CNT 4603: System Administration Spring 2014

Virtualization Cost/Benefit Analysis

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Cost/Benefit Analysis For Server Virtualization

- In most organizations, deciding whether to go forward with a project is tied directly to the project's prospective financial benefits.

- One of the primary reasons that virtualization is such a hot IT topic is because that it promises significant payback.

- There are three commonly used methods for determining the projected financial value of projects:
  - Net present value (NPV) analysis
  - Return on investment (ROI)
  - Payback analysis

Cost/Benefit Analysis For Server Virtualization

- **Net present value** (NPV) analysis is a method of calculating the expected net monetary gain or loss from a project by discounting all expected future cash inflows and outflows to the present point in time.

- Projects with a positive NPV should be considered if financial value is a key criterion.

- The higher the NPV, the better.

- Notice in the spreadsheet on page 8 that the two projects have the same cash flows but different NPV. (The cash flow represents the benefits minus costs or income minus expenses.) The NPV accounts for the time value of money (a dollar earned today is worth more than a dollar earned 5 years form now).

Cost/Benefit Analysis For Server Virtualization

- The **discount rate** (see page 8) is an indirect measure of how fast an investment will pay for itself.

- For example, if a building is purchased for $1,000,000 sale price and it produces $100,000 in positive net operating income (the amount left over after fixed costs and variable costs is subtracted from gross lease income) during one year, then the discount rate is:

$$\$100,000 \,/\, \$1,000,000 = 0.10 = 10\%$$

- In the example, the purchased building will be fully capitalized (pay for itself) after ten years (100% divided by 10%). If the capitalization rate were 5%, the payback period (see page 6) would be twenty years.

Cost/Benefit Analysis For Server Virtualization

- **Return on investment** (ROI) is calculated by subtracting the project costs from the benefits and then dividing by the costs

    ROI = (total discounted benefits - total discounted costs) / discounted costs

- For example, if you invest $100 today and next year it is worth $110, your ROI is (110-100)/100 or 10%.

- The higher the ROI, the better. Many organizations use ROI in the project selection process. In a recent *Information Weekly* study, more than 82% of IT decisions required an ROI analysis.

- Many organizations have a **required rate of return** or minimum acceptable rate of return on investment for projects.

- **Internal rate of return** (IRR) can by calculated by finding the discount rate that makes the NPV equal to zero.
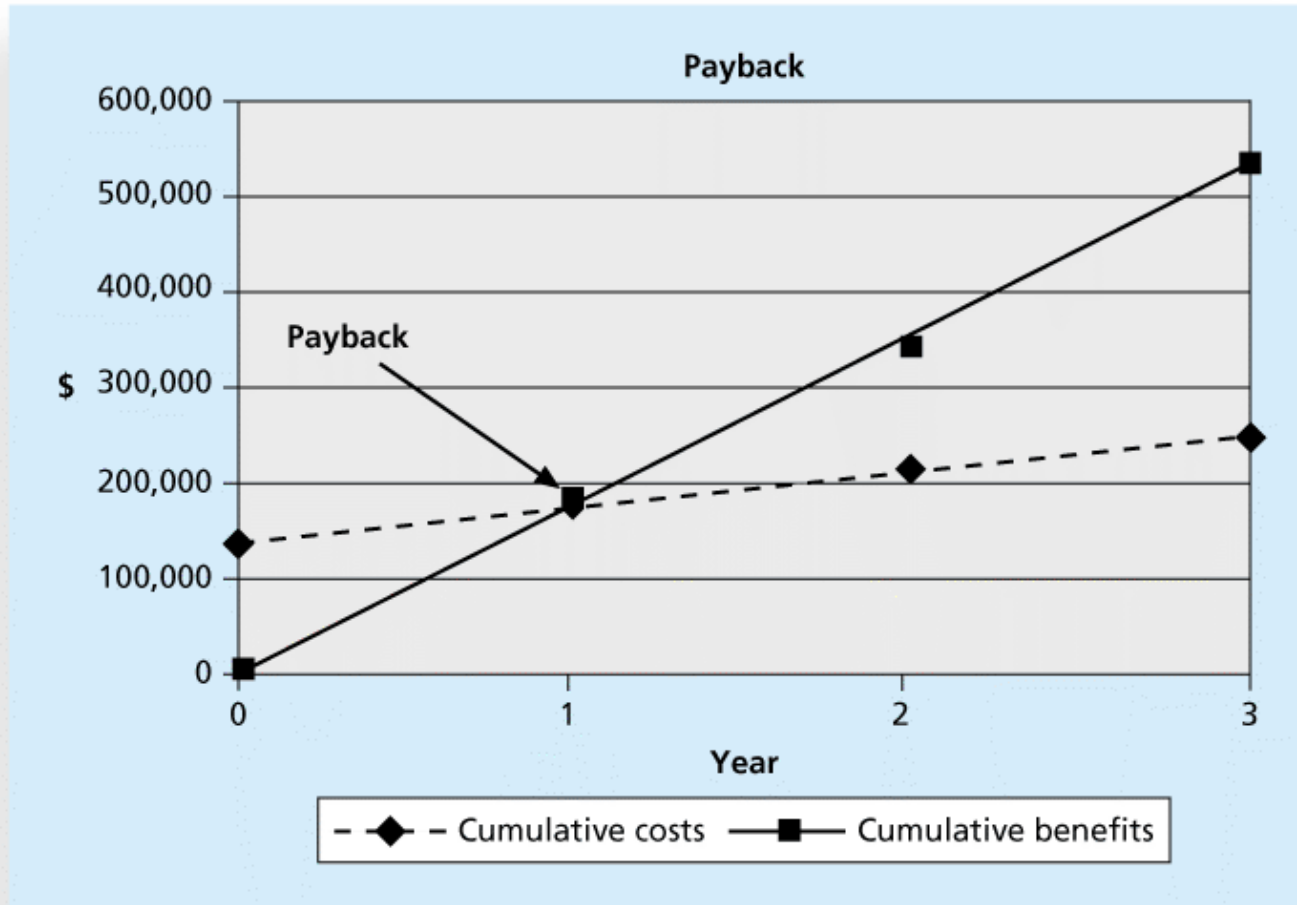
Cost/Benefit Analysis For Server Virtualization

