

# Enterprise IT Transformation

*Changing the IT Game from the  
Data Center to the Board Room*

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## **Executive Summary**

The Information Technology (IT) enterprise is a vast landscape of people, products, processes and policies that outline the best path for applying technology to achieve business strategy. This effort requires vision from the organization's leaders, talent from the technical staff, cooperation by suppliers, commitment to customers and openness to change by everyone involved. Successful commercial companies understand the impact that IT can have on the ability to support the business and are committed to making changes that reflect this understanding. Within the Federal Government space, the challenge is no less demanding or necessary as budgets shrink and requirements grow. Blending the best practices of for profit commercial world with the public trust of the government world requires a new approach to handling the IT enterprise.

The technical cornerstone of this approach is the transformation of the IT infrastructure to more closely follow the "cloud computing" paradigm of leading commercial companies. As the reliance on IT grows, the increasing demand for systems, tools, data and services is driving the O&M costs for IT Data Centers to unsustainable levels. To meet the challenges we face in the presence of ubiquitous, global mission needs we must re-engineer the way we grow and support the enterprise's IT infrastructure. By carefully realigning both the strategic and tactical goals of the enterprise with reconfigurable IT capabilities we can provide a sustainable lower cost alternative to current IT data centers. These concepts, when balanced throughout with full regard for security and risk mitigation, provide a new architectural paradigm that provides for reduced costs and improved capabilities through measurable, highly integrated, autonomous, service oriented system building blocks.

However, technology alone is not the answer. Bringing technology to bear against the strategic business objectives requires a calculated, measured and determined approach to enterprise governance. Achieving this governance requires a commitment on the part of the senior leadership to grant the power to the CIO to make decisions that define expectations and verify the performance of the IT solutions with regard to their support and sustainment of the business objectives. Solving the problem requires tearing down any internal culture that is resistant to change, breaking through organizational politics, and de-conflicting the myriad of priorities that compete for the finite set of resources available to support the enterprise. The CIO must be the chief advocate for change as organizations move from simply automating ways of doing business to creatively changing business processes to optimize the application of people, networks, systems, data, facilities, processes and policies that support the depth and breadth of the organization's mission.

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## Introduction

Transforming the IT enterprise is widely recognized within the commercial market space as a necessary part of positioning organizations for long term competitive success. This same goal is applicable to the government space to build organizations that can maintain the public trust while fulfilling the mission in light of budget reductions and growing global commitments.

Accomplishing this goal of transforming the IT enterprise follows a three pronged approach. The first is the establishment of a strong governance program under the leadership of the CIO. The second is the evolution of security from a separate component to an integral part of the people, networks, systems, data, processes and policies that define the way the organization operates. The third is the transformation of the data center to better support the service oriented concepts embodied by "cloud computing" which relies on consolidation, virtualization and ubiquitous services.

The role of the CIO has grown over the last decade from a focus on implementing IT to bridging the gap between technology and business. Today's CIO is tasked not only with bringing the right technology to bear, but also to understanding the implications that the use, or lack of use, of technology can have on the strategic direction of the business. Where the CIO once fell under the purview of the CFO as a function strictly of cost, the modern CIO is more closely aligned with the business aspects represented by the CEO. Given the nature of technology as a change agent, this elevates the CIO to a role as chief advocate for change within the environment. A strong CIO that leads through a carefully crafted governance policy is capable of bringing about change that maximizes the use of IT, while still meeting the fiscal constraints of the business.

But solid governance by a strong CIO isn't enough. Technology, especially in service oriented architectures, is all about sharing data across multiple network domains through accessible tools and flexible, adaptable processes. This sharing of data works against the traditional principles of security and risk mitigation. Moving forward, security must become an integral part of every aspect of the enterprise with specific policies that determine how security is applied to people, networks, and systems in order to drive sustainable, secure processes which support the time-critical nature of today's business environment.

Organizations today are facing both increasing operations and maintenance (O&M) costs and a flat or declining budget. This scenario is creating significant pressure on organizations to re-think the way they build and support the IT infrastructure. While we are mainly focused on our support to the Department of Defense and Intelligence Community, these same pressures are impacting the commercial work space. In response, the commercial markets have begun adopting new methods for coping with the change. These methods focus on re-engineering the data center and establishing a more flexible and consistent IT infrastructure. Much of the focus on service oriented architectures (SOA) is aimed at solving these problems. However, the SOA approach alone is not a magic bullet that can easily solve the issues. It requires a commitment at all levels of the IT stack to achieve the kind of savings that are necessary to bring O&M costs in-line with the expected budgets. These challenges are already being faced by large companies like IBM, Sun, and HP as they compete for business in both the commercial and government spaces. These companies are creating products that reduce not only the cost of operating the data center, but also the overall cost of supporting the user base and sustaining the portfolio of

systems and applications critical to meeting the businesses key objectives.

