Payoff
Keeping data center costs in line with the demands of a budget-conscious business environment means evaluating all methods to control such major line item expenses as staff, hardware, software, and maintenance. This article gives practical ideas with which to effectively manage the expenses associated with today's data center operations, including some cost-saving strategies that can be applied to decentralized IS resources running client/server applications.

Introduction
IS managers have the responsibility to maintain the highest possible level of economic efficiency in the data center. Toward this end, they must have knowledge of the expenditures in the data center and its operations, and they must be aware of all methods for reducing these costs. This article outlines the core set of data center activities and functions that together represent the major expenses in operating a data center. For each activity and function, methods to control costs are presented.

Major Line Item Expenses
The major line item expenses associated with a typical data center are as follows:

- **Staff:**
  - Employees.
  - Contractor personnel.

- **Hardware:**
  - Capital expenses.
  - Noncapital and lease expenses.

- **Software:**
  - Purchases.
  - Leases.

Although the expenditure for any particular line item and its percentage of total expenses varies among data centers, in aggregate these items represent between 90% and 95% of all data center expenditures. IS managers should use the list of line items in contemplating methods to control the major expenses associated with data center operations; these methods provide the potential for large paybacks.

Reducing Staff Costs

For most organizations, direct and indirect payroll expenses over a period of time will significantly exceed all other costs associated with data center operations. Thus, methods for controlling staff costs can provide the manager with a significant level of success in controlling the cost of a data center. Two of the more cost-effective methods managers should consider are a lights-out operation and downsizing.

Lights-Out Operation

The term *lights-out* is used as a synonym for an unattended data center. A lights-out operation implies an obvious reduction in staffing costs because the data center operates without personnel.

Most organizations that implement a lights-out data center restrict unattended operations to second and third shifts, when the need for manual intervention can be minimized through the use of such automation programs as job schedulers, task managers, and automated tape libraries. Even the few organizations that have implemented a third-shift lights-out data center must periodically run the data center with employees—drive heads must be cleaned, printed output has to be moved to the distribution center, and backup tapes must be transported to an offsite storage location. Nevertheless, utility programs can considerably reduce staffing needs, permitting a near lights-out operation to rapidly pay for itself through the avoidance of second- and third-shift premiums as well as through a reduction in the number of primary shift employees.

A wide selection of traditional mainframe automation software is available for purchase or leasing. Such products include applications for job scheduling, tape management, disk management, and multiple-console support utility programs.

Job Schedulers.

A job scheduler is a utility program that allows data center personnel to define criteria, which the program then uses to queue jobs for execution. Some queues may be assigned a high priority to perform an immediate or near-immediate execution; placement in other queues may result in a deferred execution (e.g., in the evening). Job-scheduling software can perform a task previously performed by one or more data center employees.

Tape Management Software.

This option provides a data center with a volume-tracking capability, enabling tape librarians to more effectively manage hundreds, thousands, or tens of thousands of tapes and to locate and mount requested tapes much more rapidly.
Disk Management Software.

This software enhances the data center's ability to allocate online storage to users and to back up data onto tapes or cartridges. In addition, some disk management storage utilities include a data compression feature, which compresses data during a tape backup operation. For organizations with more than a few hundred tapes, disk management software is used to compress onto one tape data that would usually require the storage capacity of three or more tapes. This saving can offset the cost of the program—and probably provide even more payback.

Multiple-Console Support.

A multiple-console support program provides large data centers with the ability to have personnel control computer operations outside the data center. Managers at an appropriate security level may be permitted to use their terminals or access the computer through a microcomputer, enabling them to assign priority to jobs and perform other functions.

LAN Administration.

In addition to its applicability to data center operations, a lights-out operating philosophy is applicable to the corporate local area network (LAN). Third-party programs are available to automate many key LAN functions, such as initiating file backup operations of each server on the network at predefined times.

Downsizing

The four major expenses associated with staffing a data center are:

- The number of employees and pay rates.
- Contractor support.
- Overtime.
- Shift operations and differential pay.

For most organizations, the number of employees directly supporting data center operations and their pay rates and benefits represent the largest staff expense. Some organizations have outsourced all or a portion of data center operations either to reduce costs or to obtain an experienced pool of employees at locations where the hiring of data processing personnel is difficult. As an alternative to outsourcing, downsizing data center operations is a practical method of controlling or reducing staffing expenses.

With a downsizing strategy, a company encourages employees reaching retirement age to leave the company. A fraction of these employees are replaced by younger, lower-paid personnel. This method considerably reduces direct personnel expenses. However, the IS manager must consider that many of those employees urged to retire early represent a pillar of knowledge and experience; the manager may not find it practical to lose this resource. Thus, most managers may wish to take a close look at productivity tools, contractor support, overtime, and shift operations in the quest to control staffing expenses.
Productivity Tools.