- Another important financial consideration is payback analysis

- The **payback period** is the amount of time it will take to recoup, in the form of net cash inflows, the total dollars invested in a project.

- Payback occurs when the net cumulative discounted benefits equals the costs.

- Many organizations want IT projects to have a fairly short payback period.

Cost/Benefit Analysis For Server Virtualization

Cost/Benefit Analysis For Server Virtualization

	A	B	C	D	E	F	G
1	Discount rate	10%					
2							
3	**PROJECT 1**	**YEAR 1**	**YEAR 2**	**YEAR 3**	**YEAR 4**	**YEAR 5**	**TOTAL**
4	Benefits	$0	$2,000	$3,000	$4,000	$5,000	$14,000
5	Costs	$5,000	$1,000	$1,000	$1,000	$1,000	$9,000
6	Cash flow	($5,000)	$1,000	$2,000	$3,000	$4,000	**$5,000**
7	NPV———▶	**$2,316**					
8		Formula =npv(b1,b6:f6)					
9							
10	**PROJECT 2**	**YEAR 1**	**YEAR 2**	**YEAR 3**	**YEAR 4**	**YEAR 5**	**TOTAL**
11	Benefits	$1,000	$2,000	$4,000	$4,000	$4,000	$15,000
12	Costs	$2,000	$2,000	$2,000	$2,000	$2,000	$10,000
13	Cash flow	($1,000)	$0	$2,000	$2,000	$2,000	**$5,000**
14	NPV———▶	**$3,201**					
15		Formula =npv(b1,b13:f13)					
16							
17							

Note that totals are equal, but NPVs are not because of the time value of money

Cost/Benefit Analysis For Server Virtualization

		Year				
Discount rate	8%					
Assume the project is completed in Year 0		**Year**				
	0	**1**	**2**	**3**	**Total**	
Costs	140,000	40,000	40,000	40,000		
Discount factor	1	0.93	0.86	0.79		
Discounted costs	**140,000**	**37,200**	**34,400**	**31,600**	**243,200**	
Benefits	0	200,000	200,000	200,000		
Discount factor	1	0.93	0.86	0.79		
Discounted benefits	**0**	**186,000**	**172,000**	**158,000**	**516,000**	
Discounted benefits - costs	(140,000)	148,800	137,600	126,400	**272,800**	←NPV
Cumulative benefits - costs	(140,000)	8,800	146,400	272,800		
ROI ———————→	**112%**					
		Payback In Year 1				

Cost/Benefit Analysis For Server Virtualization

- As a system administrator you may be in charge of performing a project's cost/benefit analysis. It is important that you understand how to approach such a project.

