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Assignment 7

Prepared For:
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Core Findings:

- Virtual adoption is not “if” but “when”
- Industry treating technology like hype
- Platform potential is truly unbounded
- Timeline driven by Management Tools
- Pervasive Multi-sided Platform
- Disruptive Tech will tip market balance
- Unparalleled Business Agility
- New frontier for ERP, CRM, SCM, etc.

Core Barriers:

- Complex implementation
- The Open Source Question
- Difficult to determine ROI and TCO
- Media Hype about wrong part of technology.
- Mixed implementation history
- Security and Compliance Questions

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Virtualization: The Undiscovered Country

Motivation:

*As the technology leader and I.T. management visionary of your company, you have to strike the delicate balance between ensuring your organization has the needed resources to execute on its strategic and business strategies decisively and keeping the business units fully leveraged in technology enabled processes that will help them maintain your companies competitive edge. At the center of all this is your management team, the core of your operational and tactical process. The stakes couldn't be higher, because the decisions concerning the **who, what, where, and how** are just as important as the **when** in terms of technology infrastructure you choose to implement. The server technology has finally afforded the necessary computational power to handle functional requirements, but now something unexpected power costs of the grid have sky rocketed, more servers are just not the answer because facility costs already are starting to gain noticeable percentages of your quarterly expenses. What technology is going to help you capture the internal needs of your business units, and respond also enable the company to estimate the market place environment and future I.T. demands for the next quarter, let alone the next several years. Are you using the best tools to get the job done? Your team of highly motivated technology decision makers and experts can model and capture the true benefits and costs of implementing anything out there, except this.*

Virtualization.

Is it the next revolution to deliver the disappointing promises of last year's SAAS architecture, or is it truly the realization in today's emergent terms, representative of the convergence of years of separate technologies blended together in a package that will allow your organization support the company as it expands market share, innovates processes to meet demand that is beyond the horizon, and help move your I.T. organization to the next level of efficiency so you can start leading the corporate technology wave instead of just riding it?



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IS Issue Discussed in the Information Space

How do CIOs and technology decision makers model and capture the true benefits and costs of implementing all or part of a virtualization solution matrix and what are some of the major strategies and issues that are core to adopting a virtualized infrastructure?

The Return on Investment (ROI) metric and the Total Cost of Ownership (TCO) models are traditionally the primary measurement that was developed by the Gartner Group to help organizations understand how to estimate and control ongoing IT infrastructure costs, but ROI has the added ambiguity that it is rarely quantifiable in a standard way, because it is difficult to contextualize both obvious and non-obvious benefits and costs into a cognitive framework when there are a high degree of complexity involved. There are many suggestions for calculating ROI/TCO, courses in making decisions in a complex environment offered at universities or online, and many opinions expressed by vendors with vested interests in product adoption, consultants or “knowledge experts” who are looking to present themselves as fully aware of the “thought leaders on the leading edge” and to then be hired for your next project. However, the vast majority of people working in the information space are simply trying to objectively find the best method or a combination of methods and strategies that will measure the tangible and intangible returns associated with adopting virtualization technologies in their infrastructures. Though there is a significant history of this fundamental problem of over/under estimating for particular projects, the core benefit that any new technology will have in the enterprise is to execute the tactical and operational strategies of firm as cost effectively as possible, while still minimizing the risk and impact of various tradeoffs to providing the required service levels necessary in both short term and long term business and corporate strategic vision. Of all the infrastructure technologies in the modern information space, virtualization stands as the most probable to be a revolutionary in not only being conceptually straight forward, but also that it will provide its self-service basket of services with relatively minimum cost, that is if you were to believe the industry press about its potential and capability. However, the reality of the landscape finds that the actual delivery of that promise is certainly proving to an elusive outcome more times than not.

Normally, firm managers use the TCO analysis which is a highly detailed attempt to gauge costs of a particular project over a given time period, while ROI analyzes the return on an investment in terms of its current monetary value or the monetized value of the benefits provided by a project. However, by that definition, ROI is subject to a high degree of subjective context, and many times can be analogized as being similar to the economic concept of “utility”. Executive managers must have a clear understanding of the specific requirements they would like virtualization to meet, or they will fall prey to scope creep or other similar issues, because virtualization as a platform, framework, and methodology is truly useful in almost every facet of the business model and strategy.

