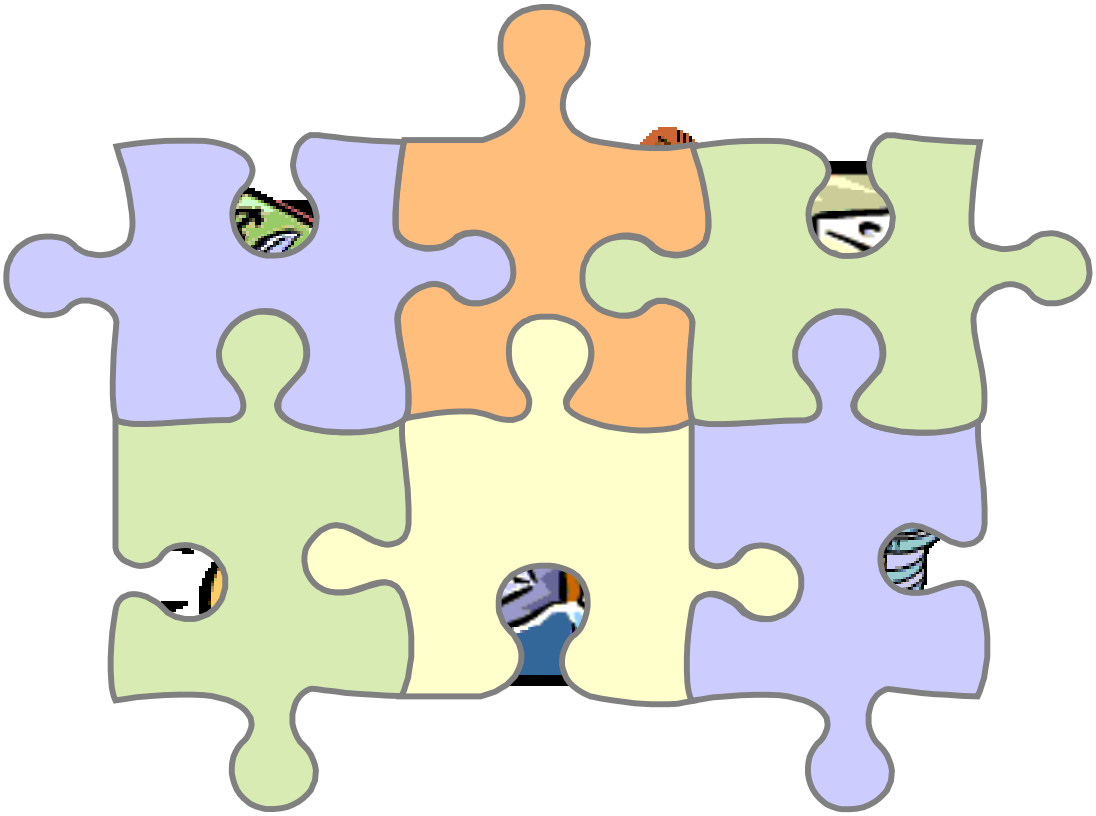
An Introduction to

Information Technology

Total Cost of Ownership



August 1, 2001

Governor's Office of Innovation and Technology (OIT)

Table of Contents

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Executive Summary

Calculation #1: Before deciding how much you are willing to pay for something, one needs to determine what value it represents to you. With respect to technology, that involves calculating its contribution to the business.

The best way to ensure that technology aligns with business objectives is for business and technology executives to sit down and say, "what is our goal?" In Colorado, the Governor's vision for technology utilization in state government includes the following key objectives:

- utilize technology and innovation *to streamline and simplify* Colorado's government in terms meaningful to Colorado's taxpayers – making it more service-friendly; and
- transform state government by implementing uses of the Internet, e-commerce, and new management efficiencies to *save taxpayers' money* and *make government more efficient*.

As technology investments become an integral part of any organization's core business strategy, maintaining such technology's reliability (high availability and performance) becomes imperative.

Calculation #2: Before identifying how much something like reliability is going to cost, one needs to determine what all of the potential associated product and service expenditures could be.