- Having a documented financial analysis is sure to help you communicate the benefits of a project, whether it deals with virtualization or not, and it can help you to "sell" the project to decision makers. (See Wikipedia's definition in box below.)

- This remainder of this set of notes is designed to step you through the process of performing a financial analysis of a virtualization project.

A well-designed feasibility study should provide a historical background of the business or project, a description of the product or service, accounting statements, details of the operations and management, marketing research and policies, financial data, legal requirements and tax obligations. Generally, feasibility studies precede technical development and project implementation. A feasibility study evaluates the project's potential for success; therefore, perceived objectivity is an important factor in the credibility of the study for potential investors and lending institutions. It must therefore be conducted with an objective, unbiased approach to provide information upon which decisions can be based.

Cost/Benefit Analysis For Server Virtualization

- There are many different techniques that can be utilized to prepare a cost/benefit financial analysis. We'll focus on a fairly standard approach that involves a five step process.

- The five steps you'll need to accomplish are:

    1. Define your proposed virtualization scheme.

    2. Establish the current cost structure.

    3. Identify the virtualization project's costs.

    4. Identifying the benefits of the proposed virtualization solution.

    5. Create the virtualization project's overview spreadsheet.

If you're interested, the National Archives has a good set of resources that deal with cost/benefit analysis. Many are very IT related and provide a good set of topics that should be included in basic cost/benefit analysis studies. Start at: Analysis of Costs and Benefits for ERM/ERK Projects and go from there.

1. Defining A Virtualization Solution

- Obviously, the first task at hand is to look at your current infrastructure and consider how you might apply virtualization to it.

- Should you consolidate a number of physical servers onto a smaller number of machines, each of which hosts a number of virtual machines?

- Do you need to construct a redundant infrastructure to allow guests to be migrated between machines to ensure high availability?

- Or do you need to virtualize your storage as well as consolidate servers?

1. Defining A Virtualization Solution

- Based on your assessment of the situation, you will identify what portion of the existing infrastructure is suitable for virtualization. (We'll look in more detail later at some of the assessment criteria necessary for making this decision.)

- Once this is assessment is completed, then you can identify the correct virtualization solution to implement.

- Once this assessment is completed, you have the basis for performing a comparison between the pre-virtualization and post-virtualization configuration.

- When this comparison is done, you can calculate the financial impact of going to virtualization as well as the operational benefits you should derive from the project.

2. Establishing Current Cost Structure

- Understanding how much your current infrastructure costs to run today is vital in determining the current baseline.

- It might surprise you to know that most IT organizations do not track their costs with very fine granularity. In other words, budgets are tracked in fairly broad categories without assigning costs in fine detail.

- The result of this is that it is difficult for the system administrator to request a report that would show the current costs of the part of the infrastructure that you want to virtualize.

- However, with some effort, you can get build a fairly accurate estimate of the current costs to use as a baseline with which to compare the potential benefits of the virtualization project.

2. Establishing Current Cost Structure

- There are two broad categories of cost: hard costs and soft costs.

- Hard costs are any costs that require paying actual money to an entity. Hard costs are often associated with a specific product and service. For example, if your organization utilizes an outside company to run security scans on your servers, the fees you pay to that company are a hard cost.

- Soft costs are typically associated with internal personnel or internal services for which no explicit chargeback system is in place. Soft costs are what the organization spends on an ongoing basis doing its daily work.

2. Establishing Current Cost Structure – Hard Costs

- Let's look more closely at hard costs first.

- A given organization might have many different types of hard costs. Typically these are easier to identify and track than soft costs.

- However, there are three hard costs that must be included in our analysis:

  1. Power

  2. Server maintenance

  3. Outside services

- We'll look at each of these three areas more closely.

2. Establishing Current Cost Structure – Hard Costs

Power

- Except for the rare organization that creates some or all of its own power, this is most assuredly a hard cost.

- Most organizations will likely have there power costs itemized at the data center level of granularity, so determining the total amount spent on power should be relatively straightforward.