A common practice of implementers is to correctly select the most beneficial use of any particular trend and evaluate it thoroughly by comparing TCO estimates for implementation and ROI for long and short term benefits. However, virtualization is unique in that it is a matter of timing, secondary technology development, and sophistication and proliferation of several trends, and a child of many parents. Virtualization is prone to miss categorization depending on

the perspective outcome you wish you achieve in your enterprise. Especially since virtualization is so flexible and slippery to neatly define it has proven a more daunting challenge to capture and articulate the ROI/TCO traditional framework of thinking. To further complicate the story, each part of what is known as “virtualization technology” is also part of an evolving landscape of complex solutions that are being discovered and put into practice constantly by the market leaders, developers, and spans almost every industry. Virtualization by itself is not the panacea for providing competitive flexibility and cost reductions, but rather a facilitation technology that enables great changes and potential for organizational infrastructures really meet the demands that are placed on it.

Schisms in organizational stakeholders have lead to interesting and particular opinions that the payoff for the massive realignment of the TCO/ROI thought process surrounding virtualization and the potential benefits are simply techno-hype by the media. In every constituent group supporting a particular “camp”, be it Linux, Unix, or Windows, distributed, centralized, or ERP based, each believes that the true value of virtualization cannot be implemented in the enterprise space without the full understanding of the nuances of the underlying technology that drive the innovation, but more specifically that it must satisfy each groups core disadvantage.ⁱⁱ Without a doubt, the underpinning technology that gives virtualization it’s truly revolutionary impact is not because it is primarily thought of as a platform and a framework that has multiple complex components with each one at various stages of development. It is more about the fact that it’s simply more difficult for managers to accurately project the ROI/TCO for these projects or qualify and quantify the “value” the various potential uses of virtualization can bring to whatever size organization under consideration. Most questions in the industry are currently centered around choosing either a full implementation of the virtualized infrastructure, (a radical clean slate), or to use the traditional method of incremental adoption, to gain advantages for both previous investment in production software and hardware architectures, while gaining the marginal competitive advantage of the emerging capabilities development landscape which is where virtualization currently resides.

However, virtualization is a foundation technology. Many decision makers do not fully understand the nuances required first before attempting to use older implementation estimates and methods many times to ruinous results. As a result, the adoption curve has slowed significantly as decision makers have opted for a “wait and see” approach, until new developments in the virtual technology stacks are released or after several years until a critical mass of adoption is achieved. These managers are watching the primary vendors begin to offer virtual machine (VM) enabled solutions to their core product lines such as SAP, ERP, etc. before even considering the technology. Normally this would be a very smart common-sense approach, however, in the case of virtualization it exposes the company to potential disadvantage in order to time eventual switch from waiting for adoption critical mass to move to active production in the current competitive environment. Time of money and businesses that wait in today’s global marketplace are apt to miss the next point. , thus it’s a risk that can be very dangerous if not a disastrous proposition as adoption costs in market share, strategic impact, and viability will rise precipitously the long they wait to enable their enterprises both large and small.ⁱⁱⁱ

The most daunting challenge evident in the various trade journals and informal discussion blogs indicates that mostly it is the cost in training, new supported hardware, retooling business

processes and the unanswered support questions about the emergent technology makes the decision to adopt even the modest forms of virtualization in the enterprise a difficult sell internally. The fact that the over/under estimation of resources traditionally is a fundamental problem for every new project estimator will make.^{iv}

Technically, it is true that virtualizations return to the forefront of discussion has unfortunately been a bit too “hype” driven over the last 4 yrs. It was originally slated to be the basis for the SOA and SaaS implementation of 1999-2003, but technological and patent issues, and the difficulty for companies to tool up the software development expertise to service their custom needs prevented the widespread adoption. It turned out that most of the fervor in the industry was based on the broad assumption of virtualizations capability to deliver on the core promise (value proposition) of massive cost reductions and easy extensibility, and thus achieve new business process flexibility to mold to any firm or enterprise solution, without the necessary buy-in from the major hardware and software vendors specializing in industry specific solutions.^v