It is important to note that the frequently heard statement "if properly used, technology can help reduce costs" – refers to overall business costs…not just the costs related to IT. The IT-related portion of the costs is commonly referred to as IT's Total Cost of Ownership (TCO). From a strictly technology perspective, the standard equation is simple:

increased technology quantity/diversity/functionality [i.e. added complexity]	=	increased technology ownership costs

TCO is a tally of all costs related to technology assets (products and services) throughout their lifecycle, from acquisition to disposal. The ability to determine some of those costs is not as straightforward as one might first imagine because many of the factors boil down to people issues – and people's time – rather than IT practice.

TCO's value proposition is the opportunity for improved decision support. The aim is to identify and quantify the overall costs associated with ownership of technology assets for the ultimate purpose of enabling decisions which minimize such costs. Power through knowledge. The benefits can cascade well beyond IT resources. That said, it should be acknowledged that while cost can be a valid way of measuring technological complexity, it is far from perfect as a metric for manageability.

Because many of the costs – especially the hidden ones related to management, training, and downtime – do not occur at acquisition time, they are often overlooked in budgets. A significant danger is the stealthy erosion of employee productivity as the un-funded or under-funded management and support responsibility for technology is silently transferred to end-users.

The purpose of this document is to raise the awareness that there are on-going costs for Colorado state government's deployed technology and to frame an understanding of them rather than determine the actual dollar value of such costs.

What is Total Cost of Ownership (TCO)? 1

The rapidly growing dependence on Information Technology (IT) solutions has expanded:

- the breadth of IT product deployment (from countless sources to countless user locations);
- the depth of such product's functional responsibilities (a hand in every aspect of the business' workflow); and
- the significant and rising costs devoted to IT infrastructure.

These realities have created both a complex and critical challenge in the area of IT infrastructure management. In other words, as IT becomes part of the fabric of the enterprise, so does the cost of procuring, installing, using and changing it.

Since an organization's relationship with and dependence on IT does not stop after its delivery, neither do the associated costs. In fact, the bulk of costs related to IT are often associated with post-delivery activities (as reflected in the example profiled in the chart below).

Definition

Total Cost of Ownership (TCO) is the term used to describe not only the costs of purchasing IT products and services…but all the hidden costs associated with using such as well.

This includes planning, design, installation, configuration, maintenance, and support from both the administrative and technical perspectives.

PC/LAN Total Cost of Ownership (TCO) – 5yr plan

• equipment purchase	21%
• technical support costs	21%
• administrative costs	13%
• end-user operations (ap development, file & data mgmt, formal/informal training, etc)	46%
Total	100%

Source: "PC Leasing: A Strategy for Managing the Desktop," GartnerGroup (4/28/97)

TCO: itself a piece of the larger puzzle

While the TCO puzzle is comprised of many pieces, from a big picture perspective it is valuable to note that TCO itself is only one piece of a larger puzzle. GartnerGroup notes that large businesses are primarily concerned with managing technology throughout the enterprise. Best practices call for a comprehensive and integrated IT infrastructure management strategy, where TCO is just one of several key components:

What do we have?	Asset Management
What does it cost?	Total Cost of Ownership (TCO)
What do we need?	IT Architecture
Who does it?	In-house/Insource/Outsource
How do we fund all the above?	Rent/Lease/Purchase

Source: "The Business Benefits of Leasing," GartnerGroup (2/13/98)

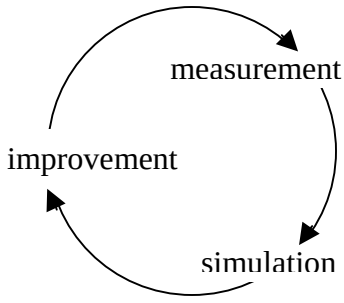
Why: the principal benefits 2

TCO's fundamental value proposition is the opportunity to improve decision support. By first identifying all the pieces of the cost puzzle and then aggregating the measurement data, one will have the instrument necessary for trend and analysis.

Using TCO information, an organization can more accurately estimate the effect of asset management, architecture, sourcing and/or funding changes including considerations of end-user productivity, risk mitigation, and cost reduction. This should allow enterprises not only to plan better improvements, but also to build better business cases for such proposals and to better measure the results.