- However, calculating the cost of power for the machines in your virtualization project is a bit trickier.

- Each machine in your current infrastructure should have documentation of how much power it draws. Use the power draw level associated with the most typical load factor for the machine.

2. Establishing Current Cost Structure – Hard Costs

Power

- If you are replacing old machines with newer machines, they will probably be more efficient in their power consumption and thereby save some on power costs.

- Since the virtualization project will also, most likely, be reducing the number of physical machines, another power cost savings is realized.

- A common ratio in the virtualization world is 5:1. This means that you take five old servers and turn them into virtual machines running on one new physical server.

- Your power savings would be amount of power to run four old servers plus the difference between the power draw of an old server and the power draw of the new server.

2. Establishing Current Cost Structure – Hard Costs

Server Maintenance

- The current machines in your data center are most likely under a service plan.

- Service plans come in many different forms; users can typically choose one of several different levels of response time guarantee. For example, reported problem might be considered in 2 hours, 4 hours, and so on. As you would expect, faster response times cost more money.

- Organizations often vary the level of service plan according to the importance of the machine. Its not very cost effective to purchase a fast responsiveness for a machine used to generate low-priority reports. On the other hand, if those reports are used to schedule the organization's work force, keeping the machine up might be vital.

2. Establishing Current Cost Structure – Hard Costs

Server Maintenance

- Server maintenance costs should be a fairly easy hard cost to establish because the costs are directly associated with individual machines.

- It might be the case that the organization has a blanket plan that covers a large number of machines, but it should still be a fairly easy task to identify how much maintenance costs per machine, and you'll need to use those numbers as the input to your assessment of baseline costs.

2. Establishing Current Cost Structure – Hard Costs

Outside Services

- It might be that the organization engages an outside organization to perform services within your data center.

- In the current world where "outsourcing" is so popular, it's often more cost effective, or just simpler, to use an outside vendor to perform work rather than rely on internal personnel.

- If your organization uses outside vendors for anything associated with keeping its infrastructure up and running (for example, someone to run backups on your machines), you have outside services hard costs that must be assigned to the baseline cost structure.

- You might need to divide this cost of the service if it pertains to a larger number of machines than you're considering for virtualization.

2. Establishing Current Cost Structure – Soft Costs

- Now let's focus on soft cost analysis.

- Things get a bit more tricky with soft costs. Some system administrators will tell you trying to assign soft costs to a specific server is like trying to nail Jell-O to the wall.

- However, with some diligent work, you can establish quite closely how much your organization spends on soft cost items for the machines in question.

- Soft costs come in various forms, so let's focus on two primary soft costs:

  1. Machine administration

  2. Backups

2. Establishing Current Cost Structure – Soft Costs

Machine Administration

- Machine administration refers to the work done by internal personnel keeping the technology infrastructure humming along.

- This term typically includes system administrators, network administrators, and database administrators.

- However, your analysis should focus on those personnel directly involved with the machines in question and discount the personnel whose work will be unaffected whether the machines are physical or virtual.

2. Establishing Current Cost Structure – Soft Costs

Machine Administration

- For example, a network administrator who spends time ensuring that the machines can connect to the network efficiently does so whether the machines are physical or virtual, so it would make sense to leave them out of the baseline cost analysis.

- On the other hand, someone who spends time administering the hardware in a data center, e.g., moving applications from one server to another so that the original server can have parts replaced, performs duties directly related to the systems in question, and the costs associated with these duties should be included in the cost structure.

2. Establishing Current Cost Structure – Soft Costs

Machine Administration

- Many organizations have very little awareness of how much time internal employees actually spend on specific tasks and even less awareness of how much time is spent on those tasks for each machine in the data center. (The movie Office Space comes to mind here!)

- This means that determining the amount spent on machine administration requires some dexterity of judgment. You may need to consult with the actual personnel to develop an estimate of how much time people spend on machine administration per machine.

2. Establishing Current Cost Structure – Soft Costs

Machine Administration

- The bottom line is that it might not be easy to track machine administration costs with any real accuracy, but with a little effort, you should be able to create a rough estimate of the cost per machine for administration.

- Even a rough estimate is better than throwing up your hands and giving up.

2. Establishing Current Cost Structure – Soft Costs

Backup

- Backup refers to creating a secure copy of the data on individual machines.