Virtualization now has the advantage that server capacity and performance has reached a tipping point. For the first time, server collective performance outstrips the functional requirements of the need it serves. Simply using clustering technologies, now a mature technology to aggregate a large number of servers smaller and smaller form factors to scale in computational power, is outstripping the demand on them. Aside from a few select instances such as network intensive services and database operations, all other functions are easily handled by even a modest blade server cluster. It is through the use of this extra capability of servers, that virtualization creates an abstraction layer which separates the physical hardware layer from a logical layer through a foundation technology called the Hypervisor. The Hypervisor allows virtual machines (VM) to be created in the logical (collective memory) layer that is thus created. This simple but powerful concept gives organizations a certain degree of independence from developing business processes and services that use to not be possible because of the required impact of adding one more server to the data pool, or because of a limitation in the OS or the capability of particular hardware.

Since virtualization software can support almost any operating system or any hardware platform provider via an interface module called the Virtual Machine Monitor (VMM). The VMM spawn and distribute VMs on one or several machines “virtually” inside the memory of the server “pool”, and create the environment that the new virtual machine runs in. All operational aspects can be specified and custom designed, limited, or isolated as if it’s a single standalone server or a group of servers, all from the single command point. However, virtualizations independence doesn’t come without a price. Lack of technical support or the threat of it by a firms business software vendors, has always been traditional bulwark-leverage tool these service software firms have used to enforce their market power against adopting or switching to competitors, and virtualization technology providers are no different. Should an old application prove incompatible with the virtualized solution that a firm installs, service software venders are freed from the bounds of SLA contracts and thus the investment in the technology becomes null. Similarly, virtualization vendors customize the Open Virtual Format, (the de facto industry standard); with their own proprietary APIs which again create vertical single vendor dominated technology stacks.

Another barrier for adoption is that there is no specific international standard for the Hyper-Visor layer or any other tools or components required to support the virtual architecture other than the open source OVF standard which was developed by VMware Inc. Several companies have developed unique APIs and capability to support their particular flavor of virtual products as a result, which further complicates the decision for enterprise managers. However, the platform and framework of a virtualized enterprise (large and small) creates a new operations layer market, and through market dynamics a highly competitive landscape where existing software providers with extensive development expertise in the monolithic architecture are rapidly shifting over production teams to convert their software to support the application in a virtualized environment.^{vi} In the information space, implementers are looking for other models to base their decisions or gain insight to handle the many ambiguities associated with the new technology such as previous market attempts to implement these blanket concept technologies.

The Software as a Service (SaaS) market has been another business model that offered “virtualization-like” market uses, with a larger distributed resources of companies such as Google, Yahoo!, MSN, etc., who are offering to create “resource clouds” for a subscription fee. *IEEE Internet Computing* offered this description of the cloud computing model, “Cloud Computing is a paradigm in which information is permanently stored in servers on the Internet and cached temporarily on clients that include desktops, entertainment centers, tablet computers, notebooks, wall computers, handhelds, sensors, monitors, etc.”^{vii} The proposition of outsourcing the core of your business infrastructure was both innovative and frightening from a business integrity viewpoint.

Companies that engage with cloud vendors, they technically “outsource” their entire datacenter and support staff to web-enabled, hosted applications in the spare computational resource capacity of the huge network server clusters and dedicated hosting companies. Search firms, for example, see the added utilization of their spare capacity as a way to increase utilization rates and thus increasing their marginal revenues as a secondary revenue stream not associated with their core business, while enterprises would benefit from no longer having to provide any of their IT functionality themselves. Salesforce.com is a notable example of a company attempting to use this business model exclusively, but it appears to only work, because the Salesforce is hosted end-to-end for their specific business model, but requires significant management costs for developing control software to meet even basic compliance requirements.