Increase Productivity	A careful analysis of the direct and indirect expenses can reveal a harmful imbalance. For instance, cuts in direct expenditures can lead to unexpected increases in indirect expenses, leaving users supporting themselves, resulting in losses in overall user productivity.
Improve Planning	Explore various scenarios in order to forecast and quantify the impact of new IT planning initiatives.
Mitigate Risk	Understand IT risks and exposures, enabling an organization to develop plans mitigating them. Unmitigated risks can result in cost and schedule overruns, business disruptions, downtime and resulting lost productivity.
Reduce Costs	Gain valuable insight into pinpointing areas for cost reduction, allowing the organization to do more with existing IT budgets. Even a 5% reduction would likely be a significant savings across the enterprise.
Increase Value	Implement and build a decision support methodology for driving continuous reductions in TCO as well as increasing the efficiency and effectiveness of IT investments.
Enable Success	Increase the odds of success with a solid framework for business case development and planning on the front end as well as the ability to measure your results on the back end.

Used as a management tool as part of an enterprise's annual planning process, TCO can become part of a continuous process of measurement, simulation and improvement. Because efforts to streamline business processes using technology-enabled solutions often result in increased IT costs, most IT budget proposals consider more than one technology configuration.



Multiple scenarios can then be created to compare what happens to TCO if different technologies are deployed, if complexity is reduced or if service levels are altered. By comparing the alternative scenarios to the current environment, the enterprise can easily quantify the effect of various choices to optimize stated objectives.

How: the puzzle's many pieces 3

Getting a true TCO figure is extremely difficult given the almost exhaustive list of things to include:

Direct Costs

Hardware/Software

- Hardware costs
- Hardware depreciation & expenses
- Memory upgrades
- Storage upgrades
- Computer peripheral upgrades
- Network upgrades
- Software costs
- Operating system
- Application software
- Utility software
- Connectivity & communication software
- Annual capital and lease costs
- Annual lease fees
- Other costs (supply & disposal fees)

Systems mgmt (labor)

- Network management
- Troubleshooting & repair
- Traffic management & planning
- Performance tuning
- End-user administration
- Operating-system support
- Maintenance
- Tier-2 support
- Systems management
- Systems research & planning
- Evaluation & purchase
- Software licensing & distribution
- Asset management
- Application mangement
- Security & virus protection
- Hardware configuration/reconfiguration
- Hardware installation/de-installation
- Storage management
- Disk & file management
- Storage capacity planning
- Data-access management
- Backup & archiving
- Disaster planning & recovery
- Repository management
- Outsourced management fees
- Maintenance contracts

Support (labor)

- Operations (overhead tasks)
- Administrative assistance
- Executive & middle management
- Casual learning (IT professionals)
- Vendor management
- Training-course development
- IT training (as instructor & student)
- End-user training (instructors)
- End-user training (users)
- Travel time
- Purchasing & procurement
- Other operations costs
- Operations fees
- Support contracts (Tier-1 helpdesk)
- Training course/certification fees
- Travel fees
- Other operations fees
- Help-desk (tier-1)

Development

- Planning labor (internal)
- Development labor (internal)
- Testing labor (internal)
- Documentation labor (internal)
- Planning fees (external)
- Development fees (external)
- Testing fees (external)
- Documentation fees (external)

Communication Fees

- Lease line expenses
- Remote-access services expenses
- Web hosting/Internet svc provider fees
- WAN costs (of client/server network)

Indirect Costs

End-user IT costs

- Peer & self-support time
- Casual learning time
- End-user scripting & development time

Downtime

- System planned downtime
- System unplanned downtime
- Network planned downtime
- Network unplanned downtime

Source: "TCO: Critical Tool for Managing IT," GartnerGroup (10/12/98)

As exhibited in the figure on the previous page and detailed further in the chart below, TCO is the combination of two major categories of ownership costs.