- This can be handled in a wide variety of methods. The data might be copied to a tape that the administrator inserts, or by replicating the data across the network to another server, or even by sending the data outside the organization (a so-called "outside the firewall" backup) to a remote backup service.

- No matter what method is used to backup existing data, someone probably spends some time making sure it happens. It is the costs associated with this time that you need to track.

2. Establishing Current Cost Structure – Soft Costs

<u>Backup</u>

- Although a number of vendors offer software designed to automate the backup process, many organizations still rely on manual work by employees to either do the work directly or to serve as non-automated tape changers.

- As with machine administration, getting an accurate picture of the amount of time personnel spend on this activity can be difficult.

- You may need to determine the actual proceed used to perform backups in your organization and how often this occurs to get a more accurate cost associated with this task.

3. Identifying Virtualization Costs

- Once you've established the current cost structure for your as-is infrastructure, you need to identify the potential benefits and costs of moving to virtualization.

- This part of the analysis is in general more difficult and tricky that determining the current cost structure because it requires estimation rather than documentation.

- Nevertheless, to understand the complete implications of moving to virtualization, you need to know the financial impact of the virtualization scenario you intend to implement.

3. Identifying Virtualization Costs

- We'll focus on five primary areas of the virtualization project's potential costs:

  1. Selection of a virtualization deployment scenario.

  2. Identifying the new hardware requirements.

  3. Consideration of other physical equipment.

  4. Purchasing new software.

  5. Training employees.

3. Virtualization Costs – Deployment Scenario

Deployment Scenario

- The first step in estimating your after virtualization costs is to define the configuration you'll most likely install.

- There are many different virtualization products and many different potential configurations.

    - For example, will you have individual virtualized servers, or a virtualized pool of server, possibly including virtualized storage as well. The decision is not always easy.

- Despite the difficulties that you may face, deciding on what to implement is critical. Without a well defined configuration, you will not be able to accurately estimate the cost of moving to virtualization. Not to mention that most organizations would frown on project plans that are ambiguous about what will actually be implemented.

3. Virtualization Costs – Deployment Scenario

Deployment Scenario

- We'll discuss some of the issues involved with defining a virtualization scenario later, but for now will let it suffice to say that despite all of the benefits of virtualization, it isn't free.

- The organization will incur a range of costs as you move to virtualization, and it is important to recognize them and estimate them in your overall cost/benefit analysis.

- For what we're doing right now, the exact deployment scenario is not as important as identifying where the costs will be located, so we'll concentrate on that aspect.

3. Virtualization Costs – New Hardware

New Hardware

- Although virtualization is a very flexible technology and is capable of running on a very wide range of hardware, including repurposed hardware that may already be running in your data center, you might also want to employ the latest generation of virtualization-oriented hardware to host you virtualized servers.

- Some considerations such as use of Xen for paravirtualization (recall from the Introduction to Virtualization that this is lightweight virtualization that most likely requires guest OS modification to achieve high performance) will require hardware with the virtualization-enabled chips from Intel or AMD.

3. Virtualization Costs – New Hardware

New Hardware

- If you're going to implement a product such as VMware, that runs only on certain types of hardware, a hardware upgrade will again, probably be in order.

- Sometimes in this sort of environment, it is useful to create two (or more) versions of the cost/benefit analysis: one with new hardware (various levels and hardware) and one without (assuming all existing hardware will be usable in the virtualized environment).

  - Note, that newer hardware is generally more energy efficient, so some cost savings will be gained from the new hardware that will help to offset its cost.

3. Virtualization Costs – New Hardware

New Hardware

- You'll need to estimate how many servers you will require.

- The primary driver of how many machines you'll need is the distribution of virtual machines; that is, how many guest systems each server will support.

  – For example, if you're planning to migrate 20 current physical servers and don't want to run more than 7 guests on each physical server, you'll need three physical servers.

- Hardware is a hard cost, so the cost of the physical servers goes into the hard costs section of the cost/benefit analysis.

3. Virtualization Costs – New Hardware

New Hardware

- The cost of the physical servers can vary quite widely, depending on how you've decided to implement your virtualization infrastructure.

- If you've elected to repurpose existing hardware, the primary physical expense will be maintenance.