Virtualization technology vendors on the other hand, can deliver a reduced scale version of the large external “clouds” vendors without distributing information and business activities external to the corporate control boundaries. It is then through localized corporate intranet services that firms mitigate the exposure of critical knowledge and data to what has been yet unproven technologies in these external “cloud” vendors. These localized versions of the resource “cloud” have the ability to run multiple virtual machines with heterogeneous operating systems, either side-by-side in isolation or sharing interconnections within a logical layer, to truly provide the functionality promised by the SaaS framework and implement control over the resources. Firms stand to gain significant business agility from the promised “on-demand service architecture”, while supporting the existing infrastructure investment in hardware, and the compatibility problems related to production software that was designed for monolithic operation in specific NOS, software, and hardware vendor solutions.^{viii}

Though many firm managers are experts and versed in a variety of fields due to significant technical training, advanced degrees, and/or significant experience, those experiences only allow them the ability to understand the operational parameters required to execute user-level applications on servers and workstations. In general, most technical managers are not equipped with the greater depth to understand the more detailed and dogmatic issues related to kernel-level application development, which virtualization really operates in. More importantly, these managers and engineers don't necessarily know how to handle the completely flexible offerings that virtualization can create nor do they have an understanding of the variety of normal and unknown costs grappling with the question of how to implement a virtual solution in their enterprise that will provide the ROI/TCO to justify the adoption expense and meet strategic needs.^{ix}

The ideal solution for handling the ROI/TCO problem would be a turn-key appliance or a complete package solution that is created using a menu like functionality, but that scenario solution has proven elusive. Conceptually, it should be very easy for virtualization vendors to simply ask for the functions a company would like to replicate virtually, and then provide a roll-out build with the entire package neatly aligned together and pre-tested. The fact that every company is unique is not being underestimated. It is a fact most organizations have a percentage of core functionality all firms share, and how virtualization will serve to meet these common organizational functions. The knowledge gap about virtualization in many first line managers and executive level decision makers is pandemic due to time constraints, lack of relevant objective expert commentary, and the time demands of maintaining day-to-day operations, not to mention the lack of objective and certified sources of objective information. The decision space is further complicated by the sporadic interplay of ERP vendors willing to forgo the extra profit margins for monolithic installations packages, and embrace the democratizing nature of virtualization that the technology gives to their customers, but traditionally are very heavy handed in their support for organizations that can pick services a'la carte.

Ordinarily, a decision maker who has a talent short fall can hire-in the necessary knowledge experts to execute a challenging technology or process. However, virtualization initiatives suffer from the same fault as wide spread open-source and Linux adoption in the enterprise in the past; principally, that its proposition has the requirement of being an all or nothing endeavor, and that the "abstraction" applications at the enterprise level have been scarce to support the granular knowledge required to successfully execute the "free" software distributions, with their risk profile for high legal ramifications and liability issues surrounding support and security failures, patent trolling, and sporadic development timeline. However, the virtual marketplace has experienced significant development and recent entrants of some significant players over the last 5 yrs. as soon as VMware open sourced its patent rights to the software virtualization market, or the Open Virtualization Format, (OVF).^x

Another significant barrier that companies are facing is how to manage and control the virtualization platform. Tool development companies are seeing opportunities to develop small, relatively low foot print applications, with a high likelihood of a company committing to enterprise wide adoption for the successful firm. The demand will only serve to continue in this area, but currently it is viewed as potentially short lived. Existing enterprise vendors in hardware

and software industry are fueled by both the raw demand of the current market, a desire to protect existing infrastructure products from this new potential threat, as well as to have the opportunity to dominate the next new paradigm market should it materialize.

However, it is understandable that software development firms don't want to commit to development as a huge initiative, but yet don't want to marginalize their current cash cows for a disruptive technology model that SaaS/SOA and virtualization uses. Historically, the virtualization market was a small but essential market dominated by a few long term and highly capitalized market players such as IBM, DEC, Unisys, offering hardware intensive high-entry cost products serviced by the professional hypervisor-based solutions. Now the same functionality as the old IBM and DEC models is present in less expensive, open, and offers all relatively the same functionality but with proprietary tools and features: VMWare ESX Server, Microsoft Hyper-V, Virtual Iron, Citrix XenServer, Red Hat Enterprise Linux, SUSE Linux Enterprise Server, Oracle VM and Sun xVM Server. Virtualization may prove finally be a motivating vector for Linux finally achieve significant enterprise class capability distinction for its flexibility, awareness, and low resource footprint in both the enterprise and SMB category markets, but it is not clear where which solution is better and the field is only getting more complicated.^{xi}

Virtualization Benefits: The Minuend

At this point it is well served to look at some of the key concepts that technical decision makers should consider when finding a solutions ROI for their specific application involving virtualization. Many operational functions can be incorporated into the ROI/TCO calculations used by enterprises large and small; however, the question of the best way to capture these individual promises of service is still highly debatable.