Hard (direct or budgeted) costs	
measures direct expenditures on IT (e.g., capital, labor and fees) including the purchase price of IT assets, implementation fees, upgrades, maintenance contracts, support contracts, and disposal costs	
Hardware and software	the capital expenditures and lease fees for servers, end-user workstations (e.g., desktop and mobile computers), peripherals and network components
Management	the direct network, system and storage-management labor staffing, activity hours and activity costs, maintenance contracts and professional services or outsourcing fees
Support	the help-desk labor hours and costs, help-desk performance metrics, training labor and fees, procurement, travel, support contracts and overhead labor
Development	the application design, development, test and documentation labor and fee expenditures including new application development, customization and maintenance
Communications fees	the inter-computer communication expenses for lease lines, server access remote access and allocated WAN expenses

Soft (indirect or unbudgeted) costs	
measures capital and management efficiency of IT in delivering expected services to end-users including costs related to management, support, training, and downtime	
End-user IS	the cost of end-users supporting themselves (and each other) instead of relying on formal IS support channels (i.e., peer and self support), end-user formal training, casual learning, self-development/scripting of applications and local file maintenance
Downtime	the lost productivity due to planned (i.e., scheduled) and unplanned network, system and application unavailability, measured in terms of lost time/wages

Because soft costs are often hidden in most organizations, they are neither measured nor tracked. The resulting slow and destructive effect is that many organizations reduce direct costs in a less-than-efficient manner – transferring the burden or support and unreliability to IT professionals with other unrelated skills or worse to the end-users themselves.

Therefore, one can view indirect costs as a second-order effect that IT spending, or lack thereof, has on the organization. Although often it cannot be measured directly – and there is not always a direct causal relationship – efficient IT spending can have a direct positive effect on both IT professional and end-user productivity. In contrast, inefficient spending or cuts – which typically lead to increased or persistent complexity – belie the truth of the real but hidden costs of rippling impacts.

Where: does the complexity come from 4

More-complex organizations or IT installations can expect a higher IT TCO (planning, implementation, deployment, support and retirement costs) associated with a wide variety of technologies.

In view of that, the primary goal of TCO analysis is to lower technology costs by identifying and reducing unnecessary complexity. Still, it is important to note that some highly complex environments are necessary and do warrant higher costs (e.g., real-time transactions) than others (e.g., data-entry).

Definition

Complexity is the state of the relationships of component parts in a system or process.

Complex can mean difficult to understand or find an answer to because of having many different parts.

Not only does the infrastructure, application and support-demand mix differ markedly between organizations, but sub-groups within an organization often carry their own distinctiveness too. Listed below, is a categorization of some of the drivers for such differentiation. Ultimately these complicate the calculation of a universal average value for IT TCO.

Enterprise profile	• industry or business type • worldwide geographic location • enterprise size • mix of end-users by type
Technology quantity and type	• servers • end-user computers – desktop • end-user computers – mobile • peripherals • network
Management practices	• technology • process • people
Complexity	• IT organization • IT processes and service • technology: software • technology: hardware • end-user organization

Lest one think the situation is hopeless chaos, there are commonalities that can serve to focus the TCO analysis. Given the plethora of IT products and services, the customer is forced to sort out and implement the proper combination of resources, products, and services to achieve their objectives – a challenging process that can soak up an enormous amount of time and energy.

Overall complexity stems from three sub-categories:

1. management complexity (IT organization and its processes)
   - one with multiple points of decision making and a high rate of reorganizations is far more complex than one with clear job descriptions, regular communications, and centralized decision making.
   - One with no project management methodology and unskilled staff is far more complex than one with mature project management methods and staff with appropriate skills.

- one that offers 7x24 availability and immediate response times is far more complex than one offering 5x8 availability and next-day or best-effort response.

2. technology complexity (hardware and software environment)
   - one with 6 or more computer operating systems is far more complex than one with only a single operating system.
   - one with custom-developed applications is far complex than one utilizing component-based development (reusable software modules).
   - one with a 10% annual PC turnover rate (10 years worth of different products) is far more complex than one with a 100% annual PC turnover rate.
   - one with 100% of mobile or portable end-users is far more complex than one with 10% or less such users.