- However, if you're moving to new hardware that more readily supports virtualization, then initial costs will be higher depending on the servers you elect to purchase. (We'll deal this more specifically later in a spreadsheet example.)

3. Virtualization Costs – Other Physical Equipment

Other Physical Equipment

- Depending on the proposed configuration you've designed for the virtualized infrastructure, you might also decide to include other physical equipment to handle virtualized storage, such as a Network-Attached Storage (NAS) or a Storage Area Network (SAN).

- Any additional physical equipment is, naturally a hard cost and should be included in that area of the cost/benefit analysis.

- Software licenses might also be required to implement other physical equipment, so you may have additional hard costs in a new software section of the analysis.

3. Virtualization Costs – New Software

New Software

- By the time you've reached this point in the virtualization project, you should have a pretty good idea how many of your current servers you'll be migrating to virtual machines.

- Depending on the load they place on the underlying physical hardware, you'll be able to estimate how many virtual machines you can support per physical machine.

- In turn, that estimate will tell you how many virtualization software licenses you'll require for the project. This too, is a hard cost.

- Even, if you elect to use one of the free or open source products and thus incur no licenses costs, you may still purchase software maintenance, thereby incurring ongoing hard costs.

3. Virtualization Costs – Training Employees

<u>Training Employees</u>

- A learning curve is associated with beginning to use any new software product.

- Many organizations educate their employees through training classes to get them up to speed on the new software more quickly.

- If your organization is likely to take advantage of this type of training, the cost of the training should be included in the hard costs of the proposed virtualization project.

4. Identifying The Virtualization Project Benefits

- After you have defined the configuration of your virtualization solution and identify the costs associated with it, you can estimate the financial benefits that will be gained by implementing the virtualization project.

- Because virtualization enables multiple systems to run on a single piece of hardware, most organizations find that they can reduce their current cost structure by using virtualization.

- Since we're trying to develop an overarching view of what this virtualization project can mean to an organization, identifying the savings that are possible is very important.

4. Identifying The Virtualization Project Benefits

- There are two primary types of financial benefits that a properly implemented virtualization project can provide an organization:

  1. Cost savings achieved by not having to spend money that is currently being spent on existing infrastructure components.

  2. Cost savings achieved through more effective and efficient operations.

- As you might expect from our earlier discussions, these two types of potential benefits are divided among hard and soft costs.

- We'll look more closely now at the breakdown of these two categories.

4. Virtualization Benefits – Hard Cost Reductions

- As you migrate operating systems and applications from physical to virtual servers, you have the opportunity to run fewer physical machines.

- For every machine you retire, you save on hardware maintenance and power costs.

- If you've done a good job of assessing the current infrastructure of your organization, you will have a very good estimate of the costs directly associated with every machine.

- The following three areas should be your focus at this point as they will typically provide the most cost benefit achievable by the virtualization project: (1) reduced hardware maintenance, (2) reduced software licenses, and (3) reduced power costs.

4. Virtualization Benefits – Hard Cost Reductions

Reduced Hardware Maintenance

- Every server that has an operating system and applications that will be migrated to the virtualized infrastructure is a candidate to be retired.

- Even modest virtualization servers can support four or more simultaneous virtualized servers, you might be able to retire a number of machines from your present infrastructure.

- Part of calculating the current costs is identifying the ongoing maintenance costs for every machine; for every machine that can be retired, you can identify the maintenance fees that will no longer be necessary and add them to the cost savings.

4. Virtualization Benefits – Hard Cost Reductions

Reduced Software Licenses

- By moving to a virtualized environment, you may be able to realize a savings on the software licenses and maintenance.

- If your analysis indicates that this will be possible, you should include these savings in the potential benefits the project will provide.

- Be careful with this analysis however as many software vendors are still grappling with the implications of virtualization, so in the end you might not be able to show any savings at all, and in fact may even pay more!

4. Virtualization Benefits – Hard Cost Reductions

Reduced Software Licenses

- For example, if you migrate to more powerful systems, even if you aren't currently using all of the processing power for the migrated system, you may pay more for your software.

- The reason for this is that some software manufacturers charge by how many processors the underlying hardware has; if you're running your virtualized server on a four-way machine but using only one processor's power, with these software vendors you may be charged a license fee for a four-processor box.

- Don't be surprised if your software license and software maintenance costs don't show any savings due to virtualization.