This three pronged approach seeks to provide the governance, the technology and the security to ensure that the enterprise's IT infrastructure is mated with efficient, repeatable processes to deliver increased services at the lowest cost to the widest audience.

### **Purpose**

This document starts by outlining a transformational approach to designing, managing and sustaining data centers and the enterprise IT infrastructures they support. It builds upon the ideas and concepts presented in the introduction to provide high-level strategies for accomplishing the transition from the current approach to a sustainable and affordable service oriented approach resulting in a "right-mix" technology base. The paper then discusses the role of the CIO in taking this technology base and applying it to the business objectives to produce the resulting enterprise IT solution. All along the way we also highlight the need for security as a integral part of the final solution.

### **The Data Center Problem**

The core of the IT enterprise is the data center, which in most cases is an amalgam of IT systems, support personnel, and infrastructure linked together by various policies and procedures to produce a facility that serves multiple purposes at once. One flaw in this plan is the need for the data center to support more than the core IT hosting services it should. Data centers become development shops where a never ending flow of developers, engineers and technicians stream in and out to constantly massage the very nature of the facility. By re-orienting our view of the data center with a focus on automated, lights-out operation, we can go from an operations center look and feel to an autonomous data center that can meet the sustainability requirements imposed by shrinking O&M funding levels. This paper supports the philosophy that a data center should be a home for IT services and nothing more -- no development, testing or quasi-production setups; just mission critical, production ready applications and services that are designed from the beginning to live in a center that operates with minimum human involvement. Removing the support staff may seem counterproductive at first, but the simple fact is that we need to redefine the way we develop applications and services in the government space. Moving beyond using the data center as a developer playground requires a disciplined approach to re-engineering not just the facility, but the methods and processes by which services and applications arrive at the facility. It also enforces a test and deployment discipline that improves security through fixed, controllable entry gates and rigorous application of data governance.

Another huge issue for government data centers is the growing need for cross domain operations. With war fighters and coalition partners operating on SIPRNET and the intelligence community operating on JWICS, the need to move data between domains is driving increases in the total number of systems that must be deployed. The typical approach is to deploy the same system two or three times and then connect them via guards or one way links. This method compounds the facility space problem, creates the need for additional software licenses and ripples throughout all levels of data center support structure. A better approach is needed. By careful and consistent application of emerging cross domain tools and technologies we can gain control of the situation and begin to solve the data center headaches brought about by the cross domain need.

Today's data centers still face the problem of supporting 'IT silos' (systems that are designed to operate by themselves, bringing with them every service they require and operating as islands within the data center). These systems create additional demands upon the support staff and they eliminate any possibility of realizing the potential savings associated with shared resources in a service oriented environment. Breaking down these 'IT silos' requires a new discipline by program managers, developers, and facilities planners to redesign and reorient these systems to create a portfolio of services that offer the flexibility to adapt to changing mission needs.

We are all too familiar with the pain of operating in current data centers. Power is carefully regulated, cooling and heat management is barely sustainable, space is at a premium and many have resorted to using data center task forces as a checkpoint for any system trying to enter. Solving these problems requires a new approach to how we establish and operate the data center. It requires a transformation in the way we plan, develop and support the applications and services our customers need. The need to drive down costs and build sustainable data centers is a reality we cannot avoid. Getting there means changing the game in infrastructure operations and maintenance.

### **Top Level Solution**

As with any transformation, a price must be paid to move forward and reinvent what is the foundation of any organization that relies upon IT technologies to satisfy core business needs. This transition cost, while significant, is designed to drive down the long term costs and provide a sustainable infrastructure that can still grow to meet the business needs. The key concept to remember is that there is no magic bullet or quick fix solution. Adopting a new paradigm requires changes in the physical structure of facilities and networks, changes in policy and procedures, changes in the philosophy by which applications are designed, changes in how support personnel are trained, managed and retained, and changes in long standing corporate traditions.

The future of the data center is a much more automated and focused environment. It's a place built with service management, security and consistency at the forefront. Leveraging concepts like the Information Technology Infrastructure Library (ITIL), adopting new technologies to improve cross domain data sharing, and transitioning to service based solutions are all part of the equation. Many aspects of the new data center are simply refinements of the old. Other areas require more far reaching changes. And in all cases, the solution requires each participant to come to the table with an open mind and a willingness to solve the problems. There can be no 'sacred cows', no turf battles, no 'not invented here', and no perpetuation of the problem to sustain a revenue stream. The end goal is to build data centers that can support themselves to the maximum extent possible and provide consistent, reliable, customer focused IT services across the enterprise.

### **Re-engineering Approach**

The re-engineering approach consists of four key areas. Each area brings a new potential for driving down costs and expanding the self-sufficiency of the end design. The four areas are: Hardware Reduction, Software Optimization, Metric Driven Processes and Integrated Service Management. Within each area, we must be mindful of security and apply IT best practices to

achieve the required levels of quality and consistency. We must also move toward true Service Oriented Architectures (SOA) that create user-focused applications from a flexible, scalable and secure set of IT services.