3. end-user organization (profile of end-user types)
   - one with predominantly project oriented work is far more complex than one with mainly process oriented work.
   - one using primarily specialized applications is far more complex than one using mostly enterprise applications.

The best of intentions

Many enterprises try to optimize their technology environment by focusing on computing platforms, particularly standardization across all business units and end-users. Although this may appear to lead to low-cost IT, it may also lead to sub-optimized functionality and reduced value from the investments.

"Cookie cutter" standardization is an example of force fitting differentiated end-users into a common IT profile just for the sake of simplicity and its promise of reduced cost.

It is dangerous to define workers by the technology they use, not only because it may not map to their job function – but workers will be more likely to do what the technology will enable them to do, rather than what is optimal based on their job description. Not every worker is a knowledge worker; therefore, most employees do not need a knowledge worker's tool (i.e., a full-function and configurable, end-user-managed environment).

Today's technology choices are broader, and technology is emerging that will more-precisely allow an enterprise to scale computer systems to an end-user's functionality, cost and value requirements (as outlined in the chart below). Therefore, part of any TCO analysis should reflect the nature of the work performed.

High performance worker	• uses IT to create product • adds considerable value to product by using technology • uses highly specialized applications • includes engineers, graphic artists, money managers, and computer programmers
Knowledge worker	• uses IT to collect data from many sources • adds considerable value to data, converting it into information and communicates

	such, creating knowledge in support of decision-making • uses a mix of personal productivity and specialized applications • includes executive staff, researchers, analysts, consultants, and project managers
Mobile worker	• a knowledge worker that is location-independent • higher investment in capital and indirect costs due to remote, self support • uses primarily personal productivity applications • includes knowledge and case workers, inspectors, and law enforcement officers (mobile computing is more platform-defined than worker-type defined)
Process worker	• uses IT to add value in a process • highly repeatable process-driven task work • uses a mix of personal productivity and enterprise applications • includes transaction processers, accounts payable staff, customer-service or helpdesk representatives, and installers
Data entry worker	• uses IT to transcribe data from one media to another • uses IT to add value to data by making it available for other uses • includes order agents, receptionists, and administrative support staff

Source: "TCO: Critical Tool for Managing IT," GartnerGroup (10/12/98)

Today, technology is available that enables a spectrum of end-user types to operate within a common architecture, with scalable functionality and cost. Specifically this is enabled by the network-computing model that offers a range technologies including: thin client/fat server to fat client/thin server, large- or narrow-pipe networking, local- or remote-application processing, dynamically loaded functionality and universal-client.

When: best practices benefit TCO 5

Typically, technology by itself has no intrinsic value.

In fact, even when used in isolation, many technological innovations contribute little to cost reduction. Not until enterprises systematically incorporate manageability into the organization's IT policies and practices do savings mount. The savings continue to increase as this functionality is added to all aspects of an infrastructure management strategy (i.e. with an amplified effect based on best practices level of implementation in an enterprise).

Definition

Best practices are the proper deployment of technology integrated with process and management practices that deliver maximum usable functionality at minimum cost.

However, as a potential counterforce the deployment and maintenance of technology both have costs as well as value. Poor implementation as well as ineffective and/or inefficient support can result in costs outweighing the benefits, producing negative value. Technology itself is seldom to blame, most often it is the failure of the organization to integrate technology into a process that causes poor value.

Thus, it is important for enterprises to assess the effect of best practices (as TCO enablers) as they affect the IT infrastructure. Listed below are some of the best practices that support TCO by increasing the likelihood of cost reductions through increased utilization of IT policies and procedures as well as end-user satisfaction.