In addition to those automation tools previously mentioned to achieve a near lights-out operation, there are hundreds of programs for automating operations on platforms ranging from mainframes to LAN servers.

An automation tool replaces a repetitive process by automating its operation. As a result of the tool's use, employee productivity increases or fewer employees are needed to perform an activity. By comparison, a productivity tool allows an employee to perform a job more efficiently but is not designed to replace a repetitive process.

For example, a remote control software program allows a LAN administrator to access and control networks at other corporate locations. One administrator can administrate multiple networks at different geographical locations as if the administrator's personal computer were locally attached to each network. The productivity tool is used to extend the span of control of employees and provide a mechanism to more cost-effectively control distributed networks. Similarly, remote control software products, such as Hewlett-Packard's series of distributed systems (DS) control programs, allow a central site operator to control the operation of minicomputers at distributed data centers, thereby reducing the need to hire additional operational staff. In both these examples, the operations are random processes and the productivity tool extends the operational capability of an employee, but it does not replace the process.

Contractors.

For most organizations, contractor support is used to provide a level of expertise not available from in-house employees. Because most contractor employees are billed at an annual salary level that is 30% to 50% higher than employee salary levels, eliminating or minimizing the use of this resource can result in significant savings. One way to eliminate or reduce the use of contractor personnel is to identify the skills they perform that are not available from current employees. The IS manager can review the records of employees to determine whether they are capable of learning the skills performed by contractor personnel. If so, the manager could then contemplate having employees take the appropriate vendor courses and attend public seminars to acquire the previously contractor-supplied skills. Once employees obtain adequate skill levels, they can work with contractor employees for a period of time to obtain on-the-job training, eventually phasing out contractor support.

Overtime.

By controlling overtime and shift operations, the IS manager may also be able to maintain data center operations within budget. Overtime, in many instances, gradually becomes an unnecessary expense. For example, overtime usually begins as a mechanism to perform a necessary operation, such as extending shift coverage to support the testing of new software or a similar function. Without appropriate controls, it becomes easy for employees to request and receive permission to use overtime to substitute for sick, vacationing, or otherwise absent workers. All too often, overtime use expands significantly and can become the proverbial budget buster. Alternatives to overtime, such as compensatory time, should be considered. These alternatives can eliminate or reduce the use of overtime.
Shift Operations.

Shift operations not only require the use of additional employees but cause premium pay rates through shift differentials. Controlling shift operations has the potential for significantly containing personnel costs. Possible methods of reducing shift operations include:

- Obtaining additional processing and peripheral device capacity to finish jobs earlier.
- Altering the job flow mixture to execute jobs that do not require operator intervention after the prime shift.
- Requiring non-prime shift jobs to be executed on specific days and at specific times.

Hardware Costs

Over the life cycle of a computer system, its hardware cost typically represents the second or third largest expenditure of funds. Controlling the cost of hardware is a means for the IS manager to maintain expenditures within budget.

Capital and Noncapital Expenses

Most organizations subdivide hardware expenditures into capital and noncapital expenses. Capital expenses must be depreciated over a period of years even though paid for upon acquisition. Noncapital hardware expenses can be written off during the year the equipment is acquired; however, the current limit for this category of hardware is $10,000. Because most hardware expenditures exceed this limit, this article discusses hardware that is capitalized.

There are several practical methods for controlling the cost of capitalized equipment. These methods include:

- Obtaining plug-compatible peripherals to satisfy peripheral expansion requirements.
- Using a lease to minimize one-time expenditures of new equipment additions.
- Buying used equipment to satisfy some or all of the data center's processing and peripheral expansion requirements.
- Platform reduction.

The major risk in acquiring used equipment is the availability and cost of maintenance. If availability of maintenance is not a problem and cost is reasonable, employing used equipment can considerably reduce equipment costs.

Platform Reduction.

Platform reduction refers to downsizing to client/server technology as a replacement for conventional mainframe and minicomputer-based applications. The rationale for considering a platform reduction is economics. A 486-based server is capable of operating at 30 Millions of Instructions Per Second for a fraction of the cost of an
equivalent millions of instructions per second (MIPS) mainframe. Of course, previously developed applications must also be moved off the mainframe, which is not a trivial task. Organizations with extensive mainframe applications can require anywhere from 18 months to two or more years to move a series of mainframe applications to client/server technology. The additional expense of moving applications to a new platform includes a period in which many programmers are no longer available to enhance existing applications, because their primary effort is focused on program conversion. The most successful platform reduction efforts are those that can identify an orderly migration of applications or the successful replacement of mainframe applications with client/server applications.