### **Hardware Reduction**

While the applications and services are the visible products of the data center, it is the hardware platforms that make the center possible. Reducing the cost associated with the hardware systems is a key step to creating a sustainable data center. The two most promising methods for this reduction are server consolidation and virtualization.

Today's data centers are suffering from a number of problems that make their future sustainment questionable. Deployment of servers for each project or application have driven the need for HVAC and power beyond what most facilities were ever intended to support. In the last few years, the move to high density data center design has reduced the floor space crunch and resulted in a higher demand for power and cooling. The trend toward ultra-high density will only compound the problem. Added to this is the drive to create “green” data centers that are more environmentally conscious and the complexity of the problem multiplies.

Fortunately, there are steps that we can take related to the IT infrastructure within the data center that address these issues. It is hard to envision a truly “green” data center when you consider the resources consumed to handle the power and cooling loads. Even with low power servers and careful energy management, data centers can only go so far. Once we get past these basic steps, the task turns to making what is in the data center more effective. This takes a careful study of the business needs and a plan for consolidating services and applications and optimizing the hardware baseline to achieve a net reduction in the total number of servers that are required. This optimization provides a logical plan for reducing the overall cost of the systems that we deploy.

#### ***Server Consolidation***

Server consolidation focuses mainly on collapsing vertical application stacks. What we once called “stove-pipe” solutions that come with their own dedicated servers. Unfortunately, most IT projects come with a long list of system needs that require additional servers to be deployed. Something as simple as a new web based application will invariably require the deployment of a new web server, instead of using an existing server. Overcoming the mentality that each application must have its own set of servers is the first step.

Every server that can be eliminated from the data center reduces the overall power and heat load that must be supported. While most people can support the idea of reducing facility resource needs, the idea of drawing down the number of servers in use seems counterintuitive in a world where increasing capability is constantly demanded by the user base. Fortunately, we can use the examples set by the storage and network subsystems to see how consolidation works. Instead of a stack of disk drives in every server, we have moved toward a consolidated approach that relies in storage area networks (SAN) and network attached storage (NAS) to support data storage needs in a more scalable manner. These same methods can be adopted to effectively reduce server counts and still provide increasing computational and storage services. Blade servers and multi-core processor technologies provide increased capability in fewer system chassis. These systems can sustain multiple applications at once, thereby reducing the total number of servers required. Smart planning and accurate load metrics from the application

developers make it possible to deploy and support more applications across fewer physical servers.

Unfortunately, this transition can be hampered by the fact that many business processes are directly tied to the underlying IT infrastructure. This can make it difficult to simultaneously host multiple applications on a single set of hardware. It requires that applications be re-written to operate in a shared server environment where the application developers do not assume full use and control of the entire server. While application rewrites are expensive, they are a necessary part of retraining the developers and moving toward true modular design. The process has to start somewhere and it will also offer an opportunity to correct deficiencies in the original designs.

In many cases, the redesign of the application is a fairly straight-forward task. In other cases, it can be deemed too costly for the long term benefit to the organization. In these cases we can turn to virtualization to support our consolidation needs.

### ***Virtualization***

Server virtualization is a process by which the physical hardware is abstracted from the user's viewpoint and a single server is made to look like multiple servers. The three most common methods of achieving this are to create virtual servers, create para-virtual servers and to implement Operating System level virtualization.

True virtual servers use a host/guest concept where guest servers that mimic the actual hardware are presented to the applications. The host server uses a virtual machine manager to keep track of each guest and to provide it with the necessary resources. The VMWare products are well known examples of a virtual server technology.

Para-virtual servers operate similar to the true virtual server except that they alter the guest operating systems code through a concept called porting. The basic operation is the same as the true virtual server, but with a few more restrictions on the flexibility of the guest operating system. The Open Source product XEN is an example of a para-virtual server technology.

The Operating System (OS) level virtualization takes a slightly different approach. Here the OS provides multiple copies of itself to each application. Each copy of the OS is a self-contained instance that provides all the same services and functions as a normal non-virtual server. The biggest restriction under this method is that all applications must run on the same host OS. Solaris Containers is an example of an OS level virtualization product.

Regardless of the method chosen, virtualization can provide a transition path for consolidating applications that assume they are the only application on the server. Virtualization has a cost in terms of raw performance since it requires some level of system resources to track and manage the various virtual servers. However, virtual servers can also stop and start applications as they are needed, so that more resources can be focused on the current needs. Applications that are used infrequently can be “turned off” or shifted to other servers to help balance processing and storage loads across all the servers in the data center. Even simple solutions like virtual web servers running under the same Apache instance can provide benefits. Fewer applications on fewer servers reduce the administrative burden. It also eases the development of transition plans COOP plans and service restoration plans.