“Our conclusion was that without realism and objectivity in the cost estimating process, bias and over optimism creep into estimates prepared by advocates of weapon systems, and the estimates tend to be too low. Therefore, staffs who are not influenced by the military organization's determination to field a weapon system, or by the contractor's intention to develop and produce the system, should review every weapon system at major decision points in the acquisition.”^{xii}

The above paragraph speaks to not only the military organizations role in estimation that gets muddled by fuzzy thinking and bureaucracy, but rather it is the more general application of this principal of structured cost estimation that will help make a project a success. Successful project planning requires good cost estimating practices that capture factors that are beyond the prediction of the cost, effort and schedule for hardware, software or systems and make rational estimations of foreseeable use.

Most cost estimation processes appear to be tool-enabled processes and decision makers adopt a mindset that has to leverage the unbiased trade-offs between scope, schedule, and budget in order to provide all the information necessary to plan and manage the development deployment of complex systems. The following will consider how virtualization contributes to ROI/TCO:

Server Consolidation: For example, do you add for a continued cost reduction, every ten server applications that are run on a single machine that are spawned? It is a fair assumption when you consider that that application would have required its own server. However, the practical metric for measure would be to NOT include it, and just consider the activity in the utilization rate as an aggregate measure. Thus, the aggregated server utilization function can become the default measure of how effective a virtualized infrastructure compares to the traditional operations in the long run, and its flexibility is normalized across the functions that it supports, thus yielding a good estimate of the “service” value it provides. Using the TCO method, plus looking at the payback period, the internal rate of return, and the net present value are all concept borrowed from finance that would be useful for technical managers to think about.

Product Lifecycle: (server and services sprawl) Developers of new software can rapidly deploy and test multiple versions of software and there for enables rapid deployment by wrapping the application in a custom configured and tested controlled virtual environment. In today’s information space, new business services and features need to be incorporated and are requested of IT on a monthly, if not even a weekly basis. Server hardware have several known factors such as mixed libraries, hardware level drivers, and other peripheral applications and driver installations that are a large time expenses, resource drains, and many times can lead to a significant amount of organizational inertia (beyond the standard bureaucratic inertia that exists for many companies regardless). Existing technicians working in the data center are normally left in a reactive or maintenance status, and rarely can provide the needed feedback to the rest of the organization. As a result, an entire industry has arisen to support the army of people needed to maintain the physical layer. That leads to the observation that the computational capacity of a server, server farm, or grid cluster, is dynamic and that functions such as sunk costs, scale effect, profitability index and the unequal lives of hardware and software based on projected obsolescence should be considered when assigning weighting values for the life cycle.

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Capture the value of Dynamic Load Balancing:

As server workloads vary, virtualization provides the ability for virtual machines to dynamically shift computational resources of a server to be moved to underutilized servers. The dynamic load balancing creates efficient utilization of server resources, and smoothes out the operating cycle for the users, therefore providing a superior use of resource, but also provides users with a seamless instance of their application. Many times entire environments are rebuilt in real time, while users are connected to the session. Severe crashes that used to require painstaking expertise and costly downtime for reinstallation of the environments are now simply re-copied to another virtual image that is spawned, and begins executing the application from the hosted operating system in mid-process. Calculating the cost per man hour, vs. the installation and run time costs of the marginal server resource is a good surrogate to help capture the incremental benefit of the server. Taking this sum, you can then multiply the sum by the estimated growth potential of the company resources year over year (i.e. 15%) time a scaling factor of 2 to provide extra capacity which would then create a DLB Load Factor. This factor will help normalize the benefit vs. cost balance and capture a bit of the expected benefit normal business cycles.

