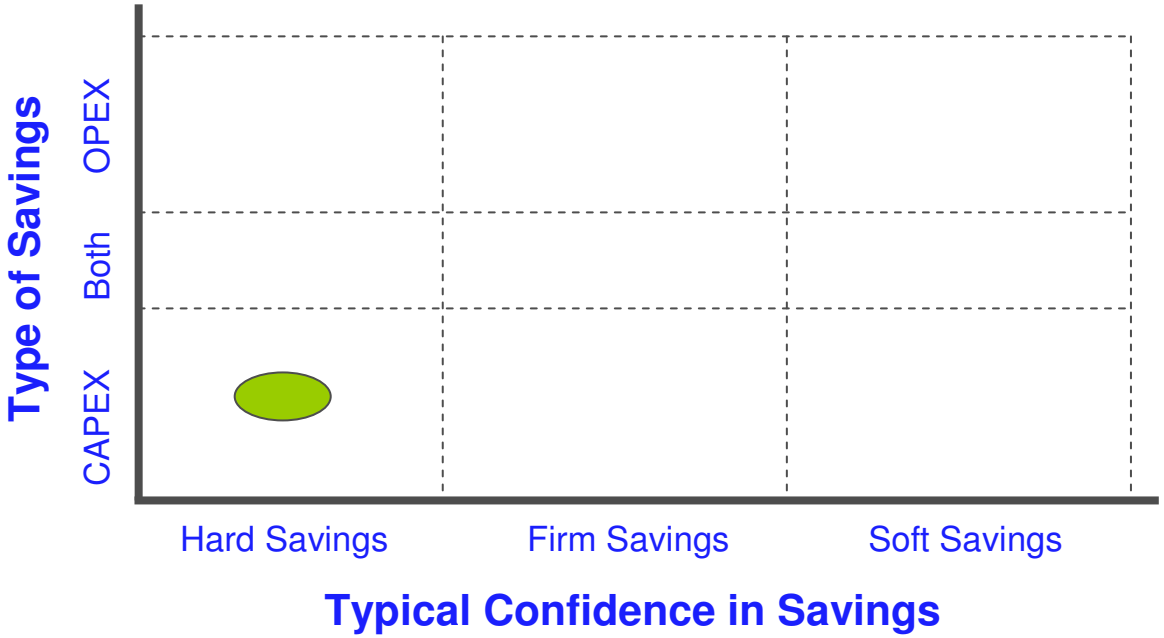
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

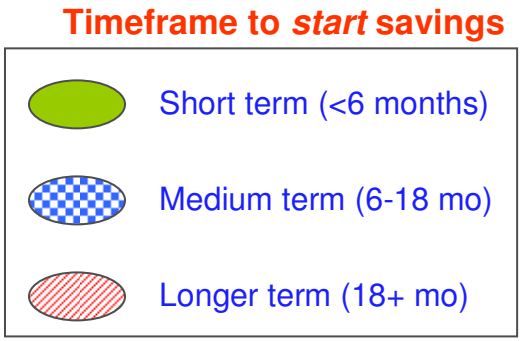
- Other Comments, observations
  - Developers are typically not good at policing their storage capacity, quotas and other behavior modification techniques may be needed
  - This type of rapid access, rapid reclamation disk is best as a lower tier

#24 – Local Storage Network Infrastructure

- Description
  - Local network segments may be used for the storage network (NAS, iSCSI using IP LAN and WAN)
  - Often a separate IP network is built and maintained for backups
  - Extra effort is needed in management, configuration, security and zoning of these secondary networks used by the storage infrastructure
- Dependencies, Relationships
  - Backup and DR networks
  - Data network management teams
- Typical effort or activities to reduce/reclaim these costs
  - Disk-based backup, replication and snapshots
  - Re-engineering the backup architecture
  - Consolidating ad-hoc CIFS and NFS networks into a unified storage (networked) pool
  - Operational process, division of labor with data network teams

#24 – Local Storage Network Infrastructure (cont.)