Technology improvements	
1. Automated asset management	electronically supported procurement, automated inventory, centralized data repository that is available to financial, administrative, technical planners, system administrators and the help desk.
2. Virus detection and repair	a network-software system that actively monitors and detects virus intrusions, alerts system operators and end-users to such events, and provides automated eradication and damage repair to the extent possible.
3. Systems management	an automated event-management system that proactively and reactively notifies system operators of failures, capacity issues, traffic issues and other transient events. The potential for system performance is optimized, problems are resolved quicker and failures are minimized.
4. Service-desk problem-management and resolution	allows calls to the help desk to be ticketed, escalated, dispatched and closed with support from a knowledge database. Common help-desk calls for trouble-ticket status, network status and password reset can be reduced through automated voice-response systems providing for proactive elimination of issues including links to the training programs to help reduce “how-to” calls.
5. Scalable architecture	a technology infrastructure that can logically and physically increase in performance and capacity without discontinuity to meet reasonable growth and change over time. Supports the best practice of standardization, by which cost and complexity are reduced.
6. Component application development	provides developers with libraries of common application components allowing reduced development time and testing through standardized code – reducing the complexity of application development and maintenance, simplifies troubleshooting and reduces application failures, leading to reduced costs.
7. Fault tolerance	recognize component failures and provide automatic and seamless switching to redundant components, minimizing unplanned downtime.
8. Wake on LAN	the ability of an end-user computer to power up (i.e., from a sleep mode) remotely on a signal from the network regardless of whether an end-user left his or her system on or not.

9. Server-based client-image control	the ability of a desktop administrator to create a user-specific configuration of applications, settings and privileges on a server and then download that automatically to a specific user workstation. This simplifies both the initial configuration of one or many workstations as well as the maintenance of those configurations in a standard way over time.
10. User state management and restore	the ability to mirror an entire user workstation's system (operating system, applications, data, etc) on the server, such that if the user's system crashes, the server will be able to restore the user system automatically to its last saved state.
11. Software inventory	electronically store inventory information (license terms and conditions, date of acquisition, end-user name and location, system-installation details, maintenance agreements, usage monitoring, history and other relevant data) in a central repository, automatically updated and maintained. This is critical to license management, support contracts, technology planning and troubleshooting, and financial management.
12. Hardware inventory	a complete listing of all network components (user computers, servers, peripherals and network-communication devices) including relevant identifications of each discrete component. This is used for technical planning and support, as well as financial management.
13. Client remote control	the ability of a support person to operate an end-user's desktop from another PC over the network enabling remote troubleshooting, training and support while eliminating travel to the deskside.
14. Low-risk, high-quality vendor/provider selection	using best-in-class vendors compared on financial viability, organizational stability, quality control, stringent testing for compatibility, independent market support for technology differentiators and responsiveness to field-service issues. This reduces the risk and associated costs of encountering quality, reliability or supply issues compared to vendors that may offer simply the lower-priced products.
15. Client-hardware event management	the ability of networked components to identify and communicate hardware-based abnormal operating and performance conditions to a systems manager or operator that can respond with corrective measures. This can enable the support team to be proactive in service calls, minimize unplanned downtime and prevent cascade effects of hardware failures.
16. Automated software distribution	the ability to install software on a user device without having to physically visit each client device. This can reduce the time and cost of software changes significantly.
17. Automated backup and restore	enables files to be backed up on a regular basis without end-user intervention and stored off-site. This can reduce the risk of data loss and reduce the cost of data recovery and downtime.
18. Hardware physical-security management	the protection of hard assets from theft, damage or compromise. This can reduce loss and insurance rates; moreover, it provides a secondary protection against data loss, theft and reconstruction.
19. Low-impact upgradability	the ability of network assets to be upgraded with a minimum amount of upgrade labor and effect to the end-user in lost productivity during the upgrade.
20. Managed-user environment	one in which a network or desktop administrator can control IT assets (applications, settings, network resources, databases, etc) an end-user can use. The end-user is presented with only the tools s/he has been trained on and need for the job. This can reduce help-desk calls and unplanned downtime, as well as create a more-predictable platform for system upgrades.
21. Locked-user environment	a limited version (machine-specific and local to the device) of the managed-user environment (above), this precludes the end-user from changing settings and installing unauthorized software. This can reduce unplanned downtime and help-desk calls, as well as provide a more-reliable target for change management.
22. Vendor standardization	by limiting the number of vendors that an organization purchases from, it can gain purchasing leverage, reduce incompatibility issues, reduce support issues, reduce vendor-liaison requirements, testing of new technology and administrative costs of vendor management. This usually enables larger discounts with volume purchasing.
23. Platform standardization	the standardization of specific system models and operating-system platforms for servers, user computers and peripherals. More specific than vendor standardization, further reduction in complexity can be realized from systems that are common among end-user groups making them easier to configure, manage, troubleshoot and upgrade.