Cost savings for Disaster Recovery:

Organization historical records are critical for firm operations and all firms need to create a plan that restores operations quickly in the event of a disaster or failure which is normally quite a

significant amount of capital expense. However, costs can be cut dramatically if the enterprise is willing to withstand longer periods of operations downtime. System crashes can create huge economic losses, preventing not only the transaction from being accounted for, and executed, but also by the fact that compliance regulations, government accounting rules now require better transparency for business processes.

In a virtualized environment DR is achieved through the deployment of network-attached storage and mirroring arrays and software from a specialized vendor. The software creates a virtual storage for our database and application servers. Thus all changes to the database are captured and sent in near real-time to the backup facility without impacting the performance of the applications. Those that use this shared-storage approach can also manage storage centrally, so that storage is bought on-demand. At the database level, the leveraging virtualizations logical partitioning technology, allowed to partition each server to look like multiple servers running multiple database servers thus sharing the capacity of the individual servers. One company, Transplace Inc., used the cost savings in the disaster recovery facility and the database server virtualization to run four to six copies of their Oracle database. A few were used for testing and development most of the time, but if an disaster event occurred to the main database, the development virtual servers would be shutdown, and a disaster recovery instance of Oracle on that same server would be instantaneously spawned. Therefore, the per unit CPU licensing costs were reduced as well as the response time in recovering the data in crashed databases.^{xiv}

One rapid adoption use of incremental use of virtualization has been to provide services to the enterprise such as fast access to data contained on tapes, and also a secondary effect of providing standardization of tape management tools and processes that lead to excellent reduction of costs. Thus, the efficient utilization and management of new tape technologies and capacities can deliver tangible and intangible benefits to the organization such as better managing and automating of key tape-related processes, the creation of broad strategies to mitigate risk, reduce TCO, address compliance requirements and optimize security and support. The TCO estimate for disaster recovery services estimations is very mature and highly reliable.

Virtual Desktops (VDI): As corporations become multinational, more enterprises are requiring the standardizations and procedural business controls to maintain business continuity. Multinational flexibility provides seamless transitions between different operating systems on a single machine reducing desktop footprint and hardware expenditure, and thus a company only has to invest in developing a single platform, that can be localized across the enterprise regardless of the location.

“Although the main benefits of VDI are with the employee as far as the flexibility to work from home, businesses experience some common soft benefits, such as employee retention and simplification of user desktop support. This is in addition to maintenance and operations cost savings, a result of not having to purchase and maintain employee's company-owned laptops or desktops.”^{xv}

Business Agility:

Currently, applications and processes are easier for organizations to conceptualize and manage when they are run using dedicated servers. This monolithic perspective results in low server

utilization rates across the data center and enterprise environment, and thus virtualization will help maximize the capacity on each physical server and by extension increase the return on the investment for current and future server budgets, but it is difficult to determine how or if the time benefit.^{xvi}

Since enterprises that utilize a virtual framework find it easier to manage the ever increasing complexity of the business needs and process environment that the market, new emergent competitors or technology shocks when they occur to the demands of the IT function, the benefit of that flexibility should be tied into the ROI/TCO estimation. The IT function needs to rapidly adapt to these shocks and desired changes in organization support by increasing profitability with a better ROI, and reducing the time for procurement, setup and delivery, and leading to the rapid deployment to full production capability of any system or process in a very short period of time, it's difficult to capture this Poisson-like demand when considering the adoption of a virtualized framework. Thus it is recommended that firms take a more marginal and incremental benefit approach to the ROI calculation, by adding into the benefit all of the costs and additional revenue that is generated from the services that are used, when they are used over a given period. Thus, using historical business cycles, it can be estimated that most businesses will experience 4-5 technology and process shocks per year. By estimating using probability of events changing they can get a rough estimate of the cost and benefit of the additional flexibility and depreciate that benefit over time as the other costs (support, labor, pricing, etc.) are normally fixed. This will give a good indicator when the technology benefit ratio is <1.0 that the infrastructure needs to be either updated or replaced.