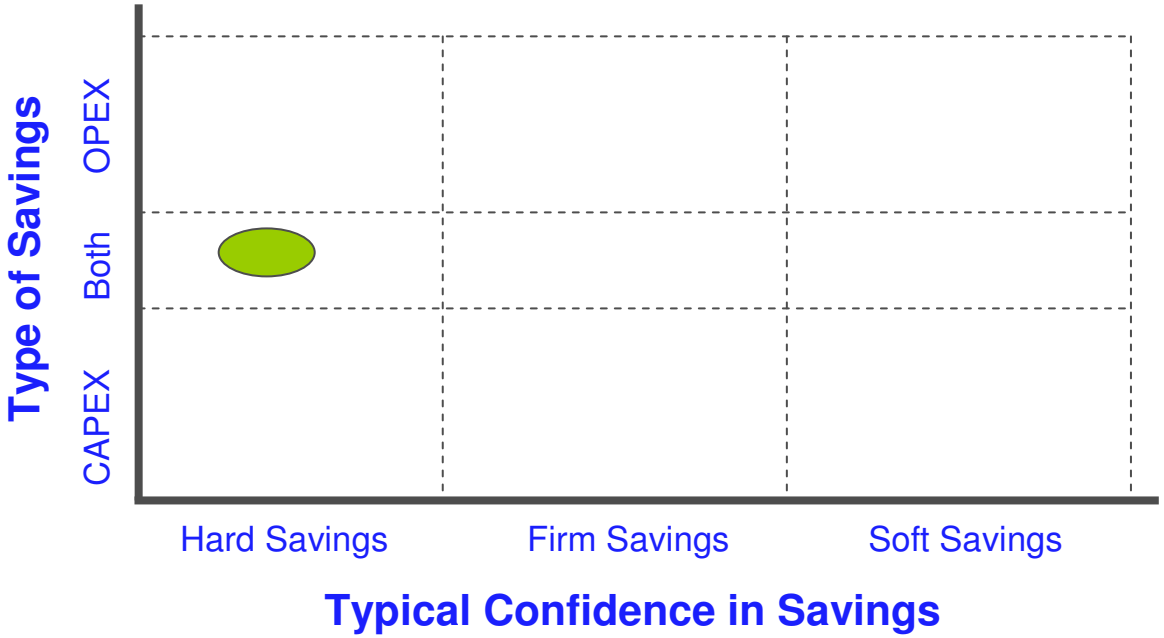


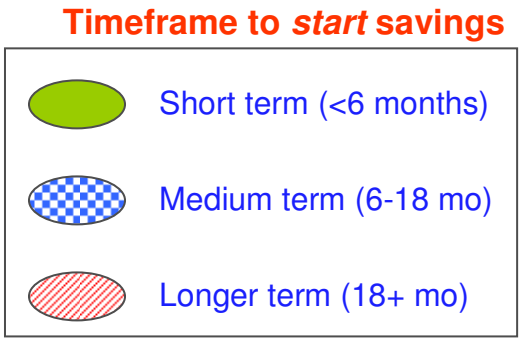
- Other Comments, observations
  - Data network teams tend to have good architecture, strategies and operational processes that could be adopted into the data network team

#25 – Long Distance Circuits

- Description
  - Storage infrastructure may use long distant circuit (i.e.. OC-12) for long distance connection to DR sites or tape vaults
  - Monthly lease fees apply to these circuits, and are based on distance and capacity
- Dependencies, Relationships
  - Out of area or metro circuits are critical to DR/BC provisions
- Typical effort or activities to reduce these costs
  - 3DC designs can reduce the total bandwidth requirements
  - Tiered storage ensures that only mission critical data volume is remotely copied

#25 – Long Distance Circuits (cont.)



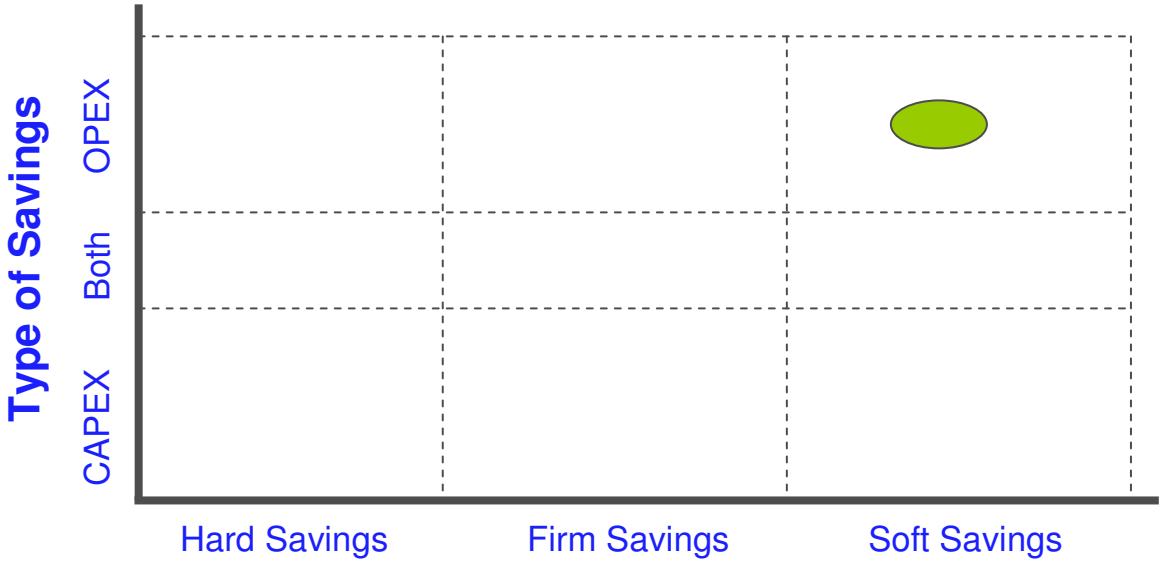


- Other Comments, observations
  - Others infrastructure users, besides storage, may use some of the lambdas (circuit segments), so complete removal may not be possible