4. Virtualization Benefits – Hard Cost Reductions

Reduced Power Costs

- When it comes to identifying the potential power saving, the process is straightforward.

- Each machine should have some documentation about how much power it draws. If you don't have the documentation any longer (shame on you – you were supposed to keep it!), the manufacturer's web site probably will have the information.

- The documentation should provide several power measurements associated with various loads. Use the power draw level associated with the most typical load factor for the machines in your infrastructure.

- The next couple of pages illustrates this for a Sun Server X2-8.

Go to Oracle's site for the Sun Server line. I chose the X2-8 model which you can find at: http://www.oracle.com/us/products/servers-storage/servers/x86/sun-server-x2-8/overview/index.html

Once here click on the Power Calculator button.

Configure your Sun Server X2-8 and calculate your system's total power consumpt[...]

Try some different configuration values here and calculate the power demands of this server.

Sun Server X2-8 Power Calculator

Item	Quantity	
Processor	E8830, 2.13GHz, 105W ∨	Select Processor Type
Number of CPUs	4 CPUs ∨	Select Number of CPUs
Memory (32 GB DIMM)	None ∨	Select number of DIMMS per CMOD
Memory (16 GB DIMM)	None ∨	Select number of DIMMS per CMOD
Memory (8 GB DIMM)	None ∨	Select number of DIMMS per CMOD
Hard Disk Drives	1 HDD ∨	Select number of Hard Drives (Min 1, Max 8 Total per System)
PCIe Express Modules	None ∨	Select number of PCIe Express Modules (Min 0, Max 8)
NEM (Network EM) 8508A 2x10GbE, 2x SAS 2.0, 2x 1GbE passthru NEM	2 NEMs ∨	Select number of NEM (Min 2, Max 2)
FEM X4871A-Z Niantic	None ∨	Select number of FEM (Min 0, Max 4)
Indicate Workload (%):	100	Select Workload range (1% - 100%)

Calculate   Reset

Sample Results

Item	Active Idle Power	Sample Power
Total Power of System (Watts)	☐ (estimated)	☐ (estimated)
Total Power of System (BTU/HR)	☐ (estimated)	☐ (estimated)

Notices and Disclaimers

You MUST allow electrical and cooling headroom for unforeseen circumstances, component upgrades, and increased computational loads. Please allow for worst-case power conditions. Actual power consumption will vary from the sample workload used in the power calculator. These include, but are not limited to, the factors below. Each of these factors may cause significant differences in power consumption:

Sun Server X2-8 Power Calculator

Item	Quantity	
Processor	X8870, 2.40GHz, 130W ⌄	
Number of CPUs	8 CPUs ⌄	Select Number of CPUs
Memory (32 GB DIMM)	32 DIMMs ⌄	Select number of DIMMS per CMOD
Memory (16 GB DIMM)	None ⌄	Select number of DIMMS per CMOD
Memory (8 GB DIMM)	None ⌄	Select number of DIMMS per CMOD
Hard Disk Drives	8 HDDs ⌄	Select number of Hard Drives (Min 1, Max 8 Total per System)
PCIe Express Modules	8 PCIe Express Modules ⌄	Select number of PCIe Express Modules (Min 0, Max 8)
NEM (Network EM) 8508A 2x10GbE, 2x SAS 2.0, 2x 1GbE passthru NEM	2 NEMs ⌄	Select number of NEM (Min 2, Max 2)
FEM X4871A-Z Niantic	2 FEMs ⌄	Select number of FEM (Min 0, Max 4)
Indicate Workload (%):	85	Select Workload range (1% - 100%)

Here's one example with the server configuration at a fairly high-end and running 85% workload.

[Calculate] [Reset]

Sample Results

Item	Active Idle Power		Sample Power	
Total Power of System (Watts)	1560	(estimated)	2530	(estimated)
Total Power of System (BTU/HR)	5323	(estimated)	8633	(estimated)

Notices and Disclaimers

You MUST allow electrical and cooling headroom for unforeseen circumstances, component upgrades, and increased computational loads. Please allow for worst-case power conditions. Actual power consumption will vary from the sample workload used in the power calculator. These include, but are not limited to, the factors below. Each of these factors may cause significant differences in power consumption:

▪ Actual workload and its fluctuations

FEM X4871A-Z Niantic	2 FEMs ▾	Select number of FEM
Indicate Workload (%):	85	

Calculate

For the previous configuration, the estimated power consumption for the server is shown after you click the Calculate button.