## **Software Optimization**

The cost of IT software is a considerable part of the operations and maintenance costs in any organization. Once the software is purchased, it requires time, personnel and money to support its continued use. Patches must be applied, license fees must be paid and updates must be planned for and completed as the products evolve. Some of the same consolidation goals we looked at for servers can also be applied to software. We need to shift our view of software to look at ways we can economize on the type and quantity and reduce the overall O&M footprint. Three key ways to accomplish this are through GOTS/Open Source solutions, reducing COTS licenses and improving cross-government sharing of software development and support.

### ***Open Source Solutions***

One question we face is how we can use Open Source and GOTS solutions effectively in the government space to reduce software licensing and maintenance costs. Many people like to present Open Source as a free alternative, but this simply isn't true. It always requires an investment in human capital to implement any software, including Open Source and GOTS solutions. In most cases, software doesn't load and configure itself, and it can't automatically define the best way for it to be integrated into existing systems. Engineers, system designers, administrators and users all need to be involved to achieve a successful software deployment for the initial deployment. While it is true that there are software management tools that can be used to automate multiple deployments, the process always starts with an engineering and integration effort. Furthermore, all software requires out-year maintenance costs.

When properly managed, Open Source and GOTS products can provide cost savings in terms of initial purchase cost and out year maintenance. These cost savings are generally reflected in a lower software purchase costs, in many cases free, which is offset by the labor required to implement. It isn't always the case, but in certain scenarios, the labor cost to implement an Open Source or GOTS product can come in less than a traditional Commercial off-the shelf (COTS) purchase. Like with COTS products, once the implementer has been through the process once, successive engagements cost less due to the reduced time to implement. Building a capability within the organization to handle Open Source or GOTS deployments can add a strategic, long term benefit to the organization; especially when you consider that Open Source and GOTS solutions rarely require development licenses. Open Source can be a viable alternative for proto-types and other rapid deployment scenarios and GOTS can provide savings for multi-seat builds.

The out-year licensing fees can also be an area where Open Source and GOTS solutions can create cost savings. The average annual licensing fees for COTS products are in the 15-18% range. This means that each year you can expect to spend 15-18% of the initial purchase price to maintain the product which would include patches and updates that are released by the product vendor. Balancing the cost of licensing fees against the labor costs associated with GOTS or Open Source can create a cost savings when dealing with mature, stable products.

### ***Lowering COTS License Costs***

When the software choice is based on COTS, the question becomes how to use the same COTS products across multiple projects. This philosophy goes hand in hand with server consolidation and virtualization to create resource pools instead of vertical cylinders for each project or application. In effect, multiple applications share the same database or web server to

reduce the total number of licenses that must be purchased. For COTS products that rely on processor based licensing this makes a great deal of sense. It maximizes the use of the software and provides the lowest resulting software licensing costs. However, it requires application developers to build applications that can run as components within a larger infrastructure and not as self contained little worlds. Application developers need to build applications that can take advantage of the available software resources that already exist instead of bringing additional copies online. This is more than just building a standard set of software packages that developers can choose from. It requires a discipline and focus to build applications that are modules within a larger context. Just because you have an enterprise license for a product, doesn't mean you should deploy multiple copies for each application. Applications need to make use of services and software that already exists. System integrators need to build solutions that co-reside with the solutions that other integrators are deploying. This means that the 'not invented here' syndrome must be eliminated.

### ***Cross Government Sharing***

In terms of the development, deployment and support of Open Source, GOTS and COTS products, the Government has the defining role in reducing the associated costs. In many cases, the simplest solution is the divestment and diversification across multiple agencies and programs. Unfortunately, Government agencies compete against each other to produce the same solutions. This duplication of effort has a significant impact on the overall cost of any solution. Instead of acknowledging the success of another program, agencies look to "one-up" each other. The focus must shift to looking at how multiple agencies can collaborate to save on GOTS, COTS, and Open Source solutions. All O&M budgets are shrinking. While there are many differences in the way each agency operates, there are significant similarities in the way their IT infrastructures operate. There has to be, since they draw from the same pool of commercial companies that are engineering and producing the products that form the core of the IT infrastructure government wide. Everyone faces the same needs for secure, mission driven, distributed, collaborative computing environments. By resolving to share the support costs across multiple organizations, the Government can create a more robust software support base for the products it uses. By sponsoring and releasing code with commercial appeal into the Open Source realm, the Government can take advantage of lower cost code maintenance and enhancement efforts. The SE Linux project is a realistic example of how the government started an Open Source effort that is now being expanded and maintained by developers outside the Government funding channels. Yet the Government gets the benefit anytime these changes roll back into products it uses.

### **Metrics Driven Processes**

Metrics help us quantify the benefits from the IT infrastructure. But metrics are often limited to the measures that the IT staff needs to manage the servers and do not encompass the entire scope of the IT spectrum.