24. Application standardization	the uniform deployment of a portfolio of release-specific, vendor-specific applications across the organization, with standards established for specific end-user types and sets. This greatly enhances interoperability when end-users must share files and data. It also simplifies change management, application support, troubleshooting and training.
25. Data-security management	involves end-user identification and authorization, proper controls on downloading and uploading files and data, firewalls and other technology barriers to prevent unauthorized access, theft and corruption.
26. More time spent planning vs. implementing	cutting corners on planning can triple the cost and time to implement enterprise-level projects. Planning requires: • adequate information about the current and target states; • accurate estimates of the time and financial investments required to change; • putting together a team with defined roles, tasks, responsibilities; • development of a vision/scope document; • the planning team to have adequate time before design and implementation.
27. Centralized and optimized procurement	rather than necessitating physical centralization of all procurement personnel, it involves the development of a common set of procurement policies and operating procedures, pooling of information about requests, vendor contracts, asset data, industry information and qualified procurement skills. This reduces costs and increases end-user satisfaction.
28. Service-level tracking and management	a contract that establishes specific services that the IS organization delivers to the end-user community with regard to various uptime, performance and problem-resolution criteria.
29. Capacity planning	a process by which the capacity of the network and assets is measured, compared to requirements (including mapping new initiatives to existing infrastructure) and adjusted as appropriate.
30. Change management	Establishing a database of changes such that both changes can be easily recognized during troubleshooting activities and to ensure that unauthorized changes are not being implemented.
31. TCO life-cycle management	measuring the TCO on a regular basis, comparing the costs to industry benchmarks and making decisions on changes that include financial, not just technical, objectives. This way investments can be verified as having positive financial effect and returns…even before implementation.

People improvements	
1. End-user training	the under-trained end-user consumes two to six times the amount of technical support (including peer support) than an adequately trained end-user. A mix of instructor-led classroom training, computer-based training and just-in- time training will help increase end-user productivity and reduce support costs.
2. IS training	training this group is critical because the IS staff in turn, delivers support and service to end-users. Professional training should reduce the amount of casual learning by IS professionals significantly and pay off in reduced time to implement and troubleshoot systems.
3. IS staff highly motivated	will operate as a team and exceed expectations. Motivation is achieved in a number of ways including having a supervisor that they like to work for, having teammates they like and respect, compensation and bonuses, and meaningful recognition, particularly outside the IS department.
4. Stable IS organization	is critical to keeping the staff members and teams consistent and focused. It enables the maturation of processes, procedures and talent. In contrast, constant reorganization, management changes and political infighting take a toll on morale, turnover, costs, risk and progress.

Conclusion: the work ahead 6

Okay, so now you know how much you're spending. You've got some opportunities to reduce costs, but how? What option will provide the most savings and the greatest return? Should you buy faster servers? Should you give users more training? Should you outsource the help desk? By looking at your TCO, the impact of these decisions can be quantified.

TCO is about the management of people as much as it's about the management of IT. In the end better tools, better training, better personnel polices and better technology can only reduce not remove human intervention in the many processes spanning technology's lifecycle. To shrink the costs such as downtime, training and user productivity, it's necessary to find some way of dramatically simplifying the complexity in the technology infrastructure.

Moving forward

The recommendation is that, using this common model or framework, each department should incorporate the calculation and analysis of the total cost of ownership into their annual IT planning process. The more information (not just data) one's armed with…the better decisions one can make. OIT has begun using these concepts to re-engineer components of its Information Management Annual Plan (IMAP) process. To ensure uniformity across the state, OIT will use these concepts in its evaluation of department's IT proposals.

Implementing the best practices of a total IT infrastructure management strategy enterprise-wide is likely a long-term project (i.e., two or three years) and will be most successfully achieved when built over time.