**Example.**

An organization has an IBM 3090E supporting 300 employees using Lotus 1-2-3/M, WordPerfect, a Canadian Independent Computing Services Association application, and PROFS for electronic mail. The mainframe versions of 1-2-3 and WordPerfect can be replaced by equivalent and more functional client/server products. PROFS can be replaced by one of 10 or more LAN E-mail programs. Thus, only the customized Canadian Independent Computing Services Association application would require a conversion effort. An orderly migration to client/server technology may entail installing the network, training employees to use the LAN, loading the ready-made client/server programs, and providing any additional user training. The conversion of the customized CICS applications to run on the client/server platform would be planned to coincide with the end of this transition effort. Such planning minimizes the time required to move to a new computing platform. In addition, such a plan would enable the organization to expediently cancel mainframe software licenses and maintenance service that for a 3090E can range between $10,000 and $25,000 a month. An expeditious and orderly migration to a new computing platform can have a considerable financial impact on the organization's bottom line.

**Software Costs**

Line item expenses associated with software are generally subdivided into purchase and lease products. For example, the computer operating system and utilities may be available only on a lease basis, whereas application programs may be available for purchase only.

**Leasing and Purchasing**

In examining lease versus purchase of software, the IS manager should be aware that many mainframe products are priced on a monthly lease basis. The expense of leasing for 30 months usually equals the cost of purchasing the product. Excluding the potential interest earned on the difference between the expense associated with an immediate purchase and the lease of software, the organization should generally purchase any software product that it anticipates using for more than 30 months. If it purchases such a product, the organization will begin to accrue savings on the software after using it for 30 months. The savings cumulatively increase each month the product is used after this break-even point.

**Multiple Processors**

Another area in which IS managers can control software costs involves multiple-processor data centers. Because most computer manufacturers charge a monthly fee for each product
use site, based on the number of and types of computers the product operates on, reducing production installation to one or a few computers can provide savings.

For example, a data center with multiple IBM 3090 processors uses Canadian Independent Computing Services Association and PROFS as well as other IBM software products. If multiple copies of each software product were licensed to run on each processor, the software licensing fee would significantly exceed the licensing fee charged for running CICS on one processor and PROFS on the second processor. In this case, it might be beneficial to establish a cross-domain network to enable users to access either processor from a common front-end processor channel attached to each 3090 computer system.

For client/server applications, the financial savings possible from obtaining LAN-compliant software rather than individual copies of a product can be considerable. For example, a data base program that is sold for $499 on an individual basis may be obtained as a network-compliant program capable of supporting 50 concurrent users for $1,995. The IS manager should examine the different types of PC software licenses and the cost of individual versus LAN licenses.

**Maintenance**

Although hardware is usually thought of as the main source of maintenance expenses, many software products have a maintenance cost to be considered in correctly budgeting data center expenditures. Concerning hardware maintenance, the IS manager can control this expense through:

- Third-party maintenance.
- Conversion of on-site to on-call support.
- Replacing old equipment with newer, more sophisticated products.

Although savings from the use of third-party maintenance and the conversion of on-site to on-call maintenance support are relatively self-explanatory, the topic of reducing expenditures by replacing old equipment with more sophisticated products requires some elaboration.

Most computer manufacturers guarantee the availability of spare parts for hardware for a specified time, such as five years from product introduction. After that time, spare parts may or may not be available from the original equipment manufacturer. If not, the organization may be forced to pay inflated prices for spare parts from third-party equipment vendors to prolong the life of aging hardware. In addition, monthly maintenance fees are usually based on the age of hardware, with maintenance costs rising as equipment life increases. At a certain point, it becomes more economical to purchase or lease newer equipment than to pay rising maintenance costs that can exceed the monthly lease and maintenance cost of the newer equipment.

As for software maintenance costs, most vendors price maintenance according to the numbers and types of computers on which their software product operates. The IS manager can control software maintenance cost by following the suggestion previously discussed for software—reducing the number of products used by dedicating specific processors to specific functions, instead of running copies of the same product on each processor.
Utilities and Conservation Practices

Conservation can serve as a practical method for controlling the cost of data center operations. Two of the most practical utility costs over which an IS manager may have significant control are water and electricity.

If the data center processors use chilled water for cooling, the manager should stipulate that the water is recirculated. Not only does this reduce the organization's water bill, it will also reduce the electric bill and possibly even the sewage bill. After chilled water is used for processor cooling, the water temperature is usually below that of natural water. Therefore, a smaller amount of energy is required to recool the used water than to chill new water. Because many cities and counties bill sewage charges on the basis of the amount of water consumed, recirculating chilled water also reduces water consumption. This in turn reduces the organization's sewage bill.