### ***Information Technology Infrastructure Library (ITIL)***

In the last 10 years, the use of the Information Technology Infrastructure Library (ITIL) has grown in popularity within the US. The original foundation of the ITIL can be traced back to early work by IBM researchers, but the efforts were organized into a set of best practices by the British Government in the 1980s. Since then, the ITIL has grown in use and is now being widely

adopted by US companies like IBM and Microsoft, by state governments (pioneered by Virginia and Wisconsin), and by the Federal government. ITIL is now in its third version and continues to bring a structured, ordered approach for applying best practices in IT service management. The result is a process infused with the right kind of metrics to drive continual IT infrastructure improvements.

In relation to data center consolidation, three of the five ITIL V3 core volumes provide key concepts that are critical elements of success. The Service Design, Service Transition and Service Operation volumes cover key aspects of service level management, capacity management, availability management, incident management, problem management and change management that must be addressed.

From an end user perspective, the service level, capacity, availability, incident and problem management areas are absolutely critical. These elements determine the metrics required by the IT support staff to effectively monitor the elements of the IT enterprise that users see. Service level management ensures that needed and agreed upon services are continually delivered to the customer. Capacity management allows for optimization of the service delivery by provisioning services according to the core business needs. Availability management includes all the traditional assurance technologies and drives the sustainment of services over time. Incident and problem management ensure that services are restored quickly and that the root cause for any interruptions in service are identified and rectified.

Switching to use ITIL can seem daunting at first, however, as a matter of practical application, these concepts are often already in play within most IT organizations. Stepping up to ITIL simply brings a more rigorous application across the entire business. For example, understanding how well we are doing by monitoring the systems and reporting the results is a critical component to any successful transformation. Organizations must understand the ROI for any spending related to the new way of business. Too often the metrics being collected are for internal IT users like the support staff, and not for the external IT users like the final consumer. The metrics focus on the availability of individual components within the infrastructure and miss the mark when it comes to reporting about the actual end-user services. In many cases, this is due to the fact that the IT group is responsible for the monitoring, and application developers simply hand off their creations and expect IT to know what to do to properly monitor and manage it. This approach doesn't work in a service oriented environment and ITIL helps apply best practices to overcome the issue.

Metrics derived by the IT team will invariably seek to present IT in the best possible light. While this isn't necessarily bad, it doesn't lend itself to the best efforts to capture key performance parameters that can demonstrate the success of the applications and services with regard to the end-users. Changing this model requires that applications be designed to report on themselves. Here is where the ITIL practices can be used to identify new design requirements for the application developers. For instance, as the developers pull together the application they must include indicators that signal reductions in capability, performance or reliability. It doesn't really matter if the servers and the software are running if the data being provided is only half-good because of a problem with some other part of the infrastructure. Understanding how all the pieces work together is critical to maintaining a service oriented architecture, and the IT department is not the best place to define these performance parameters. By employing the ITIL construct, we can get ahead of the game and start including the right metrics in the applications themselves.

From a funding perspective, changing the way we look at metrics puts the burden back on the application developers to identify what is critical to maintaining the services. This has a huge advantage in that it shifts the cost back to the development side of the house and not on the data center's O&M budget. The ITIL approach calls for creating standardized interfaces and exchanging data using structured methods like XML, so we can simplify the integration tasks when new applications and services are delivered into the data center. We also eliminate the need for larger IT support staffs with programmers and developers that build monitoring systems for every new component we add.

Self monitoring applications also lend themselves to automated methods of monitoring and provisioning. This ties back into the ITIL service level management practices. If an application can report that it is running in a sub-optimal state, then the data center management systems can react to make changes. Maybe the application gets moved to a different virtual server that has more processing capacity. Maybe a second instance is started at a different data center to split the load geographically. All these possibilities exist, but they require the applications to provide the necessary indicators. And that requires the developers who are working in conjunction with the end users to carefully define the key performance parameters of the application and then instrument the application to measure and report against these parameters. These become the external IT metrics that when combined with the internal IT metrics begin to build a holistic picture of how the data center and the IT infrastructure it supports are doing to satisfy the business needs of the organization. Similar examples can be found for the other ITIL areas we've discussed. Fortunately, most IT organizations are already using many of the best practices collected in the ITIL. What is lacking is a more consistent, structured approach to applying ITIL across the enterprise.

While not addressed in this paper, the personnel side of the picture also needs to be addressed. Most studies on data center efficiency are based on metrics related to the facility services of the center. Things like servers, power distribution systems, HVAC systems and the actual facility. A much closer look at the people side of the equation is in order. How we staff data centers has a huge impact on the overall cost. The financial management volume of the ITIL addresses each of these areas and provides guidance for establishing effective IT budgets that account for the entire picture.