Compliance and Business Continuity: One of the recent advances that virtualization software suppliers have responded to the industry demand is to create a new way for processes to have a permanence but leverage exceedingly lower cost storage media by the use of encapsulation. When a virtual machine (VM desktop/server/process) terminates, it leaves a footprint per se, or the entire system runs as a single file, which can then be archived, transferred or accessed by a new VM which can be completely different from the original VM system environment due to the standardized API for a particular hyper-visor. This additional complexity is abstracted from the users, and adds a significant level of business continuity through high availability and disaster recovery for critical production systems that can be deployed, transferred and redeployed, and so cannot really be adequately captured by either the TCO or the ROI reliably.^{xvii}

Incompatibility (Risk): An example of incompatibility is when organizations based on Windows are used to handling the hyped and mixed promises of installing the leading vendor's solution from Microsoft. However, by subjugating the NOS to a supporting role, a product like VMware ESX Server, (primarily using a Linux subsystem and interface), would appear to provide little validation for external applications that are not partnered with it.

“Risk identification, analysis and response planning. The primary manifestation of this is the risk register containing the identified risks, their probability and impact factors based on analysis, what trigger(s) indicate that the risk event could occur, who owns the risk, and what the response to the risk should be. It's also important to plan for periodic reviews of the documented risks to identify any new risks or changes to previously identified risks.”^{xviii}

Thus, enterprise server operability experts are dependent on a single solution provider once an organization converts to a standardized VDI from one of the vendors. The fact that organizations would not be completely sure of how their applications would operate in the virtual environment would mean that they would have to recertify every application in their arsenal. SAP and other ERP software providers are currently in partnerships with the leading virtualization vendors. The TCO Risk Identification Matrix does a very good job of handling the costs associated with these risks, and should be u

The Difference: It's the real question...

Current experts, even luminaries are also skeptical of the role and benefits that virtualization will provide:

“Virtualization has been around for probably 50 years. I forget when IBM started offering virtualization on their big hardware. Maybe not 50 years, but it's been all around for decades and it's very interesting in niche markets - I think the people who expected to change things radically are just fooling themselves...But also, I'd actually expect that the new form factor is in new input and output devices. If we actually end up getting projection displays on cell phones, that might actually change how people start thinking of hardware and that, in turn, might change how we interact and how we use operating systems. But virtualization will not be it.”^{xix}

A huge opportunity is being missed by the perspective of virtualization as being so short sighted by the viewpoint above. Further, if line managers, technical implementers and technical experts versed in a variety of other fields, can augment their existing through process to better capturing some of the ways that truly represent the ROI or the vaunted TCO be revisited to add for the complex flexibility inherent to the technology of virtualization, it is equally evident from the great number of expert opinions and various whitepapers stipulating the various solutions, that it will truly be a revolutionary technology. However, organizations that are waiting for the marketplace should actively engage in the debate and start incorporating the needed skill sets, organizational resources and strategic revision that having such a flexible solution would provide. Considering the nature of technology, the different trends surrounding central and decentralized control, compliance, security, and market competitive advantage sometimes being a small margin, it is imperative that organizations should implement the full infrastructure adoption of virtual technologies to truly be able to benefit from its promises. However, the inputs for traditional ROI and TCO perspectives are no longer so linear nor so sequential and incremental. The better question is asking how to quantify the value of the virtualization technology, beyond the first level advantages of immediate cost savings related to server consolidation and management in the long run, but in terms of the business agility and the long term deployment scale that a company would want to achieve in its strategic vision.

Finally, as is with any estimation, the longer amount of time you expect to have your estimate remain valid is inversely proportionally less accurate your prediction will be. The sheer magnitude of information that must be taken in to quantify virtualization ROI, such as how do you quantify a return that is truly capable of both vertical and horizontal technology stack support, is arguably a daunting task. By taking several of the concepts presented, honestly

addressing what exactly virtualization offers in terms of the benefits, the costs, and the results from the interplay of the two, virtualization technologies will be the multipurpose platform, infrastructure framework, and cognitive perspective that implementers will have to take to achieve the scalability and the degree of control required. Aside from the previous perspectives on impact to the infrastructure, the only market that implementers can watch is the virtual control and management tools market. For that is the last lynch pin left preventing firms from really adopting the technology as the dominant and only way that businesses will transact in the future.

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