#26 – Storage Performance

- Description
  - Trapped in each IT asset is the potential to run faster, more efficient
  - This pent-up saving potential can be released by investing in tools or services that change the performance characteristics
- Dependencies, Relationships
  - Revenue or transaction benefits have to be characterized according to the performance improvement
- Typical effort or activities to reduce/reclaim these costs
  - Storage performance audits and tune-ups
  - Monitoring processes, tools
  - Change to new infrastructure
    - Cache
    - Faster port speed (10GB FC), FICON
    - Faster disk type (RPM), or RAID overhead

#26 – Storage Performance (cont.)



Timeframe to *start* savings

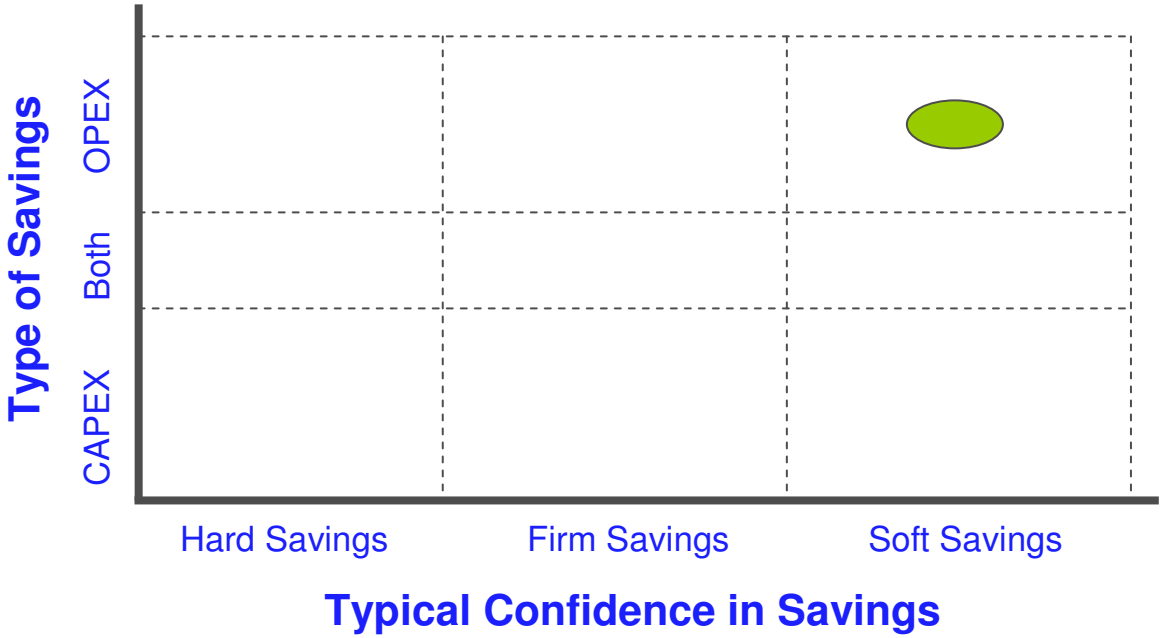
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

- Other Comments, observations
  - FICON replacement (#27) is a subset of this condition
  - Verifiable revenue improvement is often hard to show
  - This case may best be applied to high-transactional systems (eBay, stock exchange) where faster throughput = revenue

#27 – FICON vs. ESCON Performance

- Description
  - This condition exists for mainframe systems only, and is really a sub-set of the performance cost condition outlined in #26
- Dependencies, Relationships
  - CPU and applications that can take advantage of FICON
- Typical effort or activities to reduce/reclaim these costs
  - Replace ESCON adapters, directors and channel extenders to FICON

#27 – FICON vs. ESCON Performance (cont.)