Solid metrics, like those provided by applying the ITIL best practices, translate back into each improvement area. Knowing how servers and applications are performing from a capacity and availability standpoint leads to better decisions about consolidation and virtualization. Better capacity metrics allow for optimal use of software to reduce life-cycle costs. Accurate incident and problem management metrics helps create a more streamlined service support approach that improves the efficiency of the support staff and allows them to tackle additional tasks without increased head counts. ITIL change management practices help to understand and quantify the impact of changes to the infrastructure. The metrics provided feed back into the automated provisioning and management of the entire application portfolio.

### ***Financial Management***

Financial management is an integral part of any service management plan. Financial management links the cost of the operational aspects of the system with the finance and accounting systems. Systems must be built to capture and prepare financial metrics that relate the operation of the systems components and the offered IT services to the cost drivers for the

organization. Financial metrics to track the effectiveness of a data center re-engineering plan can be developed and implemented with the aid of an Enterprise Resource Planning (ERP) system such as SAP. When an ERP is configured to both capture cost elements at the appropriate level of detail and to allocate those costs to specific cost objectives, then it is possible to prepare and monitor the true cost of the current approach to data center operations, and the financial gains (costs savings or performance improvements) from implementing a restructuring plan. Furthermore, the systems can continue to collect these metrics after the re-engineering is complete to help identify the changing costs of the data center over time. This is certainly an area where the CIO's close ties to the business level drivers can bring balance to the cost equation. It also falls in line with the critical aspects of governance that the CIO office brings to bear to help drive decisions that align with user expectations across the organization.

The costs of operating a conventional IT Service Center include facility costs, hardware purchases, software costs, labor costs and allocations of agency level functions (for example, HR, legal, financial and management). These cost elements can be tracked through the ERP at a more detailed level. Facility costs can include physical plant depreciation, utilities (such as HVAC, electrical, water), maintenance and repairs. Expendable supplies include such items as IT equipment purchases (computer and storage hardware, minor repair and maintenance, cable purchase, installation and repair). Software costs include licensing fees, annual maintenance charges and the cost of special upgrades. IT labor costs can be tracked by person, by skill level, by function, by trouble ticket number or some combination of the above.

Traditionally, these financial metrics have been collected and provided through processes that are disconnected from the actual services delivered by the IT systems. By applying best practices like those from ITIL we can gain additional insights into IT processes. In many cases, these processes lend themselves to the collection of metrics about the systems and services that are provided by the IT infrastructure. Capturing these metrics and submitting them from the IT systems directly to the ERP systems we can bring new fidelity to the link between the operations and finance sides of the organization. For example, an IT service might capture statistics on its utilization rates. These statistics form a user focused metric that when compared to other services can identify the most used services in the enterprise. When we capture metrics about incident or problem management events related to this service we can more easily determine the value of the support costs relative to the service level agreements for the service. Likewise, if the number one service drops below the agreed upon service level because of a hardware performance problem, we can more easily justify an upgrade based on the overall value of the service to the organization. These same metrics drive back into the governance processes to provide key insights into how we can verify the performance of the IT enterprise as it relates to the overall business objectives.

Linking operations and finance in this manner is a new frontier and it will take some significant changes in the way applications are developed. It will also require a shift in the organizational mindset as it exposes much more detail about how IT services relate to the financial cost elements.

### **Integrated Service Management**

Integrated Service Management seeks to ensure that all parts of the IT equation work together to provide a complete end-to-end solution that addresses the full product life-cycle. Service management is about the processes and tools that control how services are delivered,

maintained and decommissioned as the organization changes over time. It includes disciplines like configuration management which is a significant contributor to O&M costs principally because so much of the CM work load is manually driven. Reworking the concept of configuration management to make it possible for systems to offload the repetitive manual processes will help drive down the overall costs to support the data center. Integrating configuration management into an overall service management plan is a key concept for building self-managing and self-sustaining systems that support service oriented architectures. The concept embodies the idea of all components within the enterprise working toward common, measurable, well-defined processes. For the next generation data center, the most critical elements of a service management plan are asset and portfolio management.

### ***Asset Management***

Asset management typically involves inventory control systems and periodic reviews of what physical assets are deployed and how they are allocated against the underlying business needs. This includes ensuring licensing compliance of software assets, maintaining leasing records, providing help desk support and the constant tracking of assets throughout their entire life-cycle. While there are many ways to accomplish asset management, two well recognized methods have emerged as the focus points. The total life-cycle asset management (TLAM) and Information Technology Infrastructure Library (ITIL) provide a more structured approach to asset management that are rapidly being adopted by organizations of all sizes and types. In the last few years, organizations on the leading edge of modern asset management techniques have begun blending both methods to reduce operational costs, improve IT efficiency, provide an enhanced customer experience and better relate IT to the business' core mission. By combining the TLAM guidance for how to best monitor and manage assets with ITIL's best practices for implementation and service delivery, we can achieve better efficiencies across the board with respect to both the internal and external customers.