Equipment Replacement

The cost of operating old equipment usually exceeds that of more sophisticated products designed to use very Large-Scale Integration (VLSI) circuitry. For some data center configurations, including front-end processors, disk drives, and mainframes that may run 24 hours a day, seven days a week throughout the year, the cost of electricity can be significant. By examining equipment for components that consume an inordinate amount of energy, performing an operational cost analysis, and replacing equipment when justified, the IS manager may realize considerable operational cost savings.

Examples.

A data center is located in a large metropolitan area, such as New York City or Los Angeles, where the cost of electricity can easily exceed 10 cents per kilowatt hour (KWH).

Some front-end processors manufactured in the mid-1980s consume 15,000 watts per hour, whereas more modern equipment using VLSI circuitry may require 3,500 watts per hour. Because most front-end processors are run continuously except during upgrading or periodic maintenance, they can be estimated to consume power 24 hours a day, 350 days a year—or 8,400 hours a year. If the front-end processor consumes 15,000 watts of electricity per hour, it will use 126,000 kilowatts of power (15,000 watts X 8,400 hours/year). At a cost of 10 cents per KWH, the cost of providing power to the processor becomes $12,600 during the year.

For the newer front-end processor that consumes 3,500 watts of electricity per hour, the yearly cost of power would be reduced to $2,940, or a decrease of $9,660. Over the typical five-year life of most front-end processors, the extra cost of electrical consumption of the older processor would exceed $48,000. This cost by itself would probably not justify acquiring new equipment. However, considered in tandem with the excess maintenance costs associated with older equipment, this alternative could provide a sufficient level of savings to justify the acquisition of new equipment.

As another example, laser printer manufacturers such as Hewlett-Packard, IBM, and others are developing a standard for a dual-mode laser printers because they recognize the high power consumption of laser printers, which usually are powered on throughout the day but only actively printing for a short period. Energy-efficient laser printers have a standby mode of operation that can reduce power consumption considerably; these savings would be especially meaningful in areas where the cost of electricity exceeds 10 cents per KWH.
Communications

If the data center provides computational support for remote locations, the IS manager should consider analyzing its expenditures for voice and data communications. Depending on the number of remote locations and traffic volumes between those sites and the data center, the manager may find several methods to control the organization's communications cost. Two of the more practical methods are the development of a T1 backbone network and negotiation of a tariff 12 agreement.

T1 Backbone Network.
A T1 backbone network permits voice and data to share transmission on high-speed digital circuits. A T1 circuit provides the capacity of 24 voice-grade channels at a monthly cost of approximately 8 voice channels. If the organization's voice and data traffic requirements between two locations exceed 8 individual voice lines, T1 circuits can significantly reduce the cost of communications.

Tariff 12 Negotiations.
This Tariff enables organizations with large communications requirements to negotiate special rates with AT&T and other communications carriers. According to vendors' information, discounts in excess of 50% have been obtained for multiyear contracts with a value of $5 million to $10 million per year. For organizations with communications requirements that do not justify Tariff 12 negotiations, savings may still be achieved with regard to each carrier providing service between the organization's remote locations and its data center. In addition to investigating AT&T, MCI Communications Corp., and US Sprint, the manager may wish to examine the cost of transmission facilities of alternative local access carriers, such as Metropolitan Fiber Systems of Chicago, which provides local access to long-distance carriers in more than 50 cities throughout the US. The choice of this alternative may permit the manager to reduce the cost of the organization's local and long-distance communications.

Supplies

One of the most overlooked areas for controlling the cost of data center operations is consumable supplies. Most consumable supplies are purchased repeatedly throughout the year. The IS manager can reduce the cost of consumable supplies by grouping the requirements of several departments, consolidating expenditures on a monthly or quarterly basis to purchase larger quantities of needed supplies. This action typically results in a decrease in the unit cost per 100 disks, per cartons of 1,000 sheets of multipart paper, and similar supplies.

Another technique is forecasting supply requirements for longer time periods. For example, purchasing multipart paper on a quarterly basis instead of each month may reduce both the per-carton cost of paper and shipping charges.

Conclusion

This article describes several practical actions IS managers can consider to control data center costs. Although only a subset of these actions may be applicable to a particular data center, by considering each action as a separate entity the IS manager is able to effectively consider the cost of many line items that cumulatively represent the major cost of operating a data center. This process is a helpful way to review current expenditures and serves as a
guide to the various options for containing or reducing data center operations costs. In an era of budgetary constraints, such cost-control actions can only increase in importance to all managers.

**Author Biographies**

Gilbert Held
Gilbert Held is the director of 4-Degree Consulting in Macon GA.