Timeframe to *start* savings

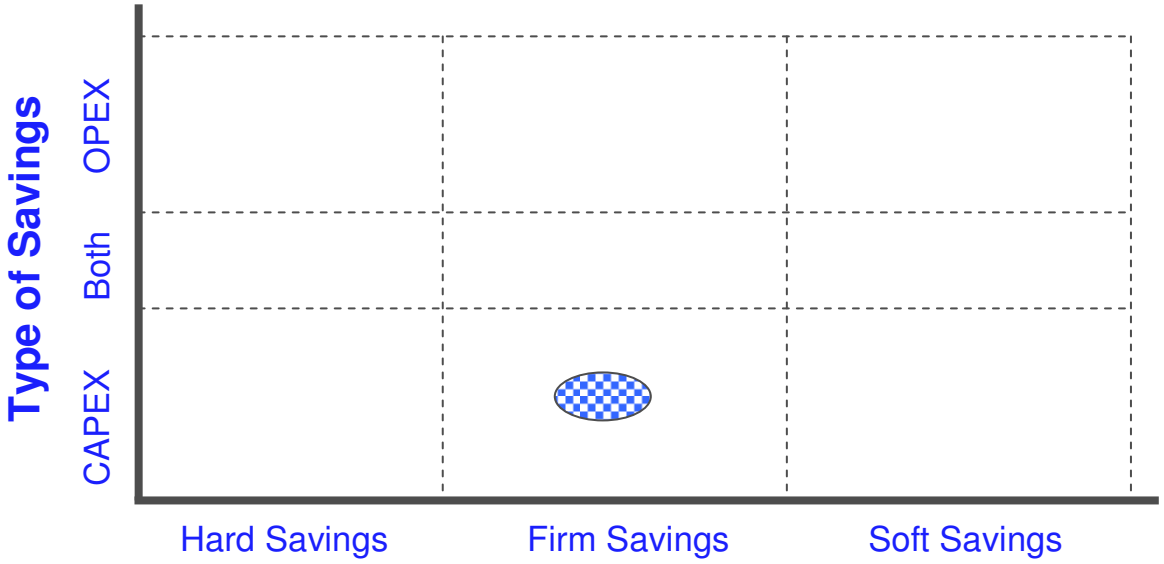
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

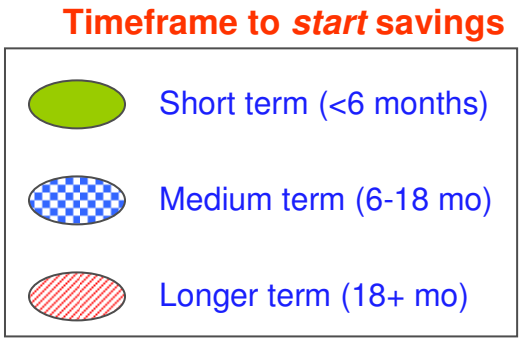
- Other Comments, observations
  - Same as #26 performance category
  - ESCON replaced as a tech refresh more often than TCO improvement
  - As a stand-alone category, this example needs to be folded into #26

#28 – Cost of Disk Waste, Fragmentation

- Description
  - There is buried in the sunk cost of storage an inherent cost of waste
  - Stranded LUNs, unallocated/un-used volumes, DBMS white space
  - This waste becomes a future CAPEX as storage is prematurely purchased to meet usable demand
- Dependencies, Relationships
  - Lack of architecture, multiple vendors, multiple SRM systems
  - No central purchasing, each storage purchase done by the projects
- Typical effort or activities to reduce/reclaim these costs
  - Advanced storage management tools
  - Operational best practices
  - Chargeback, quotas
  - Storage Consolidation
  - Virtualization

#28 – Cost of Disk Waste, Fragmentation (cont.)





- Other Comments, observations
  - Some may argue the decline in the cost of disk negates the cost of waste; that applying labor to manage waste is more costly than the resources being reclaimed
  - Remember that price ≠ cost; there is more in TCO that purchase alone

#29 – Outage Risk Due to Mgmt Errors, Capacity

- Description
  - 25% of IT outages can be attributed to storage problems
  - 20-30% of storage outages are due to poor management and configuration errors
  - Identifying these potential risks, then applying the correct remedy can reduce storage-related outages
- Dependencies, Relationships
  - Number and varieties of storage infrastructure elements (variety of vendors, products, protocols increase overall complexity)
- Typical effort or activities to reduce these costs
  - Formal development of best practices and common processes
  - SRM and storage area management tools, monitoring methods
  - Organization optimization, including help desk and tech support

#29 – Outage Risk Due to Mgmt Errors, Capacity (cont.)