Research from Gartner Inc. indicates that roughly 80% of the costs for IT assets occur after their purchase. With this large of an O&M cost looming, a holistic approach must be taken to include all aspects of the asset life-cycle from initial planning, through purchase to final disposition. Life-cycle management is all about optimizing the costs of maintaining assets throughout their life-cycle by applying a structured approach to asset management. This allows us to look at assets across the organization based on the multiple facets of their use. It helps to better understand the value of each asset, to appropriately plan for its integration into the enterprise, to adjust more readily for capacity and growth requirements and to fully support the asset until it is retired and disposed of in accordance with all applicable regulatory and contractual requirements.

Once we understand the best way to manage asset, we can turn our attention to the best practices in how to implement assets to support the services required by the business. The best practices contained in the ITIL cover all aspects of the IT enterprise. The ITIL breaks the enterprise into ten management areas that are grouped into two broad categories. The first category is service delivery and it deals with capacity, service continuity, financial, SLA, and availability management. The second category deals with service support including configuration, incident, problem, and change and release management. In total, ITIL has been proven by hundreds of organizations to reduce costs and improve productivity.

The end goal of this blended approach is an IT enterprise that more closely aligns with

business needs and creates greater opportunities to improve the efficiency of the assets and services provided.

### ***Application Portfolio Management***

Today's Federal Government CIOs face a daunting challenge in understanding how to best manage the portfolio of services that users need. The concepts behind application portfolio management are to some degree borrowed from the financial portfolio management realm. The goal in both cases is to balance the return on investment against the associated risks. In the IT realm this involves understanding and managing the various governance policies while simultaneously increasing the support to internal and external customers through new capabilities and services.

Application portfolio management is a continuous process that seeks to address the long term needs of the IT enterprise as it relates to the services offered by the business. It involves analysis and research of the services that are required to meet the critical functions of the business followed by a careful plan for monitoring, maintenance and renewal. For the data center, the biggest return is often seen in terms of the strategic management of long-term costs. A careful assessment of the applications combined with frequent reviews and realignments will translate into cost savings through server consolidation, application retirement and divestment. Server consolidation and application retirement provide the reduction in overall data center costs, both from hardware/software maintenance and from reduced facilities expense (i.e. power, HVAC). Divestment takes a pragmatic approach to outsourcing functions, capabilities and resources to achieve an overall increase in service delivery at a reduced cost. In all cases, automated tools that can collect, process and present metrics allow for accurate calculation of the total cost of ownership for each application within the portfolio.

### ***Remote Provisioning***

In a self-sustaining data center, the idea that assets are instantly identifiable along with their status, performance characteristics and their current workloads is paramount. This allows monitoring and management components within the data center to automate the tasks associated with running applications and services. If a server becomes overloaded, a similar asset can be identified and new services can be started to split the workload. This automated provisioning process can be done through automated means or by a remote provisioning system that lets support staff see a set of options and then chose the right one to implement.

### **Comprehensive Security**

Throughout this paper we have addressed security concepts within each aspect of the transformation process. Security is critical to the design of every component of the data center and must be factored into our understanding of how all the IT services that are exposed to the users interact with the infrastructure. Security must be built into the applications, the services, the software, operating systems, hardware devices and the data center facilities. It must be addressed by the processes used to manage all the integrated services including the configuration, asset, and portfolio management tools. Security, through tagging and labeling, must be extended to the data wherever and however it is stored, processed and disseminated. It is a critical component in maintaining the integrity and availability of the data center and all the IT resources it hosts. As we have indicated, security is a critical part of any effort to transform

and realign the way data centers are built and operated and it must be addressed specifically at each step along the way. However, this cannot stop at the data or system level. Security must be extended to all aspects of the enterprise, including the people inside and outside the organization and it must encompass each of the various network domains that support the organization.

### **CIO Roles**

Successful transformation is about change. Change needs and advocate and finds it in the role of the CIO. There are three main factors that serve to hinder a successful transformation. The first is the internal culture that is resistant to change. The second is organizational politics and the third is the existence of too many conflicting priorities. Each of these factors must be overcome to affect the kind of change required for a successful transformation. Since the CIO bridges the gap between the business strategy and the technology solution, this individual is uniquely equipped to address these factors.

#### **Internal Culture**

Sociologists have concluded that by and large people are creatures of habit and not generally prone to change. So it makes sense that as organizations grow in size they develop a corporate culture that is resistant to change. This resistance becomes a hindrance to any plans that require transformational style changes. One of the chief roles of the CIO is to overcome this cultural resistance and motivate people throughout the organization to accept changes and be a part of their planning and implementation. The CIO, working with the CEO and others can help bring direction and focus to the tasks that are required to effect changes to the IT enterprise. Sometimes this may result in changing perceptions or views about particular products in order to achieve a more vendor agnostic solution. In other cases it may mean overcoming misconceptions about how changes will impact the status or position of personnel outside the CIO staff with regard to technology solutions. Regardless of the reason, the CIO has a role of bringing technology changes into the organization in a way that minimizes disruptions to daily operations and maximizes adoption by the workforce.