This configuration draws about the same amount of power (in watts) as a typical hair dryer.

Sample Results

Item	Active Idle Power	Sample Power
Total Power of System (Watts)	1560 (estimated)	2530 (estimated)
Total Power of System (BTU/HR)	5323 (estimated)	8633 (estimated)

Notices and Disclaimers

You MUST allow electrical and cooling headroom for unforeseen circumstances, component upgrades, and increased computational loads. Please allow for worst-case power conditions. Actual power consumption will vary from the sample workload used in the power calculator. These include, but are not limited to, the factors below. Each of these factors may cause significant differences in power consumption:

4. Virtualization Benefits – Hard Cost Reductions

Reduced Power Costs

- If you've played around a bit with the power calculator for the Sun Server X2-8 server as demonstrated on the previous few pages, you probably noticed a fairly big difference in the idle power and the typical power when the server is loaded.

- This means that to get an accurate estimate of the power your existing physical machines consume, you need a fairly accurate picture of their average loading. (Notice that even an idle server still draws a significant amount of power.)

- Some organizations will actually place recording power meters on their servers so that they can have very accurate numbers relating to the power their server infrastructure consumes.

4. Virtualization Benefits – Hard Cost Reductions

Reduced Power Costs

- In the end, power costs can be reduced in two significant ways: (1) by retiring some physical machines and (2) replacing older less efficient machines with newer more efficient machines to serve as the virtualization platforms.

- If you use the 5:1 ratio (see page 10), the total power savings are the amount of power required to run four old servers plus the difference between the power draw of a single old server and the power draw of the new server.

- The next page gives a small scenario outlining the potential power savings of a virtualization project.

4. Virtualization Benefits – Hard Cost Reductions

Reduced Power Costs – Example Scenario

- Suppose you currently have 15 servers operating in your infrastructure. You decide to migrate all of them to new virtualization servers. Using the 5:1 ratio, you conclude you will need 3 new servers to replace the 15 old servers.

- You'll completely retire 12 machines, so you can add the power consumption of each of those machines to the power savings. In addition, you'll replace 3 of the old machines, with new, lower-power-draw machines. The power you save for these three machines will be three times the difference between the power requirements of the old machines versus the new machines, so you can add this number to the total power savings.

4. Virtualization Benefits – Soft Cost Reductions

System Administration Work Is Reduced

- Keeping a physical server up and running takes a lot of work. It needs to be monitored, have its hardware upgraded occasionally, and have backups run.

- In general, the effort needed to keep a virtualized server up and running is reduced when compared with a physical server. Some estimates show a reduction of effort in the 30-50% range.

- This is due primarily to the fact that hardware issues are reduced as you only have the host hardware to deal with.

- Also hardware system administration task no longer need to be done during expensive off-hours timeframes. (High pay system administrators do not work at 2am for free!).

4. Virtualization Benefits – Soft Cost Reductions

System Administration Work Is Reduced

- To further clarify the previous point, if the underlying hardware (the host system) requires work, you simply migrate the virtualized server to another piece of hardware at your convenience and work on the now-empty hardware at your leisure.

- Of course, the ability to migrate the virtualized servers requires additional hardware or existing hardware that can handle the additional load, so you don't typically want to have all your physical hosts running at capacity (nor your virtual servers either for that matter).

4. Virtualization Benefits – Soft Cost Reductions

<u>Soft Costs May Require Estimation</u>

- Estimating the reduced work necessary due to virtualization can be difficult since you don't actually have the environment yet in operation and thus cannot be 100% sure that your estimations are accurate.

- For this reason, soft costs are almost always separated out in cost/benefit analyzes like we're performing. In this manner you can easily incorporate estimates into the analysis but have them clearly broken out so that their impact is obvious. If any controversy arises regarding the soft cost benefits of the virtualization project, they can then be easily set aside so that you can focus on the other considerable benefits of virtualization.

5. Creating The Spreadsheet

- The culmination of your work in the first four parts of the project analysis takes the shape of a detailed spreadsheet that will clearly illustrate the costs and benefits of your proposed project.

- We'll look at the details of this final step of the cost/benefit analysis in the next set of notes.