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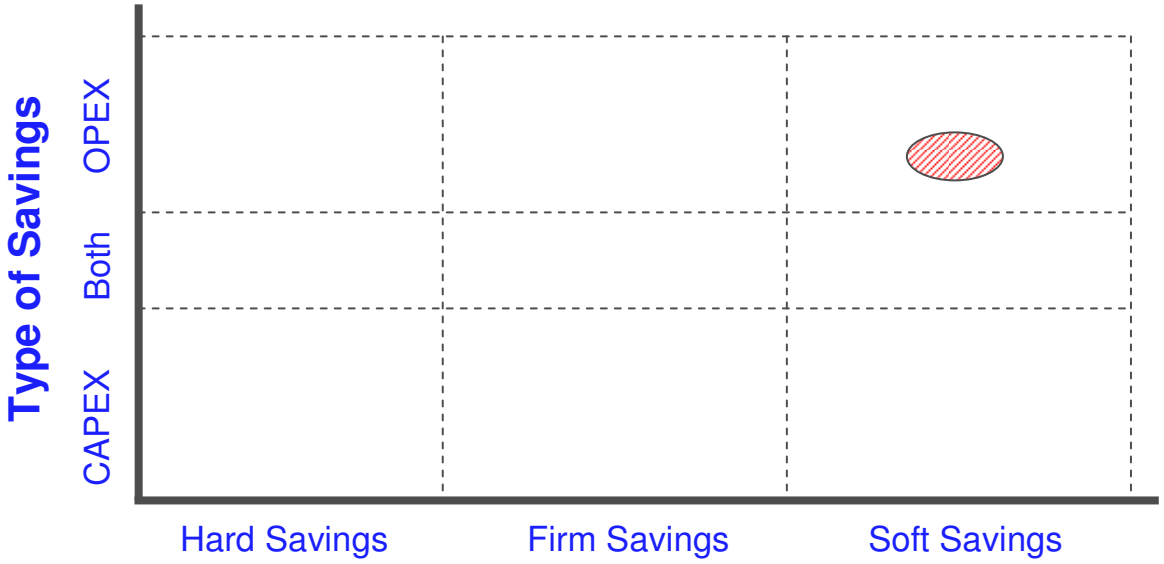


Timeframe to *start* savings

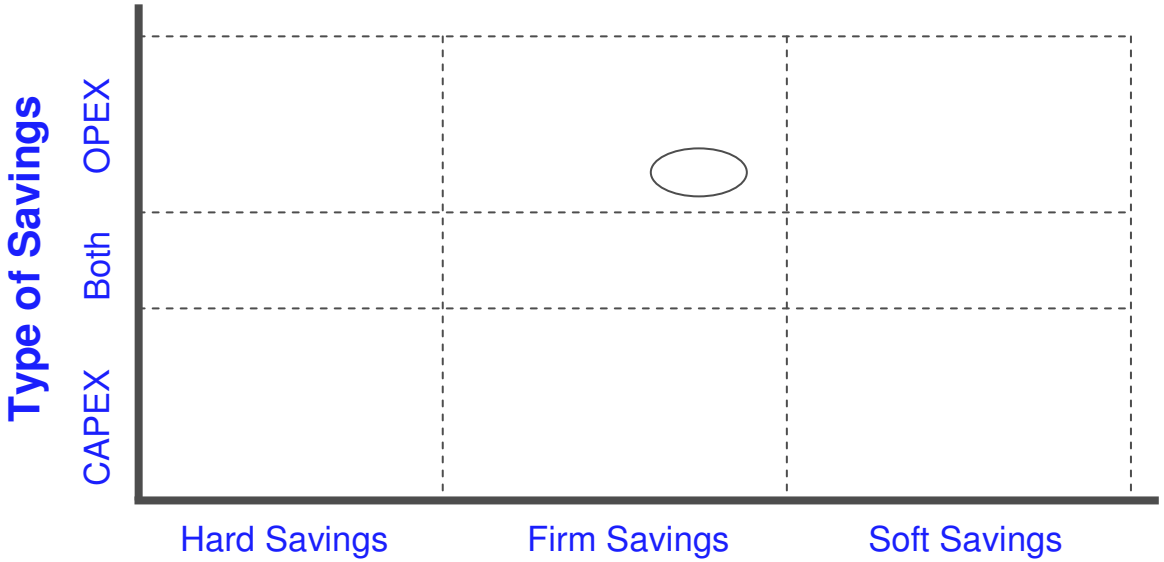
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)

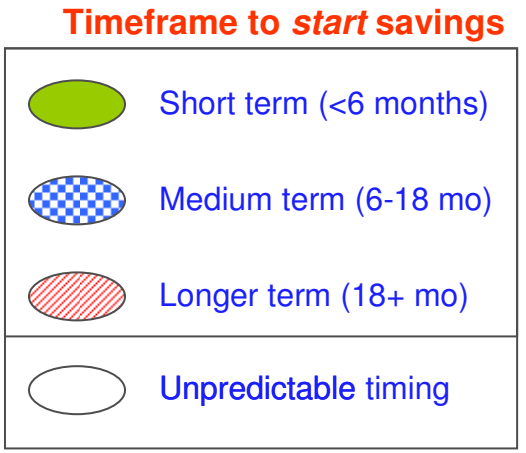
- Other Comments, observations
  - No single tool or product is a silver bullet here, a balanced blend of training, best practices and automation tools is the best recipe

#30 – Risk Related to Disaster Protection

- Description
  - Companies that do not have a disaster recovery or business continuity plan (documented, tested, verified) are running with a rated risk of business outage or disruption
  - A real cost to the business can be defined related to any disaster
- Dependencies, Relationships
  - DR/BC risk is similar in nature but fundamentally different from local data recovery or backups
  - Servers, secondary arrays, 2nd site, long distance replication is needed
  - See also category #6
- Typical effort or activities to reduce these costs
  - Formal DR/BC plan and provisions that include frequent tests, reviews
  - Intermediate plans for on-site (local) recoverability or in-area recovery
  - LD circuits, replication mechanisms, secondary hosts and storage

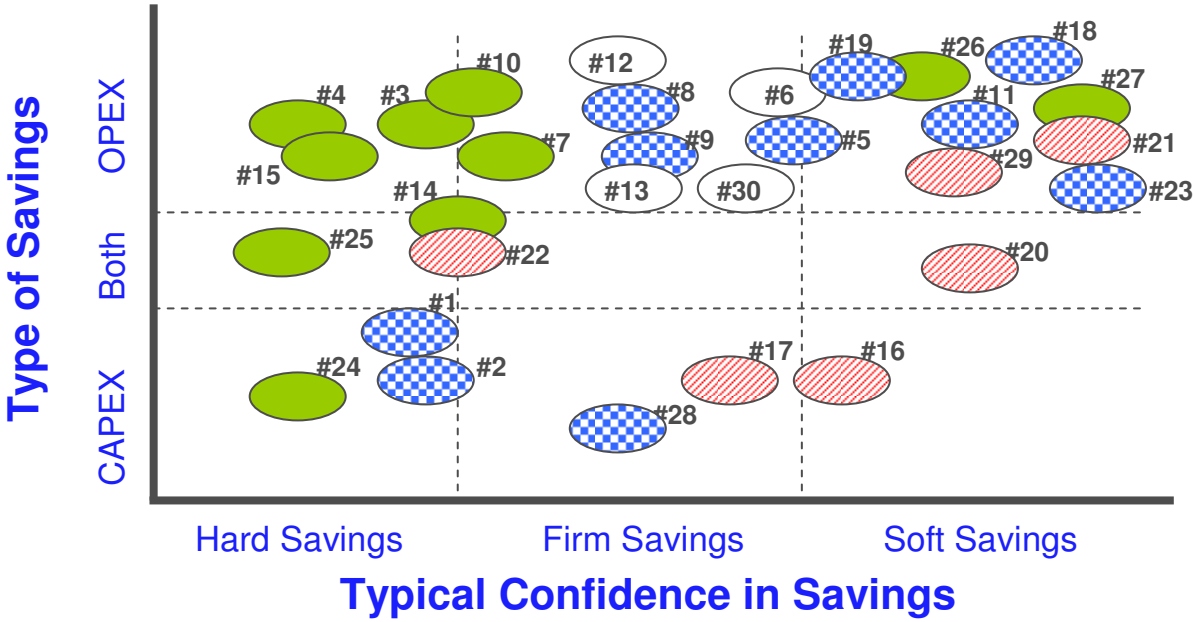
#30 – Risk Related to Disaster Protection (cont.)





- Other Comments, observations
  - Storage and data protection only represent a fraction of the DR/BC focus or investments. All other areas have to be in place a well
  - Future outages or disaster cannot be predicted, therefore delaying this type of protection only amplifies the risk

Summary Graph of Storage Cost - Types

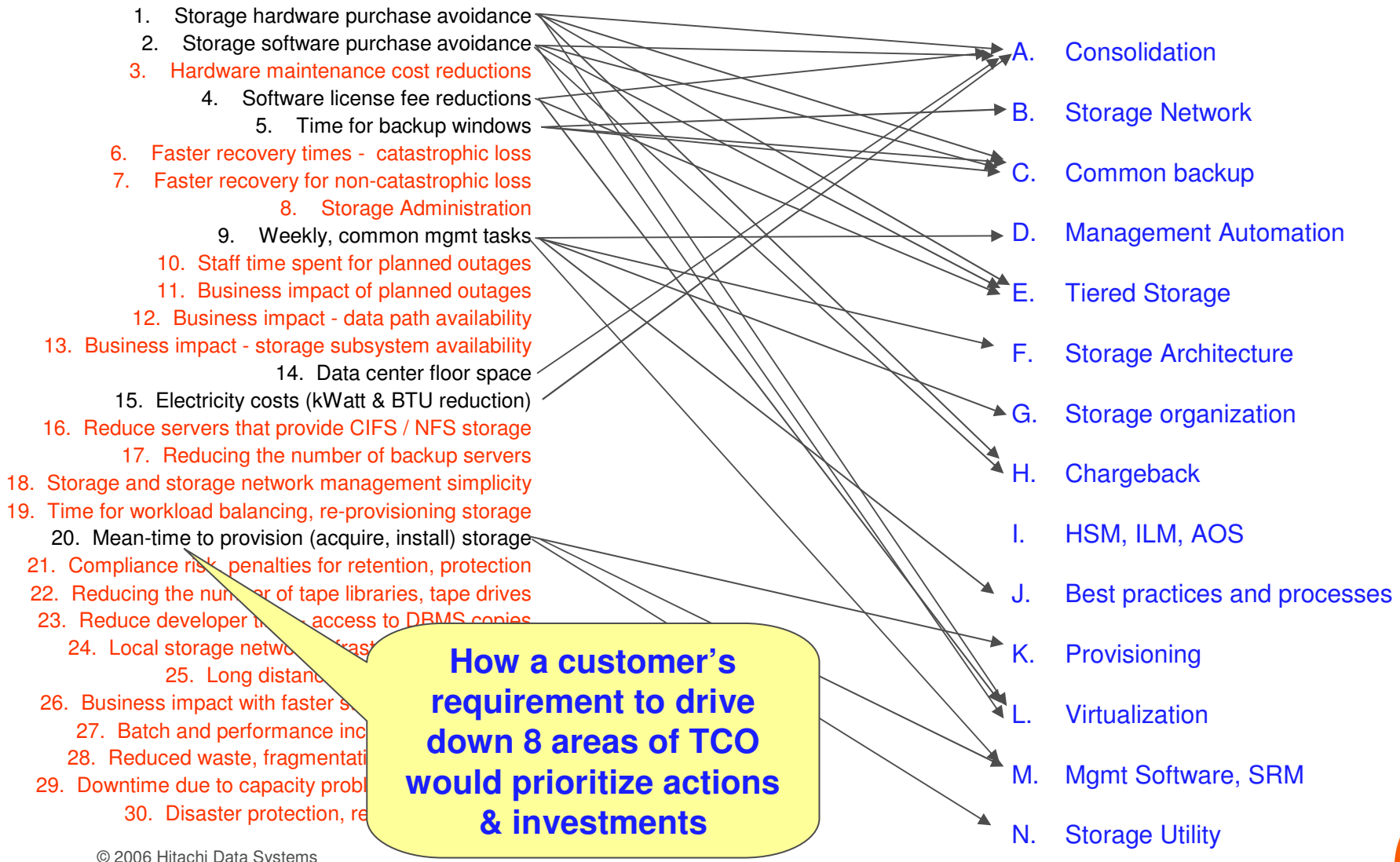


Timeframe to *start* savings

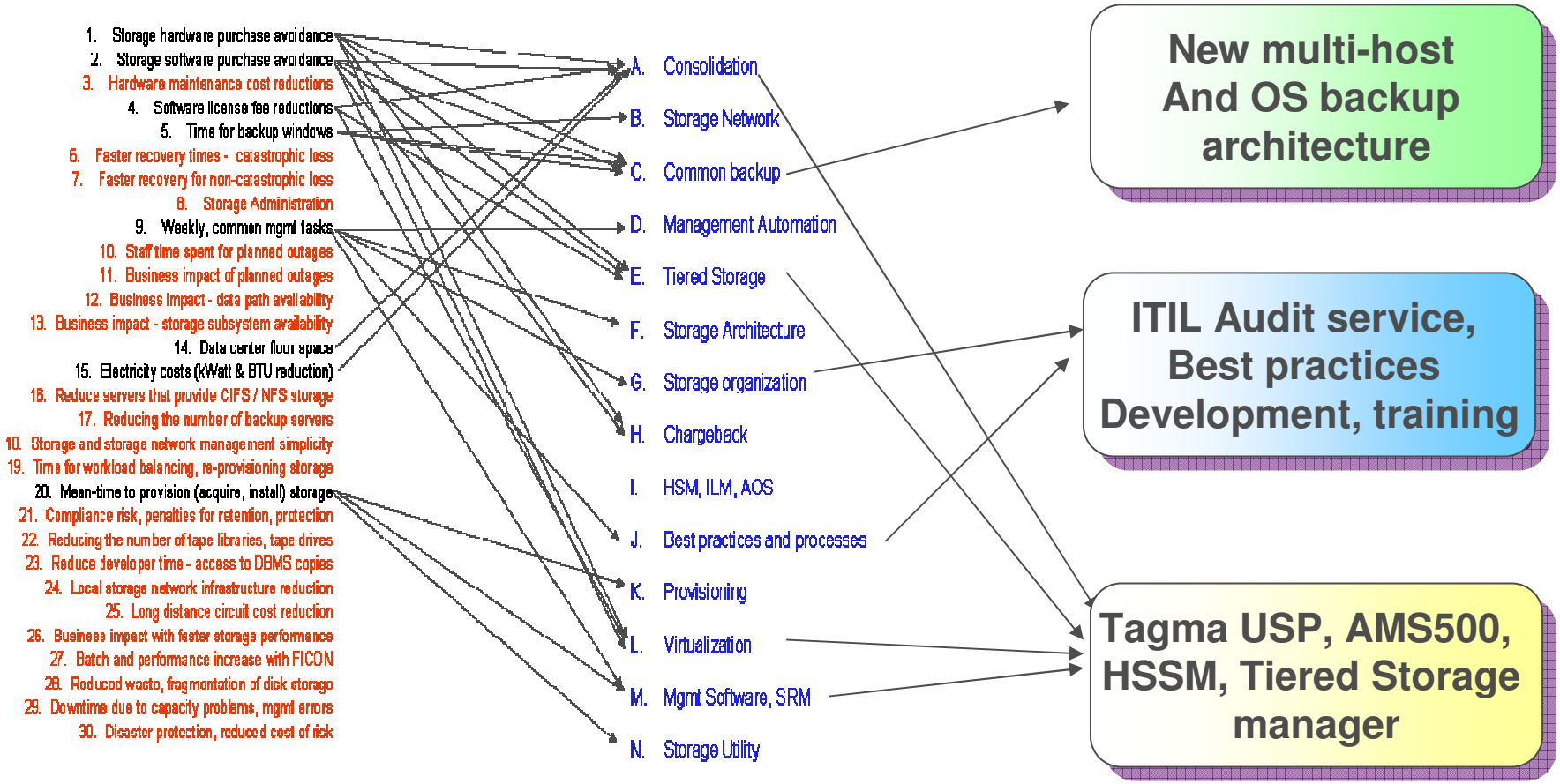
- Short term (<6 months)
- Medium term (6-18 mo)
- Longer term (18+ mo)
- Unpredictable timing

- Comments
  - The placement and timing of these categories is not absolute
  - Short-term, hard savings create “sweet spot ideas” for TCO reduction
  - Any cost defined as ‘soft’ can immediately be ‘hard’ if the client has experienced problems or costs in the past

Mapping the **Money** to the **Effort** Required



The **Money** to the **Effort** to the **Solution**



IT Investments and economics

- ***Storage Economic*** analysis helps to determine the "next best use" of the IT (storage) investment
  - **Hardware**
    - ATA, FC disk, tape, SAN, appliances, intelligent controllers
  - **Software**
    - Management automation, backup, replication, ILM
  - **Organization and People**
    - Training, organization realignment to storage infrastructure mgmt
  - **Best practices and processes**
    - Filling the operational gaps (ITIL)
  - **New business models for storage**
    - Storage utility, chargeback, multi-tiered approach
  - **Regulatory Compliance**
    - Basel II, Sarbanes-Oxley, etc.

Conclusions

- Select the types of cost that make sense for your IT environment
  - 5-7 types of cost are typical
  - A range of hard costs blended with firm or soft to provide balance
  - Be aware of the timing, cash flow of the costs
- ROI work can be done defining investments to lower these costs
- TCO comparative analysis can use these costs for side-by-side comparisons
  - Architectures and technology
  - Protocols
  - Vendors and products
- Choosing the types of costs that need to be reduced can often help with prioritizing the activities and investments needed to reduce the cost of storage ownership ($1M-per-12TB rule)

Three Critical Messages

1. Cost-per-MB is poor single metric for economic decisions
   - Price ≠ cost; take a multi-year perspective
   - IT organizations are looking to reduce OPEX, not always CAPEX
   - Cheap disk can cost more over time, and negatively impact OPEX
   - Not all storage and SAN solutions are equal in TCO

2. There are OPEX reduction opportunities within your storage infrastructure !
   - On average, $1M net OPEX potential savings in every 12TB of usable disk

3. There are specific, proven activities to discover, and harvest some of the OPEX money in storage infrastructure
   - Consolidation
   - SANs
   - Best Practices
   - Common backup
   - Multi-tiered storage
   - Best practice and management
   - Storage management (SRM)
   - Organization optimization

Storage Economics Strategy (SES) Service Can Help

HITACHI
Inspire the Next

- GSS service designed to discover, quantify and justify storage infrastructure investments. An up-stream offering that focuses on business issues of cost, best practices and operational optimization to reduce storage OPEX

- Key qualities of this vanguard service
  - Accelerates strategic storage & SAN thinking, usually for OPEX savings
  - Closed-loop service ensures completeness and verification of objectives
  - Fast, low cost, based on solid methods and experience
  - Results in business, financial and technical terms

- Service Deliver Phases
  1. **Discover** understand the storage environment already in-place, non-intrusively
  2. **Assess** your tactical and strategic storage needs via workshop, interviews
  3. **Design** storage architecture(s) to meet business requirements, infrastructure
  4. **Analyze** and compare ROI for design options, show the OPEX saving potential
  5. **Report** findings in a format to help with business cases and justification

Discussion, questions

Thank you for your time