#### **Organizational Politics**

Organizational politics in a company manifests itself through the struggle for resources, personal conflicts, competition for power and leadership, and tactical influence executed by individuals and groups to attain power, build personal stature, control access to information, not reveal real intents, build coalitions etc. Understanding these organizational politics is critical to moving the organization forward to achieve the goals set by the senior leadership. Given the CIO position within the organization, this individual is closely tied to each of the senior leaders and the organizational politics at the highest level. Overcoming the politics can be best accomplished when the CIO can negotiate based on the full support of the CEO and the Board of Directors. The CIO must represent the goals and direction set for the organization with impartiality and fairness.

#### **Conflicting Priorities**

Organizational priorities are necessarily set by the fixed resources that are available. In

some cases this is related to personnel, in other cases by facilities or equipment. But in the majority of cases it is directly tied to funding. As budgets shrink and mission requirements continue to grow, the number of conflicting priorities skyrockets. The CIO must work to balance the IT transformation against these priorities. However, most organizations have too many priorities and the CIO's task borders on the impossible. De-conflicting priorities requires the organization to take a hard look at its goals and how to best accomplish these goals. Technology is intended to support doing more with less. This would seem to make it an ideal candidate for helping to reduce the contention. However, the changes required for IT enterprise transformation add yet more priorities against the existing resources. Overcoming this will require a coordinated effort by the senior management team and the CIO is critical to this process. The organizational governance headed by the CIO helps to set expectations and provides metrics and methods for verifying the performance of the IT solutions used throughout the organization.

### **Conclusion**

Given the huge dependency we now have on technology, transforming the IT enterprise also results in a transformation of the organization. This makes it even more imperative that we address all aspects of the IT enterprise in concert with the strategic goals of the business. As we have seen, a key component is a strong, empowered CIO that can champion the changes that are necessary. It requires a CIO that can judiciously apply governance across the entire IT enterprise to enable better decision making at all levels by establishing specific expectations and verifiable performance. It also takes a CIO that can weave logical and sustainable security policy throughout the breadth and depth of the technology base, personnel, and processes.

In the current data center environment we are facing significant challenges in bringing the O&M support costs in line with the expected budgets. Many of these challenges result from the increasing costs associated with adding more IT resources to roll out new services. New servers are over-burdening the facility infrastructure (HVAC, power, space) and are driving up the number of support personnel required to man the data center. Software costs, both the upfront purchases and the follow year maintenance costs are increasing. The complexity of the service offerings is growing as more and more people move to true service oriented architectures that require multiple systems and applications to operate as one cohesive unit. These challenges are leading to an upward trend in data center costs that cannot be sustained on the flat or shrinking O&M budgets. However, there are steps that can be taken to bring the costs back in line with the budget. These steps require a new way of thinking about the function of the data center and how it will support the heterogeneous mix of services required to meet the constantly changing mission needs. By taking this fresh view of the problem and working to create more self-sufficient data centers that implement the steps listed above, we can achieve significant O&M savings without compromising the services that are delivered.

Server consolidation and virtualization can reduce the number of servers that are required to support the applications and services, thereby reducing the facilities costs and reducing the O&M impact from the hardware standpoint. A smarter software management strategy that emphasizes the maximum use of existing licenses and pushes lower cost open source or GOTS products will help reduce the software costs. New approaches to managing the configurations of systems, applications and services will provide a better end user experience without requiring additional hardware, software or support personnel. Adding remote provisioning and deployment capabilities allows for separation of the data center and the support staff, thus

allowing organizations to relocate support personnel to lower cost areas. Rethinking the metrics that are collected and presented to provide not only a system view, but a complete picture of the enterprise for both the internal and external users will improve the ability to manage down time and service restoration. During the entire process we must keep security concerns in mind. Designing for cross domain operations is a critical component of the change. We must also include best practices, like those from the ITIL, to ensure that we maintain consistency and we are taking advantage of proven techniques.

Reducing the O&M cost of the data center is possible, but it requires a commitment to change from all levels of the organization. It requires a new approach to how we address the change management process, the technology, and the operational philosophy of the data center. It requires a new independent team of data center architects and designers that can focus on moving away from the traditional methods and the baggage associated with legacy designs. It requires a change in the way applications and services are developed. And it requires us to carefully and consistently apply key performance parameters that give us measurable indicators of success.

In the commercial world, corporations like IBM, Johnson & Johnson and Caterpillar are showing the results of this transformation in data center design and the same methods and strategies can work for the government space as well. Just like these commercial organizations are seeing success, the government can too. It just takes a commitment to changing the game in infrastructure